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REMEDIAL INVESTIGATION REPORT

for

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

VOLUME IA - TEXT

Northern Division
Naval Facilities Engineering Command
Contract No. N62472-90-D-1298
Contract Task Order 0231

July 1996

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July 17, 1996

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Reference: Contract No. N62472-90-D-1298 (CLEAN)
Contract Task Order (CTO) No. 231

Subject: Submission of Final Remedial Investigation Report
NWS Earle - Colts Neck, New Jersey

Dear Mr. Kolicius:

Brown and Root (B&R) Environmental Corporation is pleased to provide six copies of the subject report. At your request, we are providing Mr. Jeff Gratz of the U.S. EPA, Region II with three copies and have sent three copies to Mr. Robert Marcolina of NJDEP. Four copies of revised appendix Sections M & F "drop-ins" have also been sent (three for NJDEP and one for EPA).

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

Sincerely,

Russell E. Turner

Russell E. Turner
Project Manager

RET/dhn

c: Jeffrey Gratz (EPA Region II)
Robert Marcolina (NJDEP)
Greg Goepfert (Navy - NWS Earle)
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File 3.2

REMEDIAL INVESTIGATION REPORT

for

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

VOLUME IA - TEXT

Northern Division
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Contract No. N62472-90-D-1298
Contract Task Order 0231

July 1996

R-51-1-6-16

REMEDIAL INVESTIGATION REPORT
FOR

NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION - NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch, Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mailstop No. 82
Lester, Pennsylvania 19223

Prepared and Submitted by:
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Contract Task Order 0231

July 1996

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EXECUTIVE SUMMARY

Under the Installation Restoration Program (IRP), which was organized by the Department of Defense (DOD) to identify and correct environmental concerns at DOD facilities, 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 performing a remedial investigation and feasibility study (RI/FS) at 27 former known or suspected waste disposal sites at Naval Weapons Station, Earle (NWS Earle). The primary objective of the program at NWS Earle is to identify and correct potential risk to human health and the environment. At this stage of the program at NWS Earle, the Navy desires to identify priority sites where immediate action can or must be taken and proceed with remediation. The Navy also wants to identify sites at which no significant human health or ecological risk exists so that these sites can be returned to beneficial use and available funds can be channeled toward site cleanups.

Brown & Root (B&R) Environmental, a division of Halliburton NUS Corporation, under the Comprehensive Long-Term Environmental Action - Navy (CLEAN) Program, Contract Number N62472-90-D-1298, was assigned to perform the field investigation activities presented in the Remedial Investigation Work Plan for Naval Weapons Station Earle, June 1995 (RI work plan) and to prepare a comprehensive report documenting the RI of 27 sites at NWS Earle, considering all the investigative results compiled to date. This report addresses the RI activities at 27 sites located within and immediately adjacent to NWS Earle and presents the results of the field work, data collection and validation, the human health risk assessment, and the preliminary ecological risk assessment (where completed) for the 27 sites. Twenty-five of the 27 sites were investigated previously under preliminary assessment (PA) or site investigation (SI) work. The two sites not previously addressed are included in the current RI to expedite investigation efforts and move all the sites toward remedial action or removal from further consideration in a timely fashion.

Between May and December 1995, the following field activities were conducted at RI sites presented in Table ES-1.

- Soil gas surveying and analysis at 190 locations.
- Sampling and analysis of subsurface soil collected from 46 soil borings.
- Drilling and installation of 28 permanent monitoring wells.

TABLE ES-1
LIST OF REMEDIAL INVESTIGATION SITES
NWS EARLE, COLTS NECK, NEW JERSEY

SITE NO.	SITE NAME	IMPACT INVESTIGATED
01	Site 1, Ordnance Demilitarization Site	Open burning of explosives
02	Site 2, Active Ordnance Demilitarization Site	Open burning of explosives
03	Site 3, Landfill Southwest of "F" Group	Domestic and industrial waste disposal
04	Site 4, Landfill West of "D" Group	Wastes burned in trenches
05	Site 5, Landfill West of Army Barricades	Domestic and industrial waste disposal
06	Site 6, Landfill West of Normandy Road	Lumber, glass, paper, and paint wastes
07	Site 7, Landfill South of "P" Barricades	Shipping containers and shop wastes
09	Site 9, Landfill South of "P" Barricades	Lumber and construction debris
10	Site 10, Scrap Metal Landfill	Demilitarized munitions and cases
11	Site 11, Contract Ordnance Disposal Area	Ordnance disposal and fire training
12	Site 12, Battery Storage Area	Forklift battery storage
13	Site 13, Defense Property Disposal Office Yard	Scrap metals and battery disposal
14	Site 14, Mercury Spill	Small mercury spill
15	Site 15, Sludge Disposal Site	Oily bilge sludge disposal
16	Site 16, EPIC Site F (Roundhouse)	Leaking underground diesel line
17	Site 17, Landfill	Scrap wood, metal, and paint waste
19	Site 19, Paint Chip and Sludge Disposal Site	Paint chip and paint sludge disposal
20	Site 20, Grit Blasting Area at Building 544	Spent blasting grit storage
22	Site 22, Paint Chip Disposal Area	Paint wastes on surface
23	Site 23, Paint Disposal Area	Paint wastes
24/25	Site 24, Closed Pistol Range	Projectile impact zone
24/25	Site 25, Closed Pistol Range	Projectile impact zone
26	Site 26, Explosive "D" Washout Area	Explosive washout disposal
27	Site 27, Projectile Refurbishing Area	Paint wastes
L	Epic Site L, MSC Van Parking Area	Scrap stored on ground
29	Site 29, PCB Spill Site	PCBs - confirmation of cleanup
Q	Epic Site Q, Fire Fighting School	Accelerants from fire simulation
BG	Background sample location	---

(Note: This list contains the 21 sites investigated in the summer and the 6 sites investigated in December of 1996)

- Installation of dedicated low-flow well purge/sampling pumps in 86 monitoring wells.
- Sampling and analysis of groundwater from 88 permanent monitoring wells.
- Measurement of static-water levels in 88 permanent monitoring wells.
- Execution of hydraulic conductivity studies at nine permanent monitoring wells.
- Sampling and analysis of groundwater from 23 hydropunch locations.
- Excavation of 16 test pits.
- Sampling and analysis of surface soil collected at 39 locations.
- Sampling and analysis of surface water collected at 38 locations.
- Sampling and analysis of sediment samples collected at 49 locations.
- Surveying of the horizontal locations and vertical elevations of soil gas survey grid corners, soil borings, monitoring wells, hydropunch locations, test pits, surface soil sample locations, surface water sample locations, sediment sample locations, and confirmation/correction of previous survey work.
- Sampling and analysis of septic tank contents.
- Sampling, analysis, and disposal of investigation-derived waste (IDW).
- Sampling and analysis of Building C-33 floor sweepings.

The data resulting from the field activities were compiled, scientifically validated per EPA Region II guidelines, and analyzed with respect to

- Nature and extent of contamination.
- Comparison to regulatory applicable and relevant or appropriate requirements (ARARs) and to be considered (TBCs).
- Fate and transport of compounds in the environment.

- Human health risk assessment guidelines.

- Ecological risk assessment guidelines.

The Navy has been performing investigation activities at areas of potential environmental concern at NWS Earle since approximately 1982. Investigation report documents include the Draft Report for Naval Weapons Station Earle, Colts Neck, New Jersey, Installation Restoration Program Phase II Confirmation Study, dated September 1986; the Draft Report of Current Situation and Draft Plan of Action, dated December 1988; 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. An IRP Phase II site inspection work plan was also prepared in September 1991. The Installation Restoration Program Remedial Investigations/Feasibility Study for 11 Sites at NWS Earle, Colts Neck, New Jersey, Volumes 1 to 3 was completed in September 1993.

In general, previous investigations have shown relatively high concentrations of metals in groundwater due to turbidity (solids) in the samples. For this investigation, the Navy installed dedicated, low-flow groundwater pumps in each of the sampled monitoring wells (where water levels were sufficient to submerge the entire pump). The pumps were constructed of inert materials and were laboratory certified to be contaminant free. A low-flow sampling procedure that was developed by EPA was followed to ensure minimal disturbance of the groundwater in the monitoring well during sampling. With a few exceptions, analyses of samples collected using this new procedure showed correspondingly lower metals concentrations in most monitoring well samples, as well as a reduction in spurious high metals readings that were previously encountered.

Human health risk assessment was carried out in accordance with current EPA risk assessment guidance (EPA, 1989a; EPA, 1991a) to evaluate the NWS Earle RI data. The objectives of the risk assessment are 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.

Section 2.4 of the RI report describes in detail the procedure followed. In several instances, the results of the human health risk assessment were biased either high or low based on the nature of the data used as inputs. This uncertainty arose due to the conflicting needs of the RI to provide high quality data on which to base a feasibility study or plan an interim removal action (e.g., at sites 19, 23, 24/25 and 27). The specific results of the risk assessment and the uncertainties to which any specific site results are subject are presented and discussed in the site-specific section. Table ES-2 presents a summary of the risk assessment results. These results should be considered along with the site-specific discussion of uncertainties to draw conclusions regarding human health risks related to the site.

Screening-level ecological risk assessments were conducted at RI sites to investigate potential risks to ecological receptors from contaminants associated with NWS Earle. Site characterizations were composed for each RI site, with emphasis on the habitats on and near each site and potential ecological receptors that may utilize the RI site areas, and each site's relation to its watershed and other RI sites was discussed. Contaminant sources, migration pathways, and exposure routes were also evaluated on a site-specific basis. All contaminants detected in samples collected in relevant media during this RI and previous studies at each site were considered preliminary contaminants of potential concern, thereby eliminating selective use of the data as a cause of uncertainty as it was in the human health risk calculations. Maximum concentrations of preliminary contaminants of potential concern in each applicable medium were used as conservative exposure point contaminant concentrations and screened against ecological screening levels that are protective of ecological receptors. The ratio of the exposure point concentration to the screening level is called the hazard quotient, which served as the basis of quantitative assessment of potential ecological risks associated with each site. Potential adverse ecological effects were considered possible, and the contaminant was retained as a final contaminant of potential concern, when the hazard quotient exceeded one; but, additional evaluations were conducted to investigate whether ecological receptors were actually at risk, as described in section 2.6 of the RI report. Data and information from this RI and previous reports not used in quantitative assessment due to questionable data quality, or other site-specific data limitation such as groundwater data, were discussed qualitatively at each site. The uncertainties associated with the ecological risk assessment and their implications for risk management were also addressed.

Potential ecological risks associated with NWS Earle RI sites generally were relatively low. Recommendations for additional study or corrective action based on ecological risks were generally in agreement with recommendations resulting from the human health risk assessment, such as the application of additional surface soil at landfills with sparse cover material. However, ecological risks were moderate or moderately high at some sites (Table ES-3), and current data are insufficient to adequately characterize potential risks. Additional sampling appears to be necessary at Mainside area Sites 3 and 13 to better gauge the extent of off-site contaminant impacts. Also, additional sampling appears to be needed at two Waterfront area sites, Sites 6 and 17. These sites are located adjacent to a tidal marsh, and contaminant concentrations detected in surface water and sediment in the marsh next to these sites were significantly elevated, as were potential ecological risks. Since other potential contaminant sources, including RI study sites, exist near the marsh, additional samples are needed to fully assess the nature and extent of contamination in the marsh watershed.

Potential ecological risks were assessed for each watershed on the base. This was performed since individual sites, or groups of sites, may contribute contaminants into the watershed in which they are located. Five watersheds were assessed in the Mainside area, and two were assessed in the Waterfront area. Similar to the individual site assessments, habitats and ecological receptors in each watershed were investigated, along with watershed-specific contaminant sources, migration pathways, and exposure routes. Hazard quotients were also calculated for contaminants detected in surface water and sediment samples collected in each watershed.

Potential risks associated with watershed-specific surface water and sediments were also relatively low (Table ES-4). Contaminant concentrations and related potential risks were insignificant in Pine Brook, Mine Brook, Hockhockson Brook, Mingamahone Brook, and Shark River watersheds in the Mainside area, although not all classes of contaminants were analyzed for in some watershed sediment samples. In the Wagner Creek watershed located in the Waterfront area, elevated levels and moderately high potential risks were present for some metals, although the contaminant source is currently not defined. Metals concentrations may be naturally elevated in that area. In the Ware Creek watershed, also located in the Waterfront area, elevated concentrations of metals and significant potential risks were present, but samples were taken upstream of the tidal marsh mentioned above, in what is essentially an urban environment. Additional watershed samples appear to be necessary in and around the marsh, in conjunction with additional samples recommended for Sites 6 and 17, to fully characterize potential ecological risks from contaminants in the marsh area.

Based on the evaluation of the large volume of data, it can be stated that past activities and waste disposal practices at NWS Earle have resulted in little apparent adverse impact to human health and the environment. Action is being taken by the Navy this year to mitigate environmental impacts at the sites where there is significant concern, namely Site 16 where free-product diesel fuel was released and is floating on groundwater; Site 26 where trichloroethene products were found in groundwater; and a few sites, such as Sites 23, 22, 19, and several of the former landfill areas, where improper disposal practices were performed.

In light of the overall results and the mitigating actions by the Navy this year, it is concluded that, in general, the NWS Earle Facility presents little adverse impact to human health and the environment.

TABLE ES-2
SUMMARY OF HUMAN HEALTH RISKS
NWS EARLE, COLTS NECK, NEW JERSEY

SITE NUMBER	GROUNDWATER		SURFACE WATER	SUBSURFACE SOIL		SURFACE SOIL		SEDIMENT
	FUTURE RESIDENTIAL RECEPTORS*	FUTURE INDUSTRIAL EMPLOYEE	FUTURE RECREATIONAL CHILD	FUTURE RESIDENTIAL RECEPTORS*	FUTURE INDUSTRIAL EMPLOYEE	FUTURE RESIDENTIAL RECEPTORS*	CURRENT INDUSTRIAL EMPLOYEE	FUTURE RECREATIONAL CHILD
01	HI	NE	-	NE	NE	-	-	-
02	HI	NE	-	-	-	NE	NE	-
03	HI	NE	-	-	-	-	-	NE
04	HI	NE	NE	-	-	-	-	NE
05	HI	NE	-	-	-	-	-	-
06	HI	NE	NE	-	-	-	-	NE
07	HI	NE	-	-	-	-	-	NE
09	-	-	-	-	-	-	-	-
10	NE	NE	-	-	-	-	-	-
11	NE	NE	-	-	-	-	-	-
12	-	-	-	-	-	LEAD	NE	NE
13	HI, CA	HI	NE	-	-	-	-	NE
14	-	-	-	-	-	-	-	-
15	-	-	NE	NE	NE	NE	NE	NE
16	HI, CA	HI, CA	-	HI, CA	HI	HI, CA	HI	NE
17	NE	NE	NE	-	-	NE	NE	NE
19	HI	NE	NE	NE	NE	-	-	NE
20	-	-	-	NE	NE	NE	NE	NE
22	-	-	-	NE	NE	-	-	NE
23	HI, CA	HI	NE	CA	NE	-	-	NE
24	-	-	-	NE	NE	-	-	-
25	-	-	-	NE	NE	-	-	-
26	HI	HI	-	NE	NE	-	-	-
27	-	-	-	NE	NE	-	-	-

TABLE ES-2
SUMMARY OF HUMAN HEALTH RISKS
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

SITE NUMBER	GROUNDWATER		SURFACE WATER	SUBSURFACE SOIL		SURFACE SOIL		SEDIMENT
	FUTURE RESIDENTIAL RECEPTORS*	FUTURE INDUSTRIAL EMPLOYEE	FUTURE RECREATIONAL CHILD	FUTURE RESIDENTIAL RECEPTORS*	FUTURE INDUSTRIAL EMPLOYEE	FUTURE RESIDENTIAL RECEPTORS*	CURRENT INDUSTRIAL EMPLOYEE	FUTURE RECREATIONAL CHILD
29	HI	NE	-	NE	NE	-	-	-
L	-	-	-	-	-	NE	NE	-
Q	NE	NE	-	NE	NE	-	-	NE
WS	-	-	NE	-	-	-	-	NE

NOTE: Media was not included in quantitative risk calculations(-)
CA - Cancer risks exceed 1E-04 for this receptor.
HI - Hazard Index exceeds 1.0 for this receptor.
NE - No exceedances occurred for this receptor.
* - *Non-cancer risk applies to child resident only; cancer risk represents lifetime (child plus adult) exposure.*

TABLE ES-3
SUMMARY OF SITE-SPECIFIC ECOLOGICAL RISK ASSESSMENTS
NWS EARLE, COLTS NECK, NEW JERSEY

RI site	Potential Ecological Risks (Applicable Media)	Recommendations
Site 1	Surface soil: Low Terrestrial plants: Low to moderate for some metals	No further action
Site 2	Surface soil: Low Terrestrial plants: Low to moderate for some metals	No further action
Site 3	Sediments: Moderate for aluminum and some PAHs	Additional sediment sampling to investigate extent of contamination in wetlands. Additional surface soil sampling to investigate potential off-site migration via overland runoff/erosion.
Site 4	Surface water: Low Sediment: Low	Additional soil cover should be placed on exposed areas of the landfill to promote plant growth and prevent erosion.
Site 5	Surface soil: Low Terrestrial plants: Low	No further action
Site 6	Surface water: Low Sediment: Moderate to moderately high for organics, mainly PAHs and pesticides	Additional surface water and sediment samples should be taken further into the marsh to investigate the extent of contaminant impacts. Additional surface soil samples should be taken at the landfill toe to investigate potential runoff/erosion of contaminants. These samples should be integrated with additional samples from nearby sites.
Site 7	Sediments: Low	Additional soil should be placed on bare areas on the landfill to promote plant growth and prevent erosion
Site 9	Investigated as part of Wagner Creek watershed assessment	See Wagner Creek watershed assessment
Site 10	Surface water: Low Sediments: Low	Additional soil cover could be placed on bare areas of the landfill to promote plant growth and prevent erosion.
Site 11	Subsurface soil: Low	Additional surface soil samples could be taken to delineate the extent of surface soil contamination, but the collection of these additional samples or remediation at the site is undesirable due to the presence of a federally-threatened plant.
Site 12	Sediments: Low to moderate	No further action; additional samples are recommended at nearby sites that will further characterize potential Site 12 contaminant inputs to the nearby marsh.
Site 13	Surface water: Moderate for silver Sediment: Moderately high for silver and PCBs	Additional samples taken downstream in the drainage area could be collected to investigate potential downstream migration, although no current evidence suggests this is occurring. Additional soil should be placed on bare areas of the landfill to promote plant growth and prevent erosion.
Site 15	Surface Water: Low Sediment: Low to moderate for aluminum and some PAHs Surface soils: Low Terrestrial plants: Moderate for aluminum	No further action
Site 16	Sediments: Low	Removal of floating product on water table to prevent discharge of organic contaminants to nearby wetlands.

TABLE ES-3
SUMMARY OF SITE-SPECIFIC ECOLOGICAL RISK ASSESSMENTS
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

RI site	Potential Ecological Risks (Applicable Media)	Recommendations
Site 17	Surface water: Moderate for some metals Sediment: Moderate to moderately high for some metals, pesticides, and PAHs Surface soil: Low	Additional surface water and sediment samples should be taken further into the adjacent marsh to investigate the extent of potential contaminant impacts. Additional surface soil samples should be taken at the landfill toe to investigate potential runoff/erosion. These samples should be integrated with additional samples from nearby sites.
Site 19	Sediments: Moderately high for several metals	Removal of sediments in the drainage ditch leading to the stream and wetlands.
Site 20	Sediments: Low	No further action
Site 22	Sediments: Moderate for some PAHs Surface soil: Low	Limited removal of sediments and surface soils behind Building D-2 to prevent erosion and runoff of contaminants
Site 23	Surface water: Low to moderate for some metals Sediment: Low	Limited removal of contaminated soils near RI sample 23 SB 04 to prevent erosion and runoff of contaminants into the drainage swale.
Site 24/25	Subsurface soil: Low	No further action
Site 26	Sediment: Low Surface soil: Low	No further action
Site 27	Sediment: Moderate for some metals	Limited removal of paint chips and associated soil to prevent erosion and runoff of metals
Site 29	Surface soils: Low	No further action
Epic L	Surface soils: Low to moderate for some PAHs Terrestrial plants: Low	At present, no further action. Additional surface soil and sediment samples should be taken to fully characterize potential risks if the site is abandoned and receptor use increases.
Epic Q	Sediments: Low to moderate for pyrene	No further action

TABLE ES-4
SUMMARY OF WATERSHED-SPECIFIC ECOLOGICAL RISK ASSESSMENTS
NWS EARLE, COLTS NECK, NEW JERSEY

Watershed	Potential Ecological Risks (Applicable Media)	Recommendations
Pine Brook	Surface water: Low Sediment: Low	No further action
Hockhockson Brook	Surface water: Low Sediment: Low	No further action
Mine Brook	Surface water: Low Sediment: Low	SVOCs were not analyzed for in sediments. Additional sediment samples may be collected and analyzed for SVOCs, but do not appear to be completely warranted since no potential source of SVOCs is apparent.
Mingamahone Brook	Surface water: Low to moderate for some metals Sediment: Low	No further action
Shark River	Surface water: Low Sediment: Low to moderate for some pesticides	No further action
Wagner Creek	Surface water: Moderately high for some metals, mainly aluminum and lead Sediment: Low to moderate for some metals, mainly aluminum and lead	The source of metals to the stream where the watershed samples were taken is unclear. Site 9 is located several hundred feet north/northwest of the watershed sampling sites in the stream. Overland runoff does not appear to be occurring from Site 9 to the stream. Groundwater samples may be taken to investigate potential groundwater-to-surface water contaminant migration, but concentrations of metals in the area may be naturally elevated.
Ware Creek	Surface water: Low to moderate for some metals Sediment: Low to moderate for some metals	Additional surface water and sediment samples are necessary further downstream in the watershed. In particular, additional samples are needed in the tidal marsh adjacent to some Waterfront RI sites. These samples should be integrated with additional samples recommended at Waterfront sites 6 and 17.

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Brown & Root (B&R) Environmental, a division of Halliburton NUS Corporation was assigned, under the Comprehensive Long-Term Environmental Action - Navy (CLEAN) Program, Contract Number N62472-90-D-1298, to perform the field investigation activities presented in the Remedial Investigation Work Plan for Naval Weapons Station Earle, June 1995 (RI work plan), and to prepare a comprehensive report documenting the remedial investigation (RI) of 27 sites at Naval Weapons Station (NWS) Earle in accordance with the requirements of Contract Task Order Number 0231. The work was performed as part of the Navy's Installation Restoration Program (IRP), a program designed to identify environmental concerns at Navy and Marine Corps facilities and to implement corrective measures if necessary.

IRP activities are typically performed in four distinct phases. Phase 1 consists of a preliminary assessment (PA), and Phase 2 consists of a site investigation (SI). Phase 3 is a remedial investigation (RI), which is intended to characterize the physical and chemical (contaminant) parameters of the site and the associated risks to human health and the environment. Phase 4 consists of remedial action (RA) designed to control and mitigate contaminated media at the site.

This report addresses the RI activities at 27 sites located within and immediately adjacent to NWS Earle. These sites were initially identified in either the Initial Assessment Study of February 1983 or the Environmental Investigation Photographic Center (EPIC) studies of November 1991 and January 1992. Twenty-five of the 27 sites were investigated previously under PA or SI work.

The Initial Assessment Study was a document prepared for the Navy that identified 29 areas of concern based on employee interviews, record searches, and site tours. Three of these 29 areas were eliminated from consideration under the Installation Restoration Program because they were active operations regulated under the Resource Conservation and Recovery Act (RCRA). One additional area, Site 8, was investigated on an accelerated schedule to enable timely reuse. EPA concurrence on no further investigation of this site was received in October 1994.

The EPIC studies were an analysis of historical aerial photographs performed for the United States Environmental Protection Agency (EPA) by the Environmental Photographic Interpretation Center. These studies identified 17 additional sites where there was evidence of some disturbance. After an initial screening of these sites in 1992, the Navy, EPA, and New Jersey Department of Environmental Protection (NJDEP) agreed to further investigation at three sites, Sites F, L, and Q. Since Site F overlapped the existing Site 16, it was agreed that Site 16 would be expanded to include it.

1.2 FACILITY LOCATION

NWS Earle is located in Monmouth County in east-central New Jersey. It is situated on approximately 11,134 acres, which include a Mainside area that is approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay and a Waterfront area, which includes an ammunition depot and associated piers. The Mainside and Waterfront areas are linked by a narrow tract of land that serves as a right-of-way for a government road and railroad. Figures 1-1 and 1-2 show the Mainside and Waterfront areas, respectively. 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.

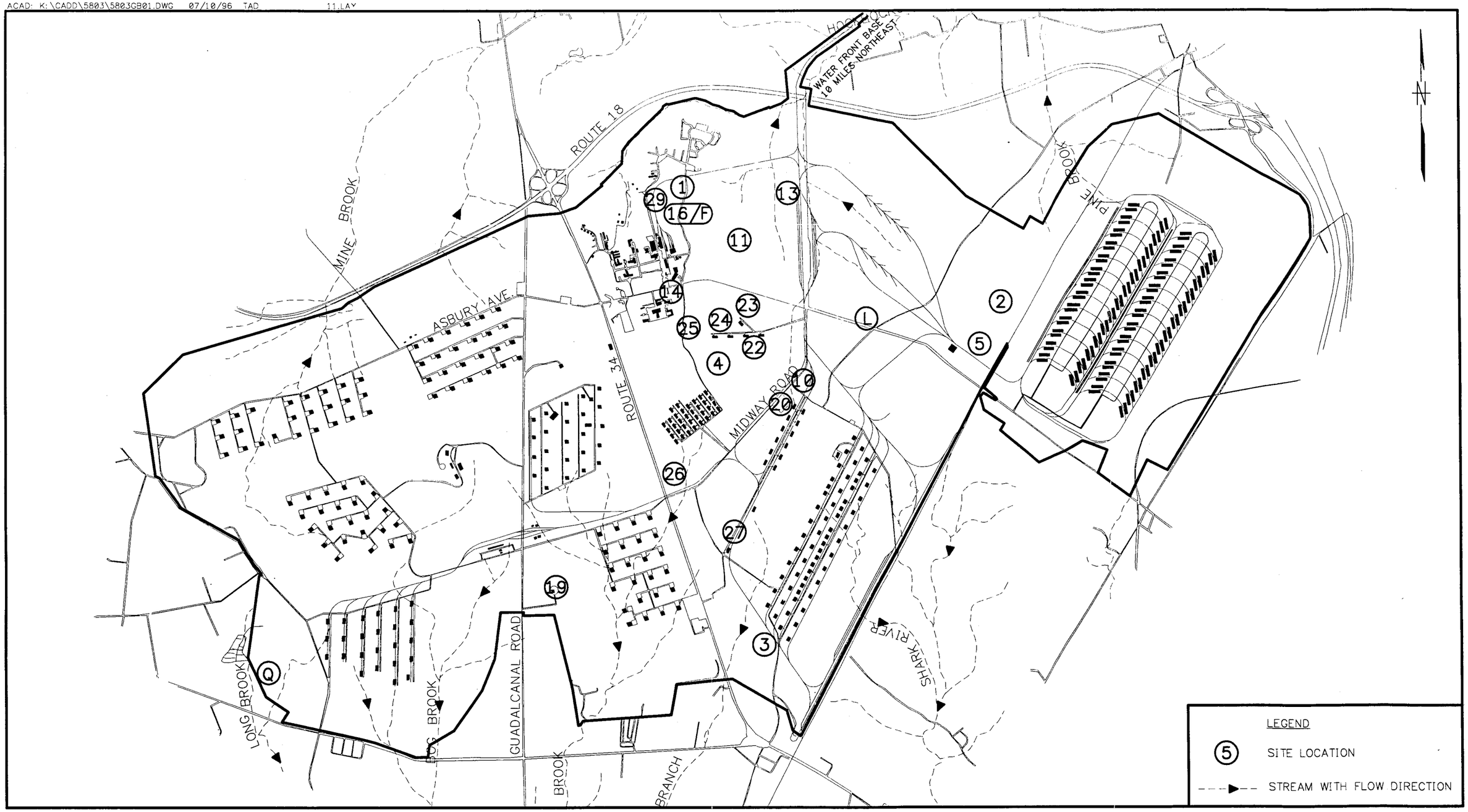
1.3 FACILITY MISSION

NWS Earle was commissioned as a Naval Ammunition Depot on December 13, 1943, with the primary responsibility of furnishing ammunition to the Naval fleet. The station's Ordnance Department coordinates all port services and logistic support for home-ported and visiting ships, conducts safety inspections, supervises ammunition loading for the United States Coast Guard, and provides afloat firefighting capability and standby tug services. Other major active divisions include the Ammunition Distribution and Control Division, responsible for ensuring that a balanced, purified stock of ammunition is maintained in support of Navy, Coast Guard, and Marine Corps programs; the Operations Division, which performs ammunition movement, ship loading, demilitarization of obsolete ammunition, and reclaiming/renovation of various munitions; the Anti-Submarine Warfare (ASW) and Special Weapons Division, which plans and carries out station-level maintenance of air and antisubmarine weapons and provides shore-based support to various commanders; 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 Quantity 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 1, 14, 16, and 29 are within the Mainside Administration and Housing area. Sites 6, 12, 15, and 17 are within the Waterfront Administration area.

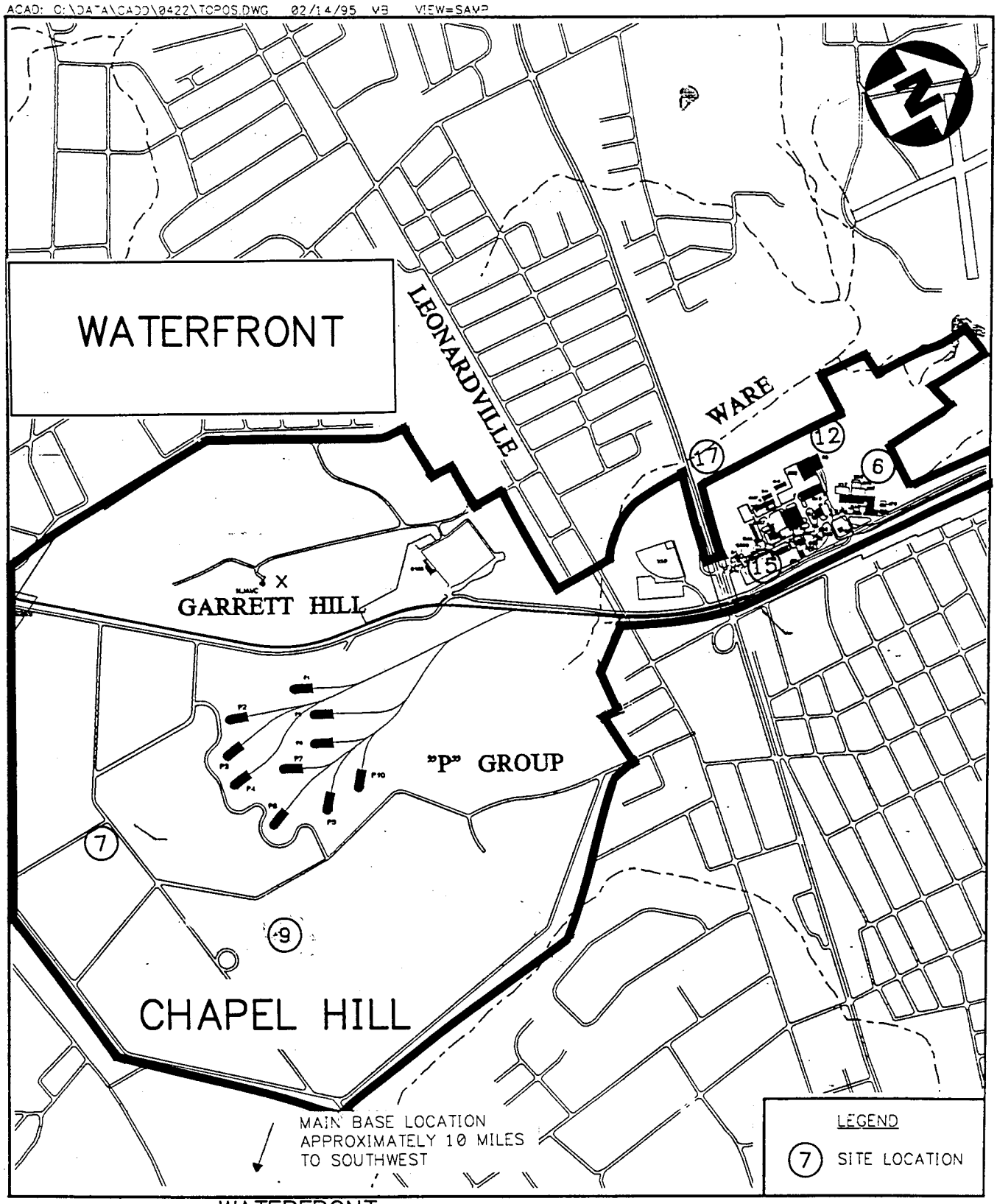
ACAD: K:\CADD\5803\5803GB01.DWG 07/10/96 TAD 11.LAY



MAINSIDE SITE LOCATIONS
NAVAL WEAPONS STATION EARLE, NJ

FIGURE 1-1

Brown & Root Environmental



WATERFRONT
SITE LOCATIONS
NWS EARLE, COLTS NECK, NEW JERSEY

0 1200 2400
SCALE IN FEET

FIGURE 1-2

Brown & Root Environmental

Future land use is not expected to vary significantly from current land use unless a major base realignment were to occur. If this were to happen, an Environmental Baseline Survey would be conducted to evaluate the impact of any proposed land-use change.

1.4 PREVIOUS INVESTIGATIONS

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 IRP by Roy F. Weston, Incorporated. Several documents prepared by Weston were submitted to the Navy, NJDEP, and EPA. These documents include the Draft Report for Naval Weapons Station Earle, Colts Neck, New Jersey, Installation Restoration Program Phase II Confirmation Study, dated September 1986; the Draft Report of Current Situation and Draft Plan of Action, dated December 1988; 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. An IRP Phase II site inspection work plan was also submitted by Weston in September 1991. In addition, Weston submitted the Installation and Restoration Program Remedial Investigations/Feasibility Study for 11 Sites at NWS Earle, Colts Neck, New Jersey, Volumes 1 to 3. The work plan for this RI, prepared by B&R Environmental, considered the results of the previous investigations as the basis for most of the 1995 RI field tasks. This RI document presents the results of the field tasks, the data evaluation, the human health risk assessment, and the preliminary ecological risk evaluation for the 27 sites.

1.5 WETLANDS DELINEATION

Maps showing wetlands delineation boundaries in this report that refer to this subsection (1.5) were developed using NJDEP Geographic Information System digital data, in conjunction with B&R Environmental's work, but this secondary product has not been verified by NJDEP and is not state authorized.

A complete wetland legend, showing the derivation of the wetland codes used on maps throughout this report, prepared by NJDEP is included in Table 1-1.

1.6 SURVEY INFORMATION

Over the years the Navy has employed various survey subcontractors to perform site survey work. Appendix F contains survey data and a reconciliation of the varying benchmarks used historically.

WETLAND LEGEND

U - Primarily represents **upland** areas, but may include unclassified wetlands less than 1 acre in area, non photo-identifiable areas and/or unintentional omissions.

ECOLOGICAL SYSTEM

E - ESTUARINE

Ecological Subsystem

1 - Subtidal

CLASS	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	RF - REEF	OW - OPEN WATER Unknown Bottom
Subclass	1. Bedrock 2. Boulder	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 4. Floating leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface	2. Mollusc 3. Worm	

2 - Intertidal

CLASS	AB - AQUATIC BED	RF - REEF	FL - FLAT	SB - STREAMBED	RS - ROCKY SHORE	BB - BEACH/BAR	EM - EMERGENT	SS - SCRUB / SHRUB	FO - FORESTED
Subclass	1. Submergent Algal 2. Submergent Vascular 6. Unknown Submergent 7. Unknown Surface	2. Mollusc 3. Worm	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic 5. Vegetated Pioneer 6. Vegetated Non-pioneer	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic	1. Bedrock 2. Boulder 6. Vegetated Non-pioneer	1. Cobble / Gravel 2. Sand	1. Persistent 2. Nonpersistent 3. Narrow Leaved Nonpersistent 4. Broad Leaved Nonpersistent 5. Narrow Leaved Persistent 6. Broad Leaved Persistent	1. Broad Leaved Decidious 3. Broad Leaved Evergreen 4. Needle Leaved Evergreen 5. Dead 6. Decidious 7. Evergreen 8. White Cedar	1. Broad Leaved Decidious 3. Broad Leaved Evergreen 4. Needle Leaved Evergreen 5. Dead 6. Decidious 7. Evergreen 8. White Cedar

ECOLOGICAL SYSTEM

M - MARINE

Ecological Subsystem

1 - Subtidal

CLASS	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	RF - REEF	OW - OPEN WATER Unknown Bottom
Subclass	1. Bedrock 2. Boulder	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 4. Floating leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface	1. Coral 3. Worm	

2 - Intertidal

CLASS	AB - AQUATIC BED	RF - REEF	FL - FLAT	RS - ROCKY SHORE	BB - BEACH/BAR
Subclass	1. Submergent Algal 2. Submergent Vascular 6. Unknown Submergent	1. Coral 3. Worm	1. Cobble/Gravel 2. Sand 3. Mud 6. Vegetated Non-pioneer	1. Bedrock 2. Boulder 6. Vegetated Non-pioneer	1. Cobble/Gravel 2. Sand

ECOLOGICAL SYSTEM

P - PALUSTRINE

No Subsystem

CLASS	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	FL - FLAT	ML - MOSS LICHEN	EM - EMERGENT	SS - SCRUB / SHRUB	FO - FORESTED	OW - OPEN WATER Unknown Bottom
Subclass	1. Bedrock 2. Boulder	1. Cobble/Gravel 2. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 3. Submergent Moss 4. Floating-Leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic 5. Vegetated Pioneer 6. Vegetated Non-pioneer	1. Moss 2.Lichen	1. Persistent 2. Nonpersistent 3. Narrow Leaved Nonpersistent 4. Broad Leaved Nonpersistent 5. Narrow Leaved Persistent 6. Broad Leaved Persistent	1. Broad Leaved Decidious 2. Needle Leaved Decidious 3. Broad Leaved Evergreen 4. Needle Leaved Evergreen 5. Dead 6. Decidious 7. Evergreen 8. White Cedar	1. Broad Leaved Decidious 2. Needle Leaved Decidious 3. Broad Leaved Evergreen 4. Needle Leaved Evergreen 5. Dead 6. Decidious 7. Evergreen 8. White Cedar	

Source: NJDEP

TABLE 1-1

ECOLOGICAL SYSTEM

L - LACUSTRINE

Ecological Subsystem	1 - Limnetic				2 - Littoral						
CLASS	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	OW - OPEN WATER Unknown Bottom	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	FL - FLAT ROCK	RS - ROCKY SHORE	BB- BEACH BAR	EM - EMERGENT	OP - OPEN WATER Unknown Bottom
Subclass	1. Bedrock 2. Boulder	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 3. Submergent Moss 4. Floating leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface		1. Bedrock 2. Boulder	1. Cobble/Gravel 3. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 3. Submergent Moss 4. Floating leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface	1. Cobble/Gravel 2. Sand 3. Mud 4. Organic 5. Vegetated Pioneer 6. Vegetated Non-pioneer	1. Bedrock 2. Boulder	1. Cobble/Gravel 2. Sand	2. Nonpersistent 3. Narrow leaved Nonpersistent 4. Broad leaved Nonpersistent	

R - RIVERINE

Ecological Subsystem	1. Tidal	2 - Lower Perennial		3 - Upper Perennial		4 - Intermittent		5 - Unkown Perennial	
CLASS	EM - EMERGENT(*)	RB - ROCK BOTTOM	UB - UNCONSOLIDATED BOTTOM	AB - AQUATIC BED	FL - FLAT	SB - STREAMBED	RS - ROCKY SHORE	BB - BEACH/BAR	OW - OPEN WATER Unknown Bottom
Subclass	1. Nonpersistent 2. Narrow-leaved Nonpersistent 3. Broad-leaved Nonpersistent	1. Bedrock 2. Boulder	1. Cobble/Gravel 2. Sand 3. Mud 4. Organic	1. Submergent Algal 2. Submergent Vascular 3. Submergent Moss 4. Floating-Leaved 5. Floating 6. Unknown Submergent 7. Unknown Surface	1. Cobble / Gravel 2. Sand 3. Mud 4. Organic 5. Vegetated Pioneer 6. Vegetated Non-pioneer	1. Cobble/Gravel 2. Sand 3. Mud 4. Organic	1. Bedrock 2. Boulder	1. Cobble/Gravel 2. Sand	

(*) EM - EMERGENTS are only found in the Riverine Tidal and Riverine Lower Perenial Ecological Subsystem. All other classes are found in all Riverine Ecological Subsystems

MODIFYING TERMS

In order to more adequately describe wetland and aquatic habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME(1)

Non-Tidal		Tidal	
A Temporary	H Permanent	K Artificial	R Seasonal Tidal
B Saturated	J Intermittently Flooded	L Subtidal	S Temporary Tidal
C Seasonal	K. Artificial	M Irregularly Exposed	T Semipermanent Tidal
D Seasonal Well-drained	Z Intermittently Exposed/Permanent	N Regular	V Permanent Tidal
E Seasonal Saturated	W Intermittently Flooded/Temporary	P Irregular	U Unknown
F Semipermanent	Y Saturated/Semipermanent/Seasonals		
G Intermittently Exposed	U Unknown		

WATER CHEMISTRY

Coastal Salinity	Inland Salinity	pH Modifiers for all Fresh Water
1 Hyperhaline	7 Hypersaline	a Acid
2 Euhaline	8 Eusaline	t Circumneutral
3 Mixohaline (Brackish)	9 Mixosaline	1 Alkaline
4 Polyhaline	0 Fresh	
5 Mesohaline		
6 Oligohaline		
0 Fresh		

SOIL

g Organic	
n Mineral	

SPECIAL MODIFIERS

b Beaver	h Diked/Impounded
d Partially Drained/Ditched	r Artificial
f Farmed	s Spoil
	x Excavated

MODL	Lawns, Stormwater Management Areas (areas are not normally inundated)
MODR	Right-of-Ways (areas maintained by utilities)
MODAg	Agricultural Lands, Turf Farms (both row crop and turf cultivation)
MODD	Disturbed Areas (surface/vegetation disturbed. Nature of activity not readily apparent)

(1) Information on the water regime modifiers found on this legend, but not found in the classification system, may be obtained from the above listed source.

TABLE 1-1 (continued)

2.0 INVESTIGATION SUMMARY

This section presents an overview of remedial investigation (RI) activities. The procedures used in this RI, including the data quality objective standards that were followed and the standard operating procedure guidelines that were adhered to [e.g., United States Environmental Protection Agency (EPA) Region I Groundwater Sampling Procedure, Lowflow Purge and Sample (Draft Final), NJDEP Field Sampling Procedures Manual, and B&R Environmental Standard Operating Procedures (SOP) GH-1.3], are discussed and presented in the Remedial Investigation Work Plan for Naval Weapons Station Earle, Colts Neck, New Jersey, June 1995, Volumes I and II. Details of the field investigation tasks at each site are discussed in Sections 4 through 30.

2.1 SUMMARY OF ACTIVITIES

Between May and December 1995, the following field activities were conducted at 27 RI sites as described in the RI work plan. Field work relating to 21 high priority sites was performed in the summer of 1995. The remaining six site (27 sites total) investigation was delayed until December 1995 due to budget restraints. All sites are shown on Figures 1-1 and 1-2.

- Soil gas surveying and analysis at 190 locations at Sites 3, 16, and 26 (Section 2.1.1.1).

- Sampling and analysis of subsurface soil collected from 46 soil borings drilled at four background locations and Sites 1, 16, 23, 26, 27, 29, and Q and from 19 hand-augered borings at Sites 15, 19, 20, 23, 24/25, 27, and Q (Section 2.1.1.2).

- Drilling and installation of 28 permanent monitoring wells at four background locations and Sites 1, 3, 4, 13, 16, 17, 19, 23, 26, 27, 29, and Q (Section 2.1.1.3).

- Installation of dedicated low-flow well purge/sampling pumps in 86 monitoring wells.

- Sampling and analysis of groundwater from 88 permanent monitoring wells at four background locations and Sites 1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 16, 17, 19, 23, 26, and 29 (Section 2.1.1.3).

- Measurement of static-water levels in 88 permanent monitoring wells at four background locations and Sites 1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 16, 17, 19, 23, 26, and 29 (Section 2.1.1.3).

- Execution of slug tests at nine permanent monitoring wells at Sites 1, 13, 16, and 23 (Section 2.1.1.4).

- Sampling and analysis of groundwater from 23 hydropunch locations at Sites 1, 4, 5, and Q (Section 2.1.1.5).

- Excavation of 16 test pits at Sites 3, 9, and 13 (Section 2.1.1.6).

- Sampling and analysis of surface soil collected at 39 locations at four background locations and Sites 2, 3, 7, 12, 15, 16, 17, 19, 20, and L (Section 2.1.2.1).

- Sampling and analysis of surface water collected at 38 locations at three background locations, 19 watershed locations, and Sites 4, 6, 13, 15, 17, 19, and 23 (Section 2.1.3.1).

- Sampling and analysis of sediment samples collected at 49 locations at three background locations, 18 watershed locations, and Sites 4, 6, 12, 13, 15, 16, 17, 19, 20, 23, and Q (Section 2.1.4.1).

- Surveying of the horizontal locations and vertical elevations of soil gas survey grid corners, soil borings, monitoring wells, hydropunch locations, test pits, surface soil sample locations, surface water sample locations, and sediment sample locations (Section 2.1.5).

- Sampling and analysis of septic tank contents (Section 2.1.6).

- Sampling and analysis of investigation-derived waste (IDW) drum contents at Site 16/F (Section 2.1.7).

- Sampling and analysis of composite Building C-33 floor sweepings (Section 2.1.8).

2.1.1 Subsurface Investigations

2.1.1.1 Soil Gas Survey

Soil gas surveys were performed at Sites 3, 16, and 26 to identify areas of potential soil and groundwater contamination and to locate possible sources of contamination. The results of the survey were used to help select soil boring and permanent monitoring well locations. Initial soil gas points were placed with a uniform grid spacing of 25 feet at Sites 3 and 26. At Site 16, four areas of concern were investigated, with grid spacing varying from 20 by 40 feet to 100 by 100 feet. A total of 190 soil gas points were placed at the three sites. One reading was obtained from each soil gas point, and quality control (QC) duplicates were obtained from approximately 10 percent of locations. The soil gas samples were collected near the soil/water interface at a depth of between 5.5 and 8 feet at Site 3, 1 and 8 feet at Site 16, and 7 and 8 feet at Site 26.

The soil gas surveys were performed by Environmental Field Service, Incorporated (EFS). For the easily accessible locations, a van-mounted probe unit was used for surveying, and for the inaccessible locations, a hand-driven portable rotary hammer was used. The procedure consisted of driving a 1.375-inch outer-diameter (O.D.) hollow-steel sampling rod equipped with an expendable drive point into the soil to the desired depth and extracting a soil gas sample through the rod. Upon reaching the desired sampling depth, the drive point was detached by pulling back on the rod, which allowed soil gas to enter the rod. A length of Teflon tubing was inserted into the rod to the bottom of the hole, and the bottom-hole tubing perforations were isolated from the annulus by an inflatable packer. A sample of the soil gas was withdrawn from the probe into the sampling system in order to purge atmospheric air from the system. A second sample of soil gas was withdrawn from the probe into the sampling system and encapsulated into a pre-evacuated glass vial at two atmospheres of pressure. The self-sealing vial was then detached from the sampling system, packaged, labeled, and stored for laboratory analysis. After the sample was collected, the tubing was withdrawn from the hole and nitrogen or atmospheric air was used to purge the sampling system. The rods were withdrawn after the sample was obtained (sacrificing the drive point), and the boreholes were sealed to the surface with a bentonite powder. The soil gas samples were analyzed on site at EFS's mobile laboratory with a photoVac 10S plus field gas chromatograph (GC) for total benzene, toluene, ethylbenzene, and xylenes (BTEX), trichloroethene (TCE), and tetrachloroethene (PCE) analyses.

Approximately 10 percent of total samples collected were quality assurance/quality control (QA/QC) samples (blanks) collected at the halfway point and at the end of each day's field activities. At the beginning of each day, the field GC was calibrated to certified calibration standards, and equipment blanks were run at various times to ensure the system was clean of outside influences.

A total of 190 soil gas samples and 24 field duplicates were collected at Sites 3, 16, and 26. A summary of these samples is provided in Table 2-1.

2.1.1.2 Soil Borings, Hand-Augered Borings, and Subsurface Soil Sampling

Forty-six soil borings were installed at Sites 1, 16, 23, 26, 27, 29, and Q and at four background locations to identify and possibly delineate the extent of soil contamination. The soil borings were drilled using hollow-stem auger drilling techniques and 4.25-inch internal-diameter (I.D.) augers. The soil borings ranged in depth from 4 to 80 feet. Fifteen of the soil borings were converted into monitoring wells. Subsurface soil samples were collected continuously from the ground surface to the water table by driving a 3-inch O.D. by 24-inch-long split-barrel sampler using a 140-pound hammer falling a distance of 30 inches. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors) and for lithologic description. Boring logs were prepared for each boring to

Table 2-1
Soil Gas Sampling Summary
NWS Earle, Colts Neck, Neck Jersey

Site	Number of Soil Gas Points	Number of Environmental Soil Gas Samples[1]	Analytical Parameters[2][3]
3	26	27	BTEX, TCE, and PCE
16	96	106	BTEX, TCE, and PCE
26	68	75	BTEX, TCE, and PCE

(1) Includes field duplicates and resampled points.
(2) BTEX (benzene, toluene, ethylbenzene, and xylenes), TCE (trichloroethene), and PCE (tetrachloroethene)
(3) Appendix B (Soil Gas Results) contains a complete list of compounds analyzed during the soil gas investigation.

document subsurface lithologies. Subsurface lithology varied little in the relatively shallow borings installed for this RI. Typical soil types encountered included silty fine-grained sand with pebbles or gravel, silty coarse-grained sand, and micaceous, silty fine-grained sand. Appendix C contains the boring logs. Soil borings that were not converted into monitoring wells were abandoned by backfilling to the ground surface with drill cuttings.

A total of 83 subsurface soil samples, including four field duplicates, were collected from the 46 borings located at Sites 1, 16, 23, 26, 27, 29, and Q and four background locations and submitted to Lancaster Laboratory or to General Physics Environmental Services (GP) for chemical analysis. Samples selected for laboratory analysis were based on site-specific criteria. Aqueous QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with Naval Facilities Engineering Service Center (NFESC) [formerly Naval Environmental and Energy Support Activity (NEESA)] data quality objective (DQO) Level D requirements. Sample logs are contained in Appendix D.

A summary of the number of soil borings and subsurface soil samples collected at Sites 1, 16, 23, 26, 27, 29, and Q and four background locations is provided in Table 2-2.

Nineteen hand-augered soil borings were installed at Sites 15, 19, 20, 23, 24/25, 27, and Q to determine the extent of shallow soil contamination. A hand auger was used to auger down to the desired depth, and the soil sample was placed directly into the appropriate bottleware. The boring depths ranged from 1 to 9 feet. The soil cuttings were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors). Boring logs are contained in Appendix C. The hand-augered sample locations were backfilled with soil cuttings from the borehole.

A total of 25 subsurface soil samples, including two field duplicates, were collected from the 19 hand-augered borings located at Sites 15, 19, 20, 23, 24/25, 27, and Q and submitted to Lancaster Laboratories for chemical analysis. Aqueous QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. Sample logs are contained in Appendix D.

A summary of the number of hand-augered sample locations and subsurface soil samples collected at Sites 15, 19, 20, 23, 24/25, 27, and Q is provided in Table 2-3.

2.1.1.3 Permanent Monitoring Well Installation, Static-Water-Level Measurements, and Groundwater Sampling

Permanent Monitoring Well Installation

Twenty-eight shallow permanent monitoring wells were installed at Sites 1, 3, 4, 13, 16, 17, 19, 23, 26, and 29 and four background locations. The shallow wells were installed to evaluate the impact of each

Table 2-2
Soil Boring and Subsurface Soil Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Soil Borings	Number of Environmental Subsurface Soil Samples[1]	Analytical Parameters[2][3]
1	10	21	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
16	20	36*	TCL VOC, TCL SVOC, TCL PCBs/pesticides, TAL metals, TPH, moisture, and pH
23	3	7	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, moisture, and pH
26	4	6*	TCL VOC, TAL metals, and explosives
27	2	6**	TCL VOC, TCL SVOC, TAL metals, and TCL pesticides/PCBs
29	2	2	TCL PCBs and TPH
Q	1	2***	TCL VOC and TCL SVOC
Background 1	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, moisture, mercury, cyanide, nitrite, nitrate, chloride, sulfate, pH, TOC, COD, phosphate, ammonia, grain size, and explosives
Background 2	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, moisture, mercury, cyanide, nitrite, nitrate, chloride, sulfate, pH, TOC, COD, phosphate, ammonia, grain size, and explosives
Background 3	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, moisture, pH, sulfate, mercury, cyanide, nitrite, nitrate, chloride, TOC, COD, phosphate, ammonia, explosives, and BOD
Background 4	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, mercury, cyanide, nitrite, nitrate, chloride, TOC, COD, phosphate, ammonia, grain size, explosives, moisture, pH, sulfate, and BOD

(1) Submitted for laboratory analysis, including field duplicates
* Some soil boring locations were sampled at two depths and some at one depth
** Soil boring locations were sampled at three depths
*** Soil boring location was sampled at two depths

Table 2-3
Hand Auger Locations and Subsurface Soil Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Hand Auger Locations	Number of Environmental Subsurface Soil Samples[1]	Analytical Parameters
15	4	5	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TPH, moisture, and pH
19	5	2	TCL VOC and TAL metals
		1	TAL metals
		2	TCL VOC, TAL metals, chromium (hexavalent), and moisture
20	3	3	TCL VOC, TCL SVOC, and TAL metals
23	1	1	TCL VOC, TCL SVOC, TCL PCBs/pesticides, TAL metals, and explosives
24/25	4	0	Counted total number of bullets found at 6-inch depth intervals to a total depth of 42-inches in each hand auger location
		9	TAL metals, moisture, nitrites, and nitrates
27	1	3*	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
Q	1	1	TCL VOC, TCL SVOC, and TPH analysis

(1) Includes field duplicates
* Hand-auger boring location was sampled at three depths

site on the local groundwater quality, to assess the potential for lateral contaminant migration, and to evaluate local vertical hydraulic gradients. The locations of some of the monitoring wells were based upon results of soil gas survey, subsurface soil sampling (soil borings), and groundwater sampling (hydropunch).

The borings were drilled with either a CME 55 drill rig or a Failing all-terrain vehicle (ATV) drill rig using hollow-stem-auger drilling techniques and 4.25-inch I.D. augers. Subsurface soil samples were collected continuously from the ground surface to the water table by driving either a 2-inch or 3-inch O.D. by 24-inch-length split-barrel sampler using a 140-pound hammer falling a distance of 30 inches. The borings were drilled to approximately 8 feet below the water table and completed as cased wells, screened across the water table.

The monitoring wells were constructed with NSF-certified 2-inch-diameter, flush jointed and threaded, Schedule 40 polyvinyl chloride (PVC) well casing and 0.10-foot slotted well screen fitted with a PVC bottom cap. Ten-foot screens were installed in all the wells, except MW3-08 (this well had a 15-foot screen installed). The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 1 to 2 feet above the top of the screen. A 2- to 3-foot annular seal, consisting of bentonite pellets, was placed on top of the filter pack. The remainder of the well annulus was backfilled with a cement grout to a height of approximately 1 foot below the ground surface. Most of the wells were completed with a 2-foot-high stickup. The balance were completed as flush mounts. All wells were completed with a 4- by 4-foot concrete pad keyed 1 foot into the well annulus.

One shallow permanent monitoring well was installed at each of the four background sites and at Sites 3, 4, 17, and 19. Two shallow permanent monitoring wells were installed at Sites 1, 26, and 29. Three shallow permanent monitoring wells were installed at Site 23, five shallow permanent monitoring wells were installed Site 13, and six shallow permanent monitoring wells were installed at Site 16. Well depths ranged from 14 to 77 feet below ground surface (bgs).

The wells were developed a minimum of 24 hours after installation with a bailer and/or a submersible pump. The groundwater temperature, pH, conductivity, and turbidity were monitored during development. All wells were developed until water turbidity was clear. An average of 95 gallons of water were removed from the shallow wells during development. Well development water was discharged directly to the ground to percolate back into the local soil in such a manner as to avoid incidental discharge to surface water bodies.

Static-Water-Level Measurements

In order to define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected in the existing permanent wells and the newly installed wells. Static-water levels were measured using an electronic water-level indicator (m-scope) or an interface probe and were recorded to the nearest 0.01 foot.

Low-Flow Purge and Dedicated Sampling Pumps

During previous groundwater investigations at NWS Earle, turbidity, as measured during groundwater sample collection, was not well controlled. The resulting groundwater sample analysis results were sometimes high in metals that were related to metals in the suspended solids of the sample, rather than being indicative of metals from release and transport in the water-bearing formation.

Turbidity occurs when the aquifer is disturbed by well installation and sampling activities. Very fine particles of soil or rock can become entrained in the water in the monitoring well as a result of well purging and sample collection activities. Numerous studies conducted by EPA and independent researchers have concluded that higher turbidity samples are typically collected when the aquifer is disturbed using more conventional sampling practices such as the use of bailers and excessive purging of multiple well volumes. Elevated levels of metals found in turbid groundwater samples may be attributable to the solid particles, particularly where the sample is obtained from a formation not conducive to solid (suspended) phase transport, such as channeling or fracture-based flow, as is generally the case across NWS Earle.

To reduce the effect on groundwater sample results for metals caused by turbidity, dedicated low-flow bladder pumps were installed in all RI wells. Eighty-six pre-cleaned bladder pump/tubing/well cap assemblies were purchased and installed. Appendix K contains copies of the material specifications for the bladder pump assemblies as well as the associated cleanliness certifications. The sampling protocol followed, as described in the RI work plan, was based on EPA Region 1 guidelines of August 10, 1994.

The sampling method utilized was successful in most cases in obtaining low-turbidity samples. For some wells where turbidity was high, a field decision was made to collect a separate filtered sample for comparison purposes.

Despite these efforts, some monitoring well groundwater samples could not be obtained with low turbidity. In cases where the turbidity could not be reduced to the goal value as specified in the EPA procedure, a separate filtered sample of the groundwater was collected and analyzed for comparison purposes. Appendix J is a table of groundwater collection endpoint turbidity values.

Groundwater Sampling

Groundwater from the newly installed and existing permanent monitoring wells was analyzed to determine the current level and extent of groundwater contamination and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. Field measurements documented during purging were pump rate (L/min), water level, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. An in-line flow cell used in conjunction with a PurgeSaver© or Hydrolab© water quality analyzer was used to measure pH, conductivity, temperature, dissolved oxygen, and salinity. Wells were

purged until groundwater parameters stabilized. The low-flow purge and sampling technique allowed for lower turbidity samples to be collected. Care was taken to ensure little or no draw down in water levels occurred throughout the purge and sample process.

Purge water was discharged to the ground and allowed to percolate back into the local soil in such a way as to avoid incidental discharge to surface water bodies.

A total of 91 groundwater samples, including field duplicates, were collected from 88 monitoring wells located at Sites 1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 16, 17, 19, 23, 26, and 29 and four background locations and submitted to Lancaster Laboratories or to GP Environmental Services for selected analysis. QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. A summary of the groundwater sampling is provided in Table 2-4. Appendix D contains sample logs.

2.1.1.4 Slug Testing

Slug tests were conducted in nine monitoring wells at Sites 1, 13, 16, and 23.

Slug tests were performed at sites where hydraulic conductivity measurements were not obtained during previous investigations (SI, RI/FS). The intended use of the data was for fate and transport (general) evaluation and to help support early technology feasibility screening for remedial alternatives.

Rising-head slug tests were performed in eight monitoring wells installed at Sites 1, 13, 16, and 23. A falling-head slug test was performed in one monitoring well at Site 16. Rising-head slug tests were performed by removing a solid slug and measuring the rate of rise of water level back to equilibrium.

The falling-head slug test was performed by inserting a solid slug into the well to raise the water level and measuring the rate of decline in water level (recovery) after the slug was inserted. Slug test data were collected using an in-situ Hermit data logger and pressure transducer. Results from the slug tests were used to calculate hydraulic conductivities.

2.1.1.5 Hydropunch Groundwater Sampling

Twenty-three hydropunch points were installed at Sites 1, 4, 5, and Q to determine the general groundwater quality at the site and to select potential locations for permanent monitoring wells. A total of 26 groundwater samples were collected from the 23 locations. One groundwater sample was collected from each location at Sites 1 and 5. An attempt was made at Site 4 to collect a groundwater sample from the water table, a mid-depth interval sample, and a sample at approximately 40 feet below the water table. In some instances, the particular interval was not producing water so a sample was not collected.

Table 2-4
Permanent Monitoring Wells and Groundwater Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Permanent Monitoring Wells	Number of Environmental Groundwater Samples[1]	Analytical Parameters
Background Site 1	1	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, cyanide, TPH, nitrite, nitrate, BOD, chloride, sulfate, ammonia, COD, TOC, phosphate, and explosives
Background Site 2	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, cyanide, TPH, nitrite, nitrate, BOD, chloride, sulfate, ammonia, COD, TOC, phosphate, and explosives
Background Site 3	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, cyanide, TPH, nitrite, nitrate, BOD, chloride, sulfate, ammonia, COD, TOC, phosphate, and explosives
Background Site 4	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, cyanide, TPH, nitrite, nitrate, BOD, chloride, sulfate, ammonia, COD, TOC, phosphate, and explosives
Site 1	5	6	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, COD, TOC, BOD, nitrite, nitrate, and TPH
		1	Dissolved TAL metals
Site 2	7	7	TCL VOC, TCL SVOC, TAL metals, chromium^{+6}, and explosives
		4	Chromium-trivalent
		1	Dissolved TAL metals
Site 3	8 (4 wells were dry)	4	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
		2	Dissolved TAL metals
		2	TCL PCBs
Site 4	7 (1 well dry)	6	TCL VOC, TCL SVOC, TAL metals, nitrite, nitrate, BOD, chloride, sulfate, COD, TOC, phosphate, and ammonia
Site 5	8	8	TCL VOC, TCL SVOC, TAL metals, nitrite, nitrate, BOD, chloride, sulfate, COD, TOC, phosphate, ammonia, and turbidity
Site 6	4	4	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, TOC, COD, phosphate, ammonia, turbidity, chloride, sulfate, nitrite, nitrate, and BOD

Table 2-4
Permanent Monitoring Wells and Groundwater Sampling Summary
NWS Earle, Colts Neck, New Jersey
Page 2 of 2

Site	Number of Permanent Monitoring Wells	Number of Environmental Groundwater Samples[1]	Analytical Parameters
Site 7	5	5	TCL VOC, TAL metals, TOC, COD, phosphate, ammonia, nitrite, nitrate, BOD, turbidity, chloride, and sulfate
Site 10	7	8	TCL VOC, TAL metals, nitrite, nitrate, ammonia, COD, TOC, phosphate, BOD, turbidity, sulfate, and chloride
Site 11	5	5	TCL VOC and TAL metals
Site 13	5	5	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, nitrite, nitrate, BOD, chloride, sulfate, ammonia, phosphate, COD, and TOC
		2	Dissolved TAL metals
		1	TPH
		1	Turbidity
Site 16	7	7	TCL VOC, TCL SVOC, TAL metals, and TPH
		2	Dissolved TAL metals
		2	GC finger print and specific gravity
Site 17	5 (1 not located)	4	TCL VOC, TCL SVOC, TAL metals, TOC, COD, phosphate, ammonia, chloride, sulfate, nitrite, nitrate, and BOD
		1	TCL pesticides/PCBs
		2	turbidity
Site 19	7 (1 dry well)	6	TCL VOC and TAL metals
		1	chromium (hexavalent)
Site 23	3	3	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, and explosives
		2	Dissolved TAL metals
Site 26	6	6	TCL VOC, TAL metals, and explosives
Site 29	2	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals

[1] Includes field duplicate samples

The hydropunch borehole samples were drilled with a high-torque, truck-mounted hollow-stem-auger drilling rig using 4.25-inch I.D. augers. At Sites 1 and 5, the boreholes were drilled to a depth of 4 to 5 feet and 22 feet bgs, respectively, where water was first encountered. At Site 4, the shallow-depth hydropunch sample's boreholes were drilled to a depth ranging between 5 and 21.6 feet bgs, where water was first encountered. The intermediate-depth boreholes were drilled to 25 feet bgs. The deep hydropunch borehole was drilled to 39 feet bgs. After the desired depth of the borehole was reached, the hydropunch tool was lowered into the borehole and deployed in the hydrocarbon sampling mode. The hydropunch was then driven approximately 3 to 4 feet below the bottom of the borehole. When the desired depth was achieved, the hydropunch was pulled back 3 feet so that the screen was exposed to the aquifer, thereby permitting groundwater to enter the hydropunch. The bottom depths of each shallow hydropunch ranged from 7 to 26 feet bgs. The total depth of the intermediate hydropunch ranged from 28 to 30 feet, and the deep hydropunch had a total depth of 42 feet. A 1-inch-diameter bailer was lowered through the rods and into the hydropunch vessel. Each hydropunch was purged a minimum of three volumes and sampled immediately afterward with the bailer. After sampling, the hydropunch and augers were withdrawn. The boreholes were abandoned by pumping a bentonite slurry into the void space. Cuttings were disposed at the site by spreading them on the soil surface.

Due to slow recharge of groundwater in the hydropunch tool, temporary well points were installed at three proposed hydropunch locations at Site Q. The temporary monitoring wells were constructed of 2-inch diameter PVC hacksaw slotted casing (Q HP 03, Q HP 04) or factory slotted casing (Q HP 02), with a 2-inch bottom cap. The boreholes were drilled to depths ranging from 10 to 20 feet below the ground surface. The wells were screened across the water table and the borehole was packed with Morie No. 1 sand to ground level.

A total of 26 groundwater samples were collected and submitted to Lancaster Laboratories or to GP Environmental Services for analysis. QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. A summary of the number of hydropunch points installed and groundwater samples collected at each site is provided in Table 2-5.

2.1.1.6 Test Pits

A total of 16 test pits were excavated at Sites 3, 9, and 13. Two test pits at Site 3 were excavated in an attempt to determine if a localized source of Target Compound List (TCL) semivolatile organic compound (SVOC) and volatile organic compound (VOC) contaminant detected in monitoring well MW3-04 during 1993 Roy F. Weston remedial investigation could be located. Two test pits were excavated at Site 9 in an attempt to better define the edge of the landfill at the site. Twelve test pits were excavated at Site 13 to determine the extent and composition of fill material at the southern boundary of the site. A backhoe

Table 2-5
Hydropunch and Groundwater Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Hydropunch Locations	Number of Environmental Groundwater Samples	Analytical Parameters
1	8	8	TCL VOC, TCL SVOC, TCL pesticides, COD, TOC, nitrite, nitrate, TPH, BOD, and explosives
4	5	8*	TCL VOC, TCL SVOC, ammonia, phosphate, COD, TOC, nitrite, nitrate, turbidity, chloride, and BOD
5	7	7	TCL VOC
Q	3	3	TCL VOC, TCL SVOC, and TPH analysis

* Includes shallow, intermediate, and deep depth intervals

was used to excavate the test pits. The material in the backhoe bucket was screened with an HNu and described on a field test pit log sheet and the test pit was photographed. No sustained HNu readings above background were encountered. The test pits were then backfilled with the excavated material. No samples were collected for chemical analysis. Test pit log sheets and test pit photos are in Appendix E.

2.1.2 Surface Soil Sampling

Thirty-six surface soil samples, including field duplicates, were collected from 39 locations at Sites 2, 3, 7, 12, 15, 16, 17, 19, 20, and L and four background locations and submitted to Lancaster Laboratory or GP Environmental Services for analysis. QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. The surface soil samples were collected from 0 to 6 inches bgs using stainless-steel trowels and placed directly into the appropriate laboratory-supplied bottleware. The surface vegetation was removed before sampling. A summary of the number of surface soil samples collected at each site is provided in Table 2-6.

2.1.3 Surface Water Sampling

Forty-two surface water samples, including field duplicates, were collected from 38 locations at Sites 4, 6, 13, 15, 17, 19, and 23, Background Sites 1, 2, and 4, and 19 watershed locations. The surface water samples were submitted to Lancaster Laboratories or to GP Environmental Services for analysis. QA/QC samples (trip blanks and field blanks) were collected in accordance with NFESC DQO Level D requirements. Surface water samples were collected by dipping the sample bottle directly into the water. Field measurements collected during surface water sampling include pH, specific conductivity, temperature, turbidity, dissolved oxygen, and salinity. A summary of the number of surface water samples collected is provided in Tables 2-7 and 2-8.

2.1.4 Sediment Sampling

Fifty-five sediment samples, including field duplicates, were collected from 49 locations at Sites 4, 6, 12, 13, 15, 16, 17, 19, 20, 23, and Q and 18 watershed locations and submitted to Lancaster Laboratories or to GP Environmental Services for analysis. QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. The sediment samples were collected using a stainless-steel trowel from 0 to 6 inches below the sediment and water interface or below ground surface (where the stream was dry). The sediment material was placed directly into the appropriate bottleware via the stainless-steel trowel. A summary of the number of sediment samples collected is provided in Tables 2-8 and 2-9.

Table 2-6
Surface Soil Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Surface Soil Sample Locations	Number of Environmental Surface Soil Samples[1]	Analytical Parameters
2	8	8	TCL SVOC, TAL metals, chromium (trivalent), chromium (hexavalent), explosives, and moisture
3	1	1	TCL VOC, TCL SVOC, TAL metals, and TCL PCBs/pesticides
7	1	1	TCL VOC, TAL metals, ammonia, COD, chloride, moisture, nitrite, nitrate, sulfate, TOC, and phosphate
12	3	4	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
15	2	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, moisture, pH, and TPH
16	3	3	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TPH, moisture, and pH
17	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
19	4	5	TCL VOC and TAL metals
		2	chromium (hexavalent) and moisture
20	5	6	TCL VOC, TCL SVOC, and TAL metals
		2	TOC and grain size
L	7	8	TCL VOC, TCL SVOCs, TPH, TAL metals, and TCL pesticides/PCBs
Background Site 1	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, mercury, cyanide, nitrite, moisture, nitrate, chloride, TOC, COD, phosphate, sulfate, pH, ammonia, grain size, and explosives
Background Site 2	1	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, mercury, cyanide, nitrite, nitrate, chloride, TOC, COD, phosphate, moisture, ammonia, grain size, explosives, sulfate, and pH
Background Site 3	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, cyanide, nitrite, nitrate, BOD, chloride, TOC, COD, phosphate, ammonia, explosives, moisture, sulfate, and pH
Background Site 4	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, TAL metals, cyanide, nitrite, nitrate, chloride, TOC, COD, phosphate, ammonia, moisture, explosives, sulfate, and BOD

[1] Includes Field Duplicates

Table 2-7
Surface Water Sampling Summary
NWS Earle Colts Neck, New Jersey

Site	Number of Surface Water Sample Locations	Number of Environmental Surface Water Samples[1]	Analytical Parameters
4	4	4	TCL VOC, TCL SVOC, TAL metals, nitrite, nitrate, turbidity, chloride, ammonia, phosphate, TOC, COD, BOD, and TCL PCBs/pesticides.
6	2	2	TCL VOC, TCL SVOC, TAL metals, ammonia, phosphate, COD, TOC, nitrite, nitrate, turbidity, chloride, BOD, and hardness
13	1	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, BOD, TPH, ammonia, phosphate, COD, TOC, nitrite, nitrate, turbidity, chloride, and explosives
15	2	2	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, and TAL metals
17	3	3	TCL VOC, TCL SVOC, TAL metals, ammonia, phosphate, COD, TOC, nitrite, nitrate, turbidity, chloride, BOD, and hardness
19	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
23	3	4	TCL VOC TCL SVOC, TCL pesticides/PCBs, TAL metals, and explosives
Background Site 1	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, phosphate, COD, cyanide, TPH, nitrite, nitrate, turbidity, BOD, chloride, hardness, explosives, and TOC
Background Site 2	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, phosphate, COD, cyanide, TPH, nitrite, nitrate, turbidity, BOD, chloride, hardness, explosives, and TOC
Background Site 4	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, phosphate, COD, cyanide, TPH, nitrite, nitrate, turbidity, BOD, chloride, hardness, explosives, and TOC
Watershed Locations 5-22 and 30*	19	-	-

(1) Includes field duplicates
* See Table 2-8 Watershed Surface Water and Sediment Sampling Summary

Table 2-8
Watershed Surface Water and Sediment Sampling Summary
NWS Earle, Colts Neck, New Jersey

Sample Number	Number of Environmental Samples[1]	Analytical Parameters
WS SW 05	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 05	1	TCL VOC, TCL pesticides/PCBs, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 06	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 06	1	TCL VOC, TCL pesticides/PCBs, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 07	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 07	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 08	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 08	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 09	2	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 09	2	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 10	1	TCL VOC, TCL SVOC, TAL metals, explosives, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 10	1	TCL VOC, TAL metals, explosives, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 11	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 11	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 12	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 12	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphate
WS SW 13	1	TCL VOC, TCL SVOC, TAL metals, explosives, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 13	1	TCL VOC, TAL metals, explosives, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates

Table 2-8
Watershed Surface Water and Sediment Sampling Summary
NWS Earle, Colts Neck, New Jersey
Page 2 of 2

Sample Number	Number of Environmental Samples[1]	Analytical Parameters
WS SW 14	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 14	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 15	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 15	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 16	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 16	1	TCL VOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 17	2	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, TOC, phosphate, and turbidity
WS SD 17	2	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, TOC, and phosphates
WS SW 18	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, phosphate, and turbidity
WS SD 18	1	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, and phosphates
WS SW 19	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, phosphate, and turbidity
WS SD 19	1	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, and phosphates
WS SW 20	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, phosphate, and turbidity
WS SD 20	1	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite, nitrate, and phosphates
WS SW 21	1	TCL VOC, TCL SVOC, TAL metals, ammonia, BOD, COD, chloride, nitrite, nitrate, hardness, phosphate, and turbidity
WS SD 21	1	TCL VOC, TCL SVOC, TAL metals, ammonia, chloride, moisture, nitrite; nitrate, and phosphate
WS SW 22	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, ammonia, BOD, COD, chloride, nitrite, nitrate, TPH, hardness, TOC, phosphates, and turbidity
WS SD 22	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, ammonia, COD, chloride, moisture, nitrite, nitrate, TPH, pH, and TOC
WS SW 30	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, ammonia, BOD, COD, chloride, nitrite, nitrate, TPH, sulfates, hardness, TOC, and phosphates

[1] Includes field duplicates

Table 2-9
Sediment Sampling Summary
NWS Earle, Colts Neck, New Jersey

Site	Number of Sediment Sample Locations	Number of Environmental Sediment Samples[1]	Analytical Parameters
4	1	1	TCL VOC, TCL SVOC, TAL metals, nitrite, nitrate, chloride, ammonia, phosphate, COD, TOC, and moisture
6	4	4	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, pH, TOC, and moisture
12	2	3	TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals
13	3	4	TCL VOC, TCL pesticides/PCBs, TAL metals, explosives, TOC, pH, and moisture
		2	TCL SVOC
		2	TPH
15	3	3	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, and TPH
16	3	5	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TPH, TOC, moisture, and pH
17	4	4	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TOC, moisture, and pH
		1	grain size
19	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, moisture, and pH
20	1	1	TCL VOC, TCL SVOC, TAL metals, TOC, and grain size
23	5	6	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, and explosives
Q	1	1	TCL VOC, TCL SVOC, and TPH
Background Site 1	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, chloride, nitrite, nitrate, phosphate, TOC, cyanide, grain size, TPH, explosives, moisture, and pH
Background Site 2	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, chloride, nitrite, nitrate, phosphate, TOC, cyanide, grain size, TPH, explosives, moisture, and pH
Background Site 4	1	1	TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, ammonia, chloride, nitrite, nitrate, phosphate, TOC, cyanide, grain size, TPH, explosives, moisture, and pH
Watershed Locations 5 through 22*	18	-	-

[1] Includes field duplicates
* See Table 2-8 Watershed Surface Water and Sediment Sampling Summary

2.1.5 Surveying

Surveying was conducted to establish the horizontal locations and vertical elevations of soil gas grid corners, hydropunch sample locations, soil borings, monitoring wells, test pits, surface soil locations, and surface water and sediment sample locations. All work was conducted by a surveyor licensed in the state of New Jersey. All vertical elevations were surveyed to the nearest 0.01 foot; all horizontal locations were surveyed to the nearest 0.10 foot. Surveying for each permanent monitoring well included the elevation of the ground surface adjacent to the well, the top of the PVC riser pipe, and the top of the steel protective casing. Surveying notes are provided in Appendix F.

2.1.6 Sampling of Septic Tank Contents

One aqueous septic tank sample (20 AQW-01) was collected (in conjunction with three subsurface soil samples taken from the leach field) at Site 20 to determine if the septic system is a potential source of site contamination. The septic tank sample was submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, and Target Analyte List (TAL) metals analyses. QA/QC samples (trip blanks, field blanks, and rinsate blanks) were collected in accordance with NFESC DQO Level D requirements. Sample logs are contained in Appendix D.

The aqueous sample was collected by lowering a disposable polyethylene bailer, by rope, to the aqueous zone and filling the appropriate bottleware via the bailer. Field measurements were not collected during sampling.

2.1.7 Waste Handling

Four types of investigation derived wastes (IDWs) were generated during the field investigation: spent personal protective equipment (PPE), drill and/or soil cuttings, decontamination liquids, and development and purge water. None of the IDWs generated during field activities represent a significant risk to human health or the environment because of the manner in which the IDWs were managed. The management of the IDWs is provided below:

- PPE: Spent PPE was bagged and placed in trash receptacles at the facility.

- Drill and/or Soil Cuttings: Cuttings and/or soils that exhibited HNu readings above background levels, had strong petroleum/chemical odors, or were visibly contaminated were containerized in Department of Transportation (DOT)-approved 55-gallon drums and stored at Site 16/F. IDW stored at Site 16/F was removed

by a licensed waste hauler (Laidlaw Environmental Services) for treatment via incineration and disposal off site (Appendix L). The remaining drill and soil cuttings were used to backfill soil borings or, if generated from monitoring wells, were spread on the ground surface near the respective well.

- Decontamination Liquids: Liquids from the decontamination of drilling rigs and sampling equipment were allowed to run off onto plastic and evaporate.

- Development and Purge Water: Groundwater generated during monitoring well development and well purging and sampling was discharged directly to the ground.

2.1.8 Floor Sweepings Sampling

Sweepings from different areas of Building C-33 were collected to determine if trace concentrations of mercury remained on the floor surface from a mercury spill. Floor sweepings were collected from five grab sample points and composited into one floor sweeping sample. The composite sample was submitted to Lancaster Laboratories for mercury analysis. A sample log is provided in Appendix C.

2.1.9 General Sampling Operations

Each sample that was submitted to the laboratory for chemical analysis was assigned a unique sample tracking number. The sample tracking number consisted of an alpha-numeric code that identified the site, the sample medium and location, and sample depth (for subsurface soils). Any other pertinent information regarding sample identification was recorded in the field logbooks.

The alpha-numeric code used in the sample system is explained below:

Sample Number

(NN)	-	(AA)	-	(NN)	-	(NN)
(Site Number)		(Medium)		(Location		(Sample Depth)

QA Samples

(AA)	-	(AA)	-	(NN)
(QA Type)		(Medium)		(QA Sample Number)

Character Type

A = Alpha
N = Numeric

Site (Note: This list contains the 21 sites investigated in the summer and the 6 sites investigation in December of 1996)

01	=	Site 1, Ordnance Demilitarization Site
02	=	Site 2, Active Ordnance Demilitarization Site
03	=	Site 3, Landfill Southwest of "F" Group
04	=	Site 4, Landfill West of "D" Group
05	=	Site 5, Landfill West of Army Barricades
06	=	Site 6, Landfill West of Normandy Road
07	=	Site 7, Landfill South of "P" Barricades
09	=	Site 9, Landfill South of "P" Barricades
10	=	Site 10, Scrap Metal Landfill
11	=	Site 11, Contract Ordnance Disposal Area
12	=	Site 12, Battery Storage Area
13	=	Site 13, Defense Property Disposal Office Yard
15	=	Site 15, Sludge Disposal Site
16	=	Site 16, EPIC Site F (Roundhouse)
17	=	Site 17, Landfill
19	=	Site 19, Paint Chip and Sludge Disposal Site
20	=	Site 20, Grit Blasting Area at Building 544
22	=	Site 22, Paint Chip Disposal Area
23	=	Site 23, Paint Disposal Area
24/25	=	Site 24, Closed Pistol Range
24/25	=	Site 25, Closed Pistol Range
26	=	Site 26, Explosive "D" Washout Area
27	=	Site 27, Projectile Refurbishing Area
L	=	Epic Site L, MSC Van Parking Area
29	=	Site 29, PCB Spill Site
Q	=	Epic Site Q, Fire Fighting School
BG	=	Background sample location

Medium

SS	=	Surface Soil
SB	=	Subsurface Soil

GW	=	Groundwater
SW	=	Surface Water
SD	=	Sediment
DRUM	=	Drum Sample
AQW	=	Aqueous waste sample (septic tank)
SG	=	Soil gas sample
F	=	Filtered groundwater sample
HP	=	Hydropunch groundwater sample

Sample Location

The sample location code was assigned based on the medium being collected, as shown below:

Subsurface soil	=	soil boring number
Surface soil	=	sample location number
Groundwater sample	=	well number or hydropunch sample number
Sediment/surface water	=	sample location number
Background sample	=	background sample location number
Soil gas	=	sample location number

Sample Depth

For subsurface soil samples, the top of the sample interval depth in feet was used in the identification.

QA Sample Designation

DUP	=	Duplicate
RB	=	Equipment Rinsate Blank
FB	=	Field Blank
TP	=	Trip Blank

Field Duplicate Labels

Field duplicates were designated as DUP-01, DUP-02, etc. so they were submitted to the laboratory "blind." The chain of custody form and other documentation submitted to the laboratory were filled out in such a way that the laboratory could not match the duplicates to the original sample. The time on the duplicate samples was noted as 00:00. The correct sample location, time, etc. were documented in the field logbook.

Quality Control Sample Labels

Quality control samples were taken periodically. These samples were used to document the effectiveness of decontamination, to determine the quality of water used for decontamination, and to identify possible cross-contamination occurring during transit. These blank samples, including trip blanks, field blanks, and equipment rinsate blanks, used the QC sample identification scheme, listed below.

Sample Number

A sequential numeric designation was assigned to each type of blank on a daily basis.

Sample Date

The format MMDDYY (M=Month, D=Day, Y=Year) was used to indicate the day the sample was generated.

Example of the Quality Control Labels

The second trip blank sample collected on December 1, 1995 would have had the sample identification label TB-02-120195. The first rinsate blank taken on January 5, 1995 would have had the label RB-01-010595.

Matrix spike and matrix spike duplicate (MS/MSD) samples were designated on the field documentation forms and sample labels.

2.1.10 Sample Handling

Sample Packaging and Shipping

Samples were packaged and shipped in accordance with B&R Environmental SOP SA-6.2. The field operations leader (FOL) was responsible for completing the following forms:

- Sample labels
- Chain-of-custody forms
- Appropriate labels applied to shipping coolers
- Chain-of-custody labels
- Federal Express air bills

Sample Custody

Custody of the samples was maintained and documented in accordance with procedures described in B&R Environmental SOP SA-6.1. Chain-of-custody began with the collection of the samples in the field. Chain-of-custody forms are included in Appendix G.

Equipment Decontamination

Equipment involved in field sampling operations, including soil gas probes, drilling rigs, down-hole tools, augers, backhoes, well casing and screens, and all sampling equipment, was decontaminated before sampling, between individual samples, and after drilling or sampling activities.

The backhoe bucket, down-hole drilling equipment, soil gas equipment, and sampling tools were cleaned using a high-pressure steam generator (steam jenny) before beginning work, between sample locations (such as test pits, soil borings, soil gas points, etc), at the completion of the drilling program, and any time the drilling rig left a site before completing a boring. The NWS Earle facility provided potable water directly from fire hydrants. Additional operations followed during drilling equipment decontamination are found in HNUS SOP SA-7.1.

The sampling equipment used for collecting samples was decontaminated before the beginning of field sampling and between samples. The following decontamination steps were followed:

- Potable water rinse.
- Alconox or liquinox detergent wash.
- Potable water rinse.
- Nitric acid rinse (for carbon steel equipment used on TAL metal samples only).
- Steam distilled water rinse (for carbon steel equipment used on TAL metal samples only).
- Methanol rinse.
- Hexane rinse (pesticide grade) (only necessary for equipment used on pesticide/PCB samples).
- Steam distilled water rinse.
- Air dry.
- Wrap in aluminum foil for transport.

Field analytical equipment such as pH, conductivity, and temperature instrument probes was rinsed first with steam distilled water, then with the sample liquid.

2.2 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of environmental contamination at NWS Earle are presented in each site section for inorganic and organic chemicals detected in surface soil, subsurface soil, sediment, groundwater, and surface water. The validated data generated during the RI provide the basis for the nature and extent presentations. The purpose of the nature and extent of contamination subsection in each site-specific section (Sections 4.0 through 30.0) is to identify primary chemical contaminants based on their frequency of detection and concentrations, to delineate (on an areal- and depth-specific basis) the extent of contamination, and to provide indications of contaminant migration via atmospheric, overland, or subsurface pathways. Tables provided in each site section present the occurrence and distribution of the data in a particular medium at that site. These tables provide the basis for selection of chemicals of potential concern (COPCs) at each site per medium. The complete analytical database is included as Appendix A.

2.3 FACILITY-WIDE CONTAMINANT FATE AND TRANSPORT

The ultimate fate of chemicals in the environment is determined by a multitude of physical, chemical, and biologically related factors. The role and significance of different physical properties such as specific gravity, solubility, and vapor pressure in determining what environmental fate and transport processes occur for a particular chemical can depend upon numerous additional factors. For example, solubilities of metals are not truly constant in the environment but may be dramatically enhanced or reduced when certain ligand species are available for complexation or precipitation, when organic matter is present in dissolved form, or when pH is altered. Physical properties such as soil/water partition ratios and groundwater retardation factors can vary considerably from location to location, even within the same geologic regime. Chemical and biological transformational processes can also be significantly affected by localized effects such as clay or mineral catalysts, chemical or biological inhibitors, and pH, Eh, and dissolved oxygen.

This section of the report will provide a summary of the physical and chemical transport properties for the chemicals detected at the site. No distinction of location or magnitude of chemicals will be made in this section. The information presented will discuss chemical persistence and transport phenomena for the general classes of compounds detected in the environmental media sampled at the sites. Each of the site-specific fate and transport sections will address probable contaminant migration routes and qualitatively identify potential routes of human exposure.

2.3.1 Physical and Chemical Properties

Physical and chemical properties of the detected contaminants are presented and discussed in this section. These parameters are used to quantitatively describe the environmental behavior of site chemicals. Empirically determined literature values of the specific gravity, vapor pressure, solubility, octanol/water partition coefficient, organic carbon partition coefficient, soil-water partitioning coefficient, and Henry's Law constant are presented. Calculated values are presented if literature values are not available. A summary of the physical and chemical transport properties for positively detected organic chemicals is provided in Table 2-10. These data are used to evaluate contaminant migration and assess exposures in the risk assessment. A discussion of the environmental significance of each of these parameters follows.

2.3.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a contaminant will have a tendency to float or sink in water if it is present as a pure compound or at very high concentrations. Contaminants with a specific gravity less than 1.0 will float, whereas contaminants with a specific gravity greater than 1.0 will sink.

2.3.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary significance at environmental interfaces, such as surface soil/air and surface water/air. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils. However, in order to conservatively evaluate chemical exposures at the sites, it will be considered. Chemicals with high vapor pressures are expected to enter the atmosphere more readily than chemicals with low vapor pressures. Semivolatile organics and pesticides and PCB compounds generally have low vapor pressures and hence are not expected to volatilize readily.

2.3.1.3 Solubility

The rate at which a chemical is leached by infiltrating precipitation is directly proportional to its water solubility. Several of the detected VOCs have relatively high water solubilities, but the low concentrations observed in soils indicate low potential for significant desorption. Pesticides and PCBs typically have low solubilities and generally do not migrate through the soil column to the water table. The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.). The solubility is also strongly dependent on pH, Eh, and the presence of other ionic species in solution (the Debye-Huckel theory). Solubility products reported in the literature vary with the type of ionic species.

TABLE 2-10 (PAGE 1 OF 3)
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS OF POTENTIAL CONCERN
SITEWIDE - GROUNDWATER, SURFACE WATER, SEDIMENT, SURFACE SOIL, AND SUBSURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	SPECIFIC GRAVITY	Koc
VOLATILES							
1,1,1-TRICHLOROETHANE	133.41	720	2.47	1.23E2 (25C)	3.00E-02	1.35	1.52E+01
1,1,2-TRICHLOROETHANE	133.41	4500	2.17	19	7.40E-04	1.4397	5.60E+01
1,1-DICHLOROETHENE	96.94	400	1.48	5.91E+02	1.90E-01	1.218	6.50E+01
1,2-DICHLOROETHANE	98.98	8690	1.48	6.10E+01	9.14E-04	1.235	1.40E+01
1,2-DICHLOROETHENE (TOTAL)	96.94	800 (20C)	-	200 (25C)	4.08E-03	1.28	5.90E+01
2-BUTANONE	72.1	35300	0.26	7.80E+01	2.08E-05	0.805	1.70E+01
4-METHYL-2-PENTANONE	100.16	1.91E+04	1.09E+00	1.00E+01	1.49E-05	0.8	2.05E+00
BENZENE	78.12	1780	2.13	95.2 (25C)	5.50E-03	-	6.50E+01
BROMODICHLOROMETHANE	163.83	4500	1.88	5.00E+01	2.41E-03	1.98	6.10E+01
CARBON DISULFIDE	76.14	2300	1.84	2.60E+02	1.13E-02	1.263	1.42E+02
CHLOROBENZENE	112.56	500	2.84	1.17E+01	3.58E-03	1.106	3.30E+02
CHLOROFORM	119.38	8200	1.97 (20C)	1.50E+02	2.88E-03	1.489	4.40E+01
ETHYLBENZENE	106.16	152	3.15	7.00E+00	6.60E-03	0.867	1.10E+03
METHYLENE CHLORIDE	84.93	13,200-20,000	1.25	362.4	2.00E-03	1.327	8.80E+00
STYRENE	104.15	3.00E+02	3.16E+00	5.00E+00	2.60E-03	0.91	2.76E+00
TETRACHLOROETHENE	165.83	200	2.6 (20C)	1.40E+01	1.53E-02	1.626	3.64E+02
TOLUENE	92.13	534.8 (25C)	2.69 (20C)	2.87E+01	6.66E-03	0.867	3.00E+02
TRICHLOROETHENE	131.39	1100	2.53	5.79E+01	9.10E-03	1.46	1.26E+02
VINYL CHLORIDE	62.5	1,100	1.4	2,660	8.14E-02	0.9106	8.20E+00
XYLENE (TOTAL)	106.16	187	2.77-3.2	6.50E+00	4.33E-63	0.86-0.88	2.48E+02
SEMIVOLATILES							
1,2,4-TRICHLOROBENZENE	181.45	30	4.02	2.90E-01	2.30E-03	1.454	9.20E+03
1,2-DICHLOROBENZENE	147	1.40E+02	3.38E+00	1.50E+00	3.00E-03	1.3	3.23E+00
1,4-DICHLOROBENZENE	147	7.90E+01	3.39E+00	1.80E+00	4.33E-03	1.25	3.23E+00
2,4-DICHLOROPHENOL	163	4,500	2.75	0.12	-	1.383	-
2-METHYLNAPHTHALENE	142.19	26-28 (25C)	4.26	0.087 (25C)	6.00E-04	0.994	5.80E+03
2-METHYLPHENOL	108.14	3.10E+04	1.95E+00	2.40E-01	8.40E-07	1	1.38E+00
4-METHYLPHENOL	108.1	4400	1.92/1.94	4.00E-02	1.29E-06	1.0347	2.43E+01
ACENAPHTHENE	154.2	3.42 (25C)	3.92	1.55E-3 (25C)	9.10E-05	1.0242	4.60E+03
ACENAPHTHYLENE	152.2	3.93 (25C)	3.72	2.90E-02	1.45E-03	-	2.50E+03
ANTHRACENE	178.2	0.045 (25C)	4.45	1.7E-5 (25C)	8.60E-05	1.283	1.40E+04
BENZO(A)ANTHRACENE	228.28	0.0057	5.61	2.20E-08	1.00E-06	-	2.00E+05
BENZO(A)PYRENE	252	0.0038 (25C)	5.98	5.60E-09	4.90E-07	-	5.50E+06
BENZO(B)FLUORANTHENE	252.3	0.0014 (25C)	6.57	5.00E-07	1.22E-05	-	5.50E+05
BENZO(G,H,I)PERYLENE	276	0.00026 (25C)	7.23	1.03E-10 (25C)	1.44E-07	-	1.60E+06
BENZO(K)FLUORANTHENE	252.3	0.0043 (25C)	6.84	5.00E-07	3.87E-05	-	5.50E+05
BIS(2-ETHYLHEXYL)PHTHALATE	390.62	0.4 (25C)	5.3	2.00E-07	3.00E-07	0.99	2.00E+09
BUTYLBENZYLPHTHALATE	312	2.9	4.78	6.00E-05	8.30E-06	1.1 (25C)	1.70E+05
CARBAZOLE	167.21	-	3.29	400 (323C)	-	1.1	1.20E+03
CHRYSENE	228.3	0.0018 (25C)	5.61	6.3E-9 (25C)	1.05E-06	1.274	2.00E+05
DI-N-BUTYLPHTHALATE	278.35	4.00E+02	5.20E+00	1.00E-01	2.80E-07	1	5.23E+00
DI-N-OCTYLPHTHALATE	391	3 (25C)	9.2	1.40E-04	1.70E-05	0.99	3.60E+09
DIBENZ(A,H)ANTHRACENE	278.4	0.005 (25C)	5.97	1.00E-10	7.30E-08	-	3.30E+06

- = Physical or chemical properties not available for this chemical in this classification

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TABLE 2-10 (PAGE 2 OF 3)
SUMMARY OF TOXICOLOGICAL DATA FOR POTENTIAL CHEMICALS OF CONCERN
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS OF POTENTIAL CONCERN
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	SPECIFIC GRAVITY	Koc
SEMIVOLATILES (CONTINUED)							
DIBENZOFURAN	168.2	10	4.12	-	-	-	8.13E+03
DIETHYLPHTHALATE	222.2	210	2.47	3.5E-3 (25C)	1.20E-06	1.12	1.42E+02
FLUORANTHENE	202.3	0.26 (25C)	5.33	5E-6 (25C)	6.50E-06	1.252	3.80E+04
FLUORENE	116.2	1.69 (25C)	4.18	7.10E-04	6.40E-05	1.203	7.30E+03
HEXACHLOROETHANE	236.74	50 (22C)	-	4.00E-01	2.49E-03	-	2.00E+04
INDENO(1,2,3-CD)PYRENE	276.3	0.00053 (25C)	7.66	1.00E-10	6.95E-08	-	1.60E+06
ISOPHORONE	138.21	1.20E+04	1.70E+00	3.80E-01	5.80E-06	0.92	1.94E+00
N-NITROSODIPHENYLAMINE (1)	198.23	3.50E+01	2.79E+00	1.00E-01	3.10E+00	-	2.81E+00
NAPHTHALENE	128.2	31.7 (25C)	3.01/3.45	8.7E-3 (25C)	4.60E-04	1.152	9.40E+02
NITROBENZENE	123.11	1.90E+03	1.85E+00	1.50E-01	2.40E-05	1.2	1.56E+00
PHENANTHRENE	178.2	1.0(25C)	4.45	9.6E-4 (25C)	2.30E-04	1.025	1.40E+04
PHENOL	94.11	8.00E+04	1.46E+00	3.50E-01	1.30E-06	1.1	1.15E+00
PYRENE	202.3	0.13 (25C)	5.18	2.5E-6(25C)	5.10E-06	-	3.80E+04
PESTICIDES/PCBs							
4,4'-DDD	320.1	0.09 (25C)	1.60E+06	1.2E-7 (25C)	2.20E-08	-	7.70E+05
4,4'-DDE	318	0.04 (20C)	4.28	6.50E-06	6.80E-05	-	4.40E+06
4,4'-DDT	354.5	0.0055 (25C)	6.19 (20C)	1.9E-7 (25C)	1.58E-05	-	3.90E+06
ALDRIN	364.91	1.70E-02	5.11E+00	2.30E-06	5.00E-04 -	1.7	4.98E+00
ALPHA-BHC	290.83	1.63E+00	3.81E+00	6E-2 (40C)	5.30E-06	1.9	3.58E+00
ALPHA-CHLORDANE	409.8	5.60E-02	2.78E+00	1.00E-05	3.70E-05	1.11	5.15E+00
AROCLOR-1248	299.5	0.054	5.75	4.9E-4 (25C)	3.60E-03	-	2.50E+05
AROCLOR-1254	325.1	3.10E-02	6.04E+00	7.70E-05	2.60E-03	-	5.72E+00
AROCLOR-1260	375.7	0.08 (24C)	7.15	4E-5 (25C)	0.74	-	6.70E+06
BETA-BHC	290.83	7.00E-01	3.80E+00	1.70E-01	2.30E-07	1.9	3.58E+00
DELTA-BHC	290.83	2.10E+01	4.14E+00	2.00E-02	2.50E-07	1.9	3.58E+00
DIELDRIN	380.91	1.90E-01	4.09E+00	1.80E-07	5.80E-05	1.8	3.23E+00
ENDOSULFAN I	406.95	3.20E+00	3.55E+00	1.00E-05	1.00E-04	1.7	2.30E+00
ENDOSULFAN II	406.95	3.30E-01	3.62E+00	1.00E-05	1.91E-05	1.7 (20/20C)	2.30E+00
ENDOSULFAN SULFATE	422.92	2.20E-01	3.66E+00	NA	2.60E-05	-	1.62E+00
ENDRIN	380.92	2.60E-01	5.60E+00	2.00E-07	4.00E-07	1.7	3.23E+00
ENDRIN ALDEHYDE	380.92	2.60E-01	5.60E+00	2.00E-07	3.90E-07	-	2.83E+00
ENDRIN KETONE	380.92	-	-	-	4.00E-07	-	-
GAMMA-BHC (LINDANE)	290.83	7.00E+00	3.24E+00	9.40E-06	4.90E-07	1.9	3.58E+00
GAMMA-CHLORDANE	409.8	5.60E-02	2.78E+00	1.00E-05	3.70E-05	1.11	5.15E+00
HEPTACHLOR	373.32	5.60E-02	4.40E+00	3.00E-04	1.50E-03	1.6	4.08E+00
HEPTACHLOR EPOXIDE	389.32	3.50E-01	3.65E+00	2.60E-06	3.20E-05	-	2.34E+00
METHOXYCHLOR	345.65	4.00E-02	4.68E+00	-	3.00E-05	1.4	4.90E+00
EXPLOSIVES							
2,4,6-TRINITROTOLUENE	227.15	1.50E+02	2.00E+00	5.51E-06 (25C)	1.10E-08	1.654	2.72E+00
2,4-DINITROTOLUENE	182.15	500	1.98E+00	1(20c)	1.86E-07	1.3208	2.40E+00
2-AMINO-4,6-DINITROTOLUENE	197.17	-	-	-	-	-	-
4-AMINO-2,6-DINITROTOLUENE	-	-	-	-	-	-	-
HMX	296.2	5.00E+00 (25C)	2.60E-01	3.33E-14	2.60E-15	1.9	5.40E-01
NITROBENZENE	123.11	1.90E+03	1.85E+00	1.50E-01	2.40E-05	1.2	1.56E+00

- = Physical or chemical properties not available for this chemical in this classification

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TABLE 2-10 (PAGE 3 OF 3)
SUMMARY OF TOXICOLOGICAL DATA FOR POTENTIAL CHEMICALS OF CONCERN
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR CHEMICALS OF POTENTIAL CONCERN
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	MOLECULAR WEIGHT	SOLUBILITY (mg/L)	Log Kow	VAPOR PRESSURE (mmHg, 20C)	HENRY'S LAW CONSTANT (atm cu. m/mol)	SPECIFIC GRAVITY	Koc
EXPLOSIVES (CONTINUED)							
NITROCELLULOSE	>504	-	-	-	-	1.35-1.6	-
RDX	222.15	60 (25C)	8.70E-01	4.03E-09	1.96E-11	1.82	2.00E+00
INORGANICS							
ALUMINUM	26.98	INSOLUBLE	-	0	-	2.708	-
ANTIMONY	121.75	-	-	1 (886C)	-	6.684	-
ARSENIC	74.92	-	-	1 (372C)	-	5.72	-
BARIUM	137.34	DECOMPOSE	-		-	3.5	-
BERYLLIUM	9.01	-	-	1 (1520C)	-	1.85	-
CADMIUM	112.4	INSOLUBLE	-	1 (1284C)	-	8.642	-
CALCIUM	40.08	DECOMPOSE	-		-	1.57	-
CHROMIUM	52	INSOLUBLE	-	0	-	7.2	-
COBALT	58.93	INSOLUBLE	-	0	-	8.9	-
COPPER	63.54	INSOLUBLE	-	1 (1628C); 10 (1870C)	-	8.92	-
IRON	55.85	INSOLUBLE	-	0	-	7.86	-
LEAD	207.19	INSOLUBLE	-	1 (980C)	-	11.35	-
MAGNESIUM	24.312	-	-	-	-	1.738	-
MANGANESE	54.94	DECOMPOSE	-	1 (1292C)	-	7.2	-
MERCURY	200.59	5.6E-03g/100cc	-	2E-03 (25C)	-	13.5939	-
NICKEL	58.71	INSOLUBLE	-	1 (1810C)	-	8.902	-
POTASSIUM	39.1	DECOMPOSE	-	-	-	0.862	-
SELENIUM	78.96	INSOLUBLE	-	0	-	4.26-4.81	-
SILVER	107.87	INSOLUBLE	-	0	-	10.5	-
SODIUM	22.9898	DECOMPOSE	-	-	-	0.97	-
THALLIUM	204.37	-	-	-	-	11.85	-
VANADIUM	50.94	-	-	-	-	5.96	-
ZINC	65.37	-	-	1 (487C)	-	7.133	-
CYANIDE	27	SOLUBLE	-	657.8 (21.9C)	-	0.699	-

- = Physical or chemical properties not available for this chemical in this classification

2.3.1.4 Octanol-Water Partition Coefficient (Kow)

The octanol/water partition coefficient (Kow) is a measure of the equilibrium partitioning of chemicals between octanol and water. A linear relationship between the Kow and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been determined (Lyman et al., 1990). The Kow is useful in characterizing the sorption of compounds by organic soils where experimental values are not available. Larger organic molecules such as semivolatiles and pesticides and PCBs are very likely to partition to fatty tissues, and less complex organic chemicals have lower Kow values.

2.3.1.5 Organic Carbon Partition Coefficient (Koc)

The soil/sediment partition (organic carbon partition) coefficient (Koc) indicates the tendency of a chemical to bind to soil particles containing organic carbon. Chemicals with high Kocs generally have low water solubilities and vice versa. This parameter may be used to infer the relative rates at which more mobile chemicals are transported in groundwater. Complex organic chemicals are relatively immobile and are preferentially bound to the soil phase. These compounds are not subject to rapid groundwater transport. These immobile chemicals are, however, easily transported by erosional processes when they are present in surface soils.

2.3.1.6 Distribution Coefficient (Kd)

The soil-water partitioning (distribution) coefficient (Kd) is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the Koc and the amount of organic carbon in the soil. The Koc and the fractional organic carbon content of the soil (FOC) may be used to determine an equilibrium distribution coefficient (Kd) for the solid and aqueous matrices:

$$Kd = Koc \times FOC$$

where: Kd = Distribution coefficient
FOC = Fractional organic carbon content of the soil
Koc = Organic carbon partition coefficient

Published values exist for Kd for inorganics. These are specific to the type of mineral-clay; however, Kd values are also dependent on the complexation (ligands) present in solution with the inorganic.

2.3.1.7 Henry's Law Constant (H)

Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface water bodies and groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculate the equilibrium contaminant concentrations in the vapor versus the liquid phases for dilute solutions. In general, chemicals with a Henry's Law constant below 5×10^{-6} atm-m^3/mole should volatilize very little and be present only in minute amounts in the atmosphere or in soil gas. Henry's Law constant will be used to calculate the equilibrium soil gas vapor concentration for volatile organic compounds in groundwater.

2.3.1.8 Bioconcentration Factor (BCF)

The bioconcentration factor (BCF) provides a measure of the accumulation tendency for chemicals in biological and ecological systems. BCFs represent the ratio of aquatic animal tissue concentration to the water concentration of a chemical. The ratio is both contaminant and species specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water partition coefficient. All of the organic chemicals detected during the RI are bioaccumulative to some extent, but many of the semivolatile organics are more bioaccumulative than the volatile organics.

2.3.1.9 Summary

Table 2-10 presents a summary of the fate and transport data that are used in this RI in discussions of the nature and extent of contamination, contaminant fate and transport, and the baseline risk assessment sections.

2.3.2 Contaminant Persistence

The persistence of the classes of organic contaminants is discussed in this section. The text will address general classes of the detected chemicals because the fate of chemicals in the environment is usually similar for chemicals within a particular chemical family.

2.3.2.1 Ketones

Ketones are characterized by high aqueous solubility and volatility and are readily biodegradable in both soil and water. Hydrolysis is not considered to be a significant fate process for this class of chemicals. The bioaccumulation of ketones is not significant, due to low octanol/water partitioning coefficient. In general, ketones were not pervasive at any site. The lack of detection of acetone at many sites demonstrates that this common laboratory contaminant is actually not present. This is in direct contrast to unvalidated historical data collected at the NWS Earle sites.

2.3.2.2 Chlorinated Aliphatics

Research has demonstrated that aerobic bacteria predominantly degrade organic compounds containing zero, one, or two halogens, and anaerobic bacteria predominate when more halogens are present. Thus, highly chlorinated aliphatic hydrocarbons such as PCE are subject to reductive dehalogenation via the action of anaerobic bacteria. It does not appear that appreciable degradation of highly halogenated aliphatics occurs in aerobic aquatic systems or unsaturated soils (Lyman, et al., 1982).

The transformation pathways for chlorinated aliphatic hydrocarbons in soil systems have been documented by Dragun et al. (1988). PCE and TCE are transformed via reductive dechlorination to 1,1-dichloroethene (1,1-DCE) and 1,2-DCE isomers. The terminal product of the transformation series is vinyl chloride, the chlorinated ethene with highest toxicity.

2.3.2.3 Phthalate Esters

Phthalate esters are considered to be relatively persistent environmental contaminants. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, it appears that this is a very slow process in both soil and surface water. Certain microorganisms have been shown to excrete products that increase the solubility of phthalate esters and enhance their biodegradation (Gibbons and Alexander, 1989). Biodegradation of bis(2-ethylhexyl) phthalate and other phthalate esters is an important fate mechanism, as is bioaccumulation. Hydrolysis of phthalate esters is very slow, with calculated half-lives of 3 years (dimethyl phthalate) to 2,000 years [bis(2-ethylhexyl) phthalate] (EPA, December 1979). Similarly, photolysis is considered to be an insignificant degradation mechanism (EPA, December 1982).

2.3.2.4 Monocyclic Aromatic Hydrocarbons

Monocyclic aromatic compounds such as benzene, toluene, ethylbenzene, and xylenes are not considered to be persistent environmental contaminants in comparison to PAHs, phthalate esters, and metals. Monocyclic aromatics are subject to degradation in both soil and water via the action of microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, oxygen, etc.

Although these compounds are amenable to microbial degradation, the rate of degradation cannot be predicted without information on the availability of nutrients and the type of bacteria present. If these contaminants discharge to a surface water body, volatilization and biodegradation may occur relatively rapidly. For example, a reported first-order biodegradation rate constant for benzene is 0.11 day^{-1} in aquatic systems (Lyman et al., 1990). This corresponds to an aquatic half-life of approximately 6 days. Other monocyclic aromatics are subject to similar degradation processes in aquatic environments (EPA, December 1982).

Additional degradation processes such as hydrolysis and photolysis are considered to be insignificant fate mechanisms for monocyclic aromatics (EPA, December 1982). However, some monocyclic aromatic compounds, such as benzene and toluene, have been shown to undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

2.3.2.5 Polynuclear Aromatic Hydrocarbons (PAHs)

PAHs are common constituents of oil and grease. Landspreading applications have indicated that PAHs are amenable to microbial degradation. Studies have demonstrated that PAHs are much more amenable to degradation in soil matrices than in aquatic environments (EPA, December 1979). Under existing site conditions, the rate of microbial degradation cannot be predicted without knowledge of microbial populations. PAHs do not contain functional groups that are susceptible to hydrolytic actions, and hydrolysis is considered to be an insignificant degradation mechanism. Photolysis may be a major degradation mechanism in aquatic environments but is probably insignificant in surface soil.

2.3.2.6 Pesticides

Whether pesticides are sprayed, dusted, or applied directly to the soil, the soil is the ultimate sink for these chemicals. Pesticides are subject to degradation mechanisms in the environment. Pesticides typically have a high affinity for binding to organic particulates in soil, are relatively insoluble in water, and have very low vapor pressures and Henry's Law constants. Consequently, the chemicals are some of the most immobile and persistent of environmental contaminants.

2.3.2.7 Metals

The transport and fate of metals in the environment are primarily controlled by sorption to soil/sediment material. The metal-organic relationships, both in soil and water, increase in importance as the organic carbon content increases. Fulvic and humic acids can affect sorption, but the cation exchange capacity of the clay lattice is also important. Some metals, such as arsenic, are extremely soluble and mobile in the environment. Many other metals, such as nickel, selenium, zinc, and copper, have an affinity for hydrous iron and manganese oxides, as well as for organic materials, and are therefore preferentially adsorbed to soil. The mobility of most metals increases as the soil pH decreases.

2.3.2.8 Explosives

Most of the explosive compounds are nitro-substituted monocyclic aromatics and exhibit properties similar to other monocyclic aromatics of similar molecular weight in the environment. Due to the requirement that

explosives release large amounts of energy upon combustion, in general, the parent compounds are considerably less stable in the environment due to their higher energy state. Loss of nitro groups is a common environmental degradation reaction and the related by-products are included on the TCL when analyzing for explosives. The parent compounds are not considered to be persistent environmental contaminants compared to other common organic contaminants such as PAHs, phthalate esters, and PCBs. Like other monocyclic aromatics, nitroaromatics are potentially subject to degradation in both soil and water via the action of microorganisms. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil reaction (pH), temperature, oxygen, etc.

Although these compounds are amenable to microbial degradation, the rate of degradation cannot be predicted without information on the availability of nutrients and the type of bacteria present. If these contaminants discharge to a surface water body, volatilization or biodegradation may occur relatively rapidly. Biodegradation rates and aquatic half-lifes for explosives are not generally available, as is the case with the more common organic pollutants.

Degradation processes such as hydrolysis and photolysis may be significant fate mechanisms for nitroaromatic explosives, particularly for the relatively unstable parent compounds. Like certain other substituted monocyclic aromatics, nitroaromatics may also undergo clay-, mineral-, and soil-catalyzed oxidation (Dragun, 1988).

2.3.3 Contaminant Migration Routes

Based on the positively detected chemicals and associated analytical results for NWS Earle, general conclusions can be made with respect to contaminant fate and transport and the possible exposure endpoints.

Groundwater chemical contaminants can migrate from the original source of the release. The most common transport mechanism is water infiltration through a contaminated zone, where partitioning from solid to aqueous phase can occur. The potential amount of chemical dissolving into infiltration water is determined by a number of factors including residence time, solubility, partitioning factor, and pH of infiltration water.

The dissolved chemicals continue downward migration and are able to interact with stationary (soil) particles in the saturated and/or unsaturated zones.

After percolation through the capillary zone, dissolved contaminants are then able to enter groundwater where transport can occur via advection. The chemical concentrations in groundwater increase significantly to a maximum level shortly after initial groundwater impact. The longer-term effects at the source are a gradual decrease in the concentrations over time as chemical removal from the source area occurs. Short-term variations in release rate and impact to groundwater can occur, but long-term trends of decreased levels are usually observed. Molecular diffusion and hydrodynamic dispersion occur in the groundwater flow regime.

As materials are transported by the groundwater, a number of processes occur that can reduce the concentration of the chemicals. Diffusion and attenuation effects are nontransformational mechanisms that result in a direct decrease in chemical concentration. Chemical and biological reactions with dissolved chemicals can also result in decreases in chemical concentration. The products of chemical/biological reactions, however, may have significantly different chemical, transport, and toxicological properties from the parent compounds.

Groundwater chemical concentration can vary over periods of time as climatic and meteorological conditions change. Also, as materials from the release (source) area are depleted, lower concentrations of contaminant are released into the groundwater. Eventually, the impacts to groundwater cease, and residual chemicals are subjected to dilution and degradation via natural mechanisms.

Groundwater chemicals can discharge to surface water bodies, carrying chemicals dissolved in groundwater to the surface water and sediments. However, this transport mechanism is not a primary migration pathway for most sites at NWS Earle. More important surface water pathways include surface water runoff and erosional dispersion, which may transport contamination from surface soils and allow limited migration of contaminated sediments. Some degree of migration in surface soil could occur also through windblown particulate emissions; however, fugitive dust exposure is controlled by vegetative cover and climatic factors that result in a limited rate of windblown migration at NWS Earle sites.

2.4 HUMAN HEALTH RISK ASSESSMENT APPROACH

This section provides a description of the human health risk assessment methods used to evaluate the NWS Earle RI data. The objectives of the risk assessment are 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 estimates 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 will be combined to estimate potential risks for each NWS Earle site. The risk assessment processes used at NWS Earle are in accordance with current 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) is primarily concerned with the Identification of Chemicals of Potential Concern (COPCs, Section 2.4.1.1), Distributional Analysis of the data (Section 2.4.1.2), and Representative Concentrations for the COPCs (2.4.1.3). 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) presents available Health Effects (2.4.2.1) 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) identifies potential human health exposure including the presentation of a Site-Conceptual Model (Section 2.4.3.1), selection of Potential Receptors (Section 2.4.3.2), and Exposure Routes (Section 2.4.3.3) 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) 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) via estimated intakes in exposure routes (established in Section 2.4.3) compared to appropriate toxicity values (established in Section 2.4.2). 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 policy 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 Ammended Risk Assessment (Section 2.4.6) presents the amended risk assessment procedures applied to a site.

2.4.1 Data Evaluation

This section presents the approaches for identifying COPCs (Section 2.4.1.1), distributional analysis of the data (Section 2.4.1.2), and representative concentrations (Section 2.4.1.3).

2.4.1.1 Identification of Chemicals of Potential Concern

COPC selection is based on various aspects of chemical occurrence, distribution, and toxicity. Chemicals are selected to represent site contamination and will provide the framework for the quantitative risk assessment.

Inorganic and organic samples were collected from the NWS Earle sites in surface soil, subsurface soil, sediment, groundwater, and surface water media. The positively detected chemicals for each site are presented in occurrence and distribution tables in subsequent sections of this report. COPC selection is based on these tables and the following rules:

- Inorganics in all media sampled at NWS Earle can be naturally occurring; therefore, sample results were compared to background results. Site-wide background samples were collected from locations away from any possible influence of site-related contamination for each medium type. Background sample media consist of groundwater, surface water, sediment, subsurface soil, and surface soil. (Note that a subset of the data for subsurface soils, the 0- to 2-foot depth, is treated as background surface soil.) If the site-related inorganic chemical concentration range exceeded the background concentration range, that chemical was selected as a COPC. Exceptions to this rule are the EPA-designated carcinogenic inorganic chemicals: arsenic (via ingestion and inhalation), beryllium (via ingestion and inhalation), cadmium (via inhalation), chromium VI (via inhalation), and lead (suspected via ingestion and inhalation). Arsenic, beryllium, cadmium, chromium, and lead are included as COPCs for any site if they were detected in site-related media, regardless of their levels in background samples. Chromium speciation data were generated for selected media at two sites at NWS Earle, Site 2 and Site 19. The proportion of hexavalent chromium to total chromium was calculated for samples analyzed for both total and hexavalent chromium, and the proportion of trivalent chromium was computed as the difference (total chromium minus hexavalent). These results are as follows: Site 2 (subsurface soil, 10.2 percent Cr VI and 89.8 percent Cr III; groundwater, 17.9 percent Cr VI and 82.1 percent Cr III) and Site 19 (subsurface soil, 33.2 percent Cr VI and 66.8 percent Cr III). (Note that this estimation could not be applied to groundwater at Site 19 because very low positive total chromium levels were less than the minimum detection limit for hexavalent chromium.) For these media and sites, chromium was selected as a COPC and the representative concentration was multiplied by the percentage of each chromium species. The risks for these media were run based on this adjusted concentration of Cr III and Cr VI, as calculated from their estimated proportions.

  Additional exceptions to the above rule for selection of inorganic COPCs are calcium, magnesium, potassium, and sodium, which are essential nutrients and/or common minerals and generally are not considered to be toxicologically significant and therefore were not selected as COPCs for any site.

- Because most organic chemicals on the TCL are not naturally occurring, every organic compound positively detected at an NWS Earle site was selected as a COPC. An exception to this rule was made for explosives detected at NWS Earle. 2,4,6-Trinitroluene was the only explosive included in the human health risk assessment as a COPC (toxicity criteria to estimate a quantitative risk were not available for other detected explosives at NWS Earle). The occurrence and distribution tables in each section of this report

(Sections 4 through 30) present the site-related chemical concentration range and a background concentration range for organic chemicals. The background samples were collected for the purpose of comparing inorganic concentrations at NWS Earle sites, and a similar comparison was made for organic chemicals. However, selection of COPCs for organics has not been based on a comparison of organic chemicals in background samples, in accordance with EPA risk assessment guidelines.

2.4.1.2 Distributional Analysis of the Data

Statistical analyses discussed in this section adhere to the guidance referenced in several EPA and related publications (1989a, 1989b, 1991b, and 1992c) referenced in Appendix I. Section 2.4.5.4 discusses the general limitations and uncertainties of statistical procedures, particularly with regards to confidence and decision making power when limited numbers of samples are involved. Before representative concentrations (Section 2.4.1.3) could be estimated for each site, the underlying statistical distribution of data was determined for each chemical in each medium. The Shapiro-Wilk W test was performed to determine if the data set of chemical concentrations matches the shape of a normal or lognormal distribution. Normally distributed data exhibit a characteristic "bell-shape" curve that is symmetrical, whereas lognormal data have a skewed shape (more results at the high-concentration tail). For each chemical in each medium at a site, the W test was performed once using the original data and once after data were converted to their logarithms. A five percent level of significance was used to determine if the data deviate from either hypothesized distribution. If the W test indicated a normal distribution, then the estimation of the reasonable maximum exposure point concentration (using the upper 95th percentile, as discussed in the next section) was based upon a normal distribution and standard deviation. If taking the logarithms of the data provided a better match to the data than a normal distribution, a lognormal transformation of data was used before the upper 95th percentile concentrations were computed. In most cases, the distribution of data fit one of the above two categories. If neither distribution matched well, the default assumption of an underlying lognormal distribution was followed (EPA, 1989a). Results of the Shapiro-Wilk tests are provided in Appendix I.

To determine if results of site samples were elevated relative to background sample results, a qualitative evaluation of the overall range (low and high values) was performed for each chemical in each medium. Additional statistical tests were also performed in each case. The means of the two data sets were compared if both site and background matched the same type of distribution (normal or lognormal) and exhibited equal standard deviations (based upon Bartlett's test for equal variances). If the arithmetic mean of the site data and the background data could be compared directly, then a t-test was performed to evaluate whether the site mean was significantly greater than the background mean. Conversely, if the site data and background data were determined to be from different distributions, then alternate statistical

tests were applied that do not make any assumptions about the underlying distribution of the data. The Z-test was used to determine if the proportion of positively detected results out of all samples was greater in the site data versus the background data. The Mann-Whitney U-test was also used to determine whether the site and background data were from populations with identical medians. The Mann-Whitney test involves combining the two data sets, ranking results from smallest to largest, and evaluating whether the two sites have a similar distribution of data within the range of low to high ranks. All statistical tests for comparison of site and background results (the t-test, Z-test, and Mann-Whitney U-test) were performed using a critical value (cutoff) for decision making of a five percent or less probability that site and background data are not the same.

2.4.1.3 Representative Concentrations

The risk assessment for NWS Earle was performed using a representative concentration for each COPC in each medium identified at the particular site of interest. Only current concentrations detected at each site medium were evaluated. Usability of results is discussed below. The representative concentration was calculated using the latest risk assessment guidance from EPA (EPA, 1989a).

The validated data were used to calculate representative concentrations. All data were collected by B&R Environmental during the summer and fall of 1995. For chemicals with at least one positive detection, non-detects were assumed to be one-half the detection limit (sample quantitation limit). Rejected values (R) were eliminated from further consideration. Estimated and biased values (J, K, L) were used as the reported value.

Duplicate samples were averaged together and considered as one result. For duplicates, where one result was positive and the other result was a non-detect, the problem of calculating an average result arose whenever half the detection limit exceeded the positive result. It was considered undesirable for the average to exceed the positive result; therefore, the positive result was used to represent the non-detect in such cases.

The calculation of the representative concentration is a two-step process. First, the distribution of the data must be determined, as discussed in the preceding section. Then, based on the distribution of the data, a representative concentration is either calculated or selected.

Several important points are associated with distribution of the data:

- The distribution of a data set is determined using a Shapiro-Wilk test.

- The distributions are classified as either lognormal, normal, or unknown.

- Environmental data are usually determined to be lognormally distributed (default).

- If the data are not determined to be either a lognormal or normal distribution, they are classified as an unknown distribution and a lognormal distribution is assumed.

If the data are considered to be lognormally distributed, then the standard deviation of the log transformed sample set must be determined, as follows:

$$S = [\Sigma\ (X_i - X_m)^2/(n-1)]^{0.5}$$

where:	S	=	Standard deviation of the log-transformed data
	X_i	=	Individual sample value (log-transformed)
	X_m	=	Arithmetic mean of the log-transformed n samples
	n	=	Number of samples

The one-sided upper 95 percent confidence limit (UCL_{LOG}) is then calculated as follows:

$$UCL_{LOG} = \exp[X_m + (0.5S^2) + (SH)/(n-1)^{0.5}]$$

where:	exp	=	exponential function (inverse of the natural log)
	X_m	=	Arithmetic mean of the log-transformed data
	H	=	H-statistic (e.g., from table published in Gilbert, 1987)
	S	=	Standard deviation of the log-transformed data
	n	=	Number of samples

The representative concentration is then selected as the lesser value of the two-sided 95 percent UCL and the maximum positive value in the data set.

If the data are determined to be normally distributed, then the standard deviation of the sample set is used to calculate the one-sided 95 percent UCL, as follows:

First, the standard deviation of the sample set must be determined:

$$S = [\Sigma (X_i - X_m)^2/(n-1)]^{0.5}$$

where:	S	=	Standard deviation
	X_i	=	Individual sample value
	X_m	=	Arithmetic mean for the n samples
	n	=	Number of samples

The one-sided upper 95 percent confidence limit (UCL_{NOR}) is then calculated:

$$UCL_{NOR} = X_m + (tS)/(n^{0.5})$$

where:	X_m	=	Arithmetic mean
	t	=	One-sided t distribution factor
	S	=	Standard deviation
	n	=	Number of samples

For small sample sets or sample sets in which all positive results equal less than one-half the detection limit, the UCL can exceed the maximum detected concentration. In these cases, the maximum concentration was selected as the representative concentration.

2.4.2 Toxicity Assessment

The purpose of this section is to identify the potential health hazards associated with exposure to each of the COPCs. A toxicological evaluation characterizes the inherent toxicity of a compound. The literature indicates that the COPCs have the potential to cause carcinogenic and/or noncarcinogenic health effects in humans. Although the COPCs may cause adverse health effects, dose-response relationships and the potential for exposure must be evaluated before the risks to receptors can be determined. Dose-response relationships correlate the magnitude of the intake with the probability of toxic effects, as discussed below. Quantitative toxicity parameters for the COPCs at all sites at NWS Earle are presented in Table 2-11. In evaluating the likelihood for effects from chemical exposures, it is also important to consider qualitative toxicity information, such as the cancer weight-of-evidence criteria presented for chemicals in Table 2-12 and also the target organs potentially affected by chronic (noncarcinogenic) toxicity for chemicals in Table 2-13. Appendix I contains detailed toxicological information regarding each chemical detected at NWS Earle.

TABLE 2-11

DOSE-RESPONSE PARAMETERS - POTENTIAL CHEMICALS OF CONCERN (ORGANICS)

NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	Fraction of COPC Absorbed in the Gastrointestinal Tract (unitless)**	TOXICITY VALUES						
		RfD* Oral (mg/kg)/day	RfD Dermal (mg/kg)/day	RfD* Inhalation (mg/kg)/day	SF* Oral 1/(mg/kg)/day	SF Dermal 1/(mg/kg)/day	SF* Inhalation 1/(mg/kg)/day	Weight of Evidence
4,4'-DDD	0.80	-	-	-	2.40E-01	3.00E-01^^	-	B2
4,4'-DDE	0.80	-	-	-	3.40E-01	4.25E-01^^	-	B2
4,4'-DDT	0.80	5.00E-04	4.00E-04^^	-	3.40E-01	4.25E-01^^	3.40E-01	B2
ALDRIN	0.50	3.00E-05	1.50E-05^^	-	1.70E+01	3.40E+01^^	1.70E+01	B2
ALPHA-BHC	1.00	-	-	-	6.30E+00	6.30E+00^^	6.30E+00	B2
BETA-BHC	1.00	-	-	-	1.80E+00	1.80E+00^^	1.80E+00	C
DELTA-BHC	1.00	-	-	-	-	-	-	D
GAMMA-BHC	1.00	3.00E-04	-	-	1.30E+00 H	1.30E+00^^	-	C
ALPHA-CHLORDANE	0.80	6.00E-05	4.80E-05^^	-	1.30E+00	1.63E+00^^	1.29E+00	B2
GAMMA-CHLORDANE	0.80	6.00E-05	4.80E-05^^	-	1.30E+00	1.63E+00^^	1.29E+00	B2
DIELDRIN	0.50	5.00E-05	2.50E-05^^	-	1.60E+01	3.20E+01^^	1.61E+01	B2
HEPTACHLOR	0.40	5.00E-04	2.00E-04^^	-	4.50E+00	1.13E+01^^	4.55E+00	B2
HEPTACHLOR EPOXIDE	0.40	1.30E-05	5.20E-06^^	-	9.10E+00	2.28E+01^^	9.10E+00	B2
ENDOSULFAN I	0.60	6.00E-03	3.60E-03^^	-	-	-	-	-
ENDOSULFAN II	0.60	6.00E-03	3.60E-03^^	-	-	-	-	-
ENDOSULFAN SULFATE	1.00	-	-	-	-	-	-	-
ENDRIN	0.65	3.00E-04	1.95E-04^^	-	-	-	-	D
ENDRIN KETONE	1.00	-	-	-	-	-	-	-
ENDRIN ALDEHYDE	1.00	-	-	-	-	-	-	-
METHOXYCHLOR	0.90	5.00E-03	4.50E-03^^	-	-	-	-	D
AROCLOR 1248	0.85	-	-	-	7.70E+00	9.06E+00^^	-	B2
AROCLOR 1254	0.85	2.00E-05	1.70E-05^^	-	7.70E+00	9.06E+00^^	-	B2
AROCLOR 1260	0.85	-	-	-	7.70E+00	9.06E+00^^	-	B2
1,1,1-TRICHLOROETHANE	0.50	9.00E-02 W	4.50E-02^^	2.86E-01 W	-	-	-	D
1,1,2-TRICHLOROETHANE	0.50	4.00E-03	2.00E-03^^	-	5.70E-02	1.14E-01^^	5.60E-02	C
1,1-DICHLOROETHENE	1.00	9.00E-03	9.00E-03^^	-	6.00E-01	6.00E-01^^	1.75E-01	C
1,2-DICHLOROETHANE	1.00	-	-	2.86E-03 E	9.10E-02	9.10E-02^^	9.10E-02	B2
1,2-DICHLOROETHENE (TOTAL)	1.00	9.00E-03 H	9.00E-03^^	-	-	-	-	D
2-BUTANONE	1.00	6.00E-01	6.00E-01^^	2.86E-01	-	-	-	-
4-METHYL-2-PENTANONE	1.00	8.00E-02	8.00E-02^^	2.29E-02	-	-	-	-
BENZENE	1.00	-	-	1.71E-03 E	2.90E-02	2.90E-02^^	2.90E-02	A
BROMODICHLOROMETHANE	1.00	2.00E-02	2.00E-02^^	-	6.20E-02	6.20E-02^^	-	B2
CARBON DISULFIDE	0.50	1.00E-01	5.00E-02^^	2.00E-01	-	-	-	-
CHLOROBENZENE	0.30	2.00E-02	6.00E-03^^	5.71E-03 A	-	-	-	D
CHLOROFORM	1.00	1.00E-02	1.00E-02^^	-	6.10E-03	6.10E-03^^	8.05E-02	B2

- = No dose-response value is available for this chemical in this classification
* = All toxicity values are from Integrated Risk Information System (IRIS) unless otherwise noted
** = Modifying factor applied only to the dermal RfDs and SFs, from ATSDR
H = Health Effects Assessment Summary Tables (HEAST, 1995)
A = HEAST Alternative (HEAST, 1995)
E = EPA-NCEA Regional Support provisional service (EPA, 1995c)
^ - Corrected value.
^^ - Value does not apply to soil dermal exposure for sites with refined risk assessment.
W = Withdrawn from IRIS or HEAST

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TABLE 2-11

DOSE-RESPONSE PARAMETERS - POTENTIAL CHEMICALS OF CONCERN (ORGANICS)

NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	Fraction of COPC Absorbed in the Gastrointestinal Tract (unitless)**	TOXICITY VALUES						
		RfD* Oral (mg/kg)/day	RfD Dermal (mg/kg)/day	RfD* Inhalation (mg/kg)/day	SF* Oral 1/(mg/kg)/day	SF Dermal 1/(mg/kg)/day	SF* Inhalation 1/(mg/kg)/day	Weight of Evidence
ETHYLBENZENE	0.80	1.00E-01	8.00E-02^^	2.86E-01	-	-	-	D
METHYLENE CHLORIDE	1.00	6.00E-02	6.00E-02^^	8.57E-01 H	7.50E-03	7.50E-03^^	1.64E-03	B2
STYRENE	1.00	2.00E-01	2.00E-01^^	2.86E-01	-	-	-	C
TETRACHLOROETHENE	1.00	1.00E-02	1.00E-02^^	-	5.20E-02 E	5.20E-02^^	2.03E-03 E	-
TOLUENE	1.00	2.00E-01	2.00E-01^^	1.14E-01	-	-	-	D
TRICHLOROETHENE	1.00	6.00E-03 E	6.00E-03^^	-	1.10E-02 W	1.10E-02^^	6.00E-03 E	B2
VINYL CHLORIDE	1.00	-	-	-	1.90E+00 H	1.90E+00^^	3.00E-01 H	A
XYLENE (TOTAL)	0.90	2.00E+00 H	1.80E+00^^	8.57E-02 W	-	-	-	D
1,2,4-TRICHLOROBENZENE	1.00	1.00E-02	1.00E-02^^	5.71E-02 H	-	-	-	D
1,2-DICHLOROBENZENE	1.00	9.00E-02	9.00E-02^^	4.00E-02 A	-	-	-	D
1,4-DICHLOROBENZENE	1.00	-	-	2.29E-01	2.40E-02 H	2.40E-02^^	-	C
2,4-DICHLOROPHENOL	1.00	3.00E-03	3.00E-03^^	-	-	-	-	D
2-METHYLNAPHTHALENE	0.50	-	-	-	-	-	-	-
2-METHYLPHENOL	1.00	5.00E-02	5.00E-02^^	-	-	-	-	C
4-METHYLPHENOL	0.60	5.00E-03 H	3.00E-03^^	-	-	-	-	C
ACENAPHTHENE	0.50	6.00E-02	3.00E-02^^	-	-	-	-	-
ACENAPHTHYLENE	1.00	-	-	-	-	-	-	D
ANTHRACENE	0.65	3.00E-01	1.95E-01^^	-	-	-	-	D
BENZO(A)ANTHRACENE	0.50	-	-	-	7.30E-01 E	1.46E+00^^	6.10E-01 E	B2
BENZO(A)PYRENE	0.15	-	-	-	7.30E+00	4.87E+01^^	6.10E+00 W	B2
BENZO(B)FLUORANTHENE	0.50	-	-	-	7.30E-01 E	1.46E+00^^	6.10E-01 E	B2
BENZO(G,H,I)PERYLENE	0.50	-	-	-	-	-	-	D
BENZO(K)FLUORANTHENE	0.50	-	-	-	7.30E-02 E	1.46E-01^^	6.10E-02 E	B2
BIS(2-ETHYLHEXYL)PHTHALATE	0.50	2.00E-02	1.00E-02^^	-	1.40E-02	2.80E-02^^	-	B2
BUTYLBENZYLPHTHALATE	1.00	2.00E-01	2.00E-01^^	-	-	-	-	C
CARBAZOLE	1.00	-	-	-	2.00E-02 H	2.00E-02^^	-	B2
CHRYSENE	0.50	-	-	-	7.30E-03 E	1.46E-02^^	6.10E-03 E	B2
DI-N-BUTYLPHTHALATE	0.90	1.00E-01	9.00E-02^^	-	-	-	-	D
DI-N-OCTYLPHTHALATE	1.00	2.00E-02 H	2.00E-02^^	-	-	-	-	-
DIBENZ(A,H)ANTHRACENE	0.10	-	-	-	7.30E+00 E	7.30E+01^^	6.10E+00 E	B2
DIBENZOFURAN	1.00	4.30E-03 E	4.30E-03^^	-	-	-	-	D
FLUORANTHENE	0.50	4.00E-02	2.00E-02^^	-	-	-	-	D
FLUORENE	0.50	4.00E-02	2.00E-02^^	-	-	-	-	D
HEXACHLOROETHANE	1.00	1.00E-03	1.00E-03^^	-	1.40E-02	1.40E-02^^	1.40E-02	C
INDENO(1,2,3-CD)PYRENE	0.50	-	-	-	7.30E-01 E	1.46E+00^^	6.10E-01 E	B2

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TABLE 2-11
DOSE-RESPONSE PARAMETERS - POTENTIAL CHEMICALS OF CONCERN (INORGANICS)
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	Fraction of COPC Absorbed in the Gastrointestinal Tract (unitless)**	TOXICITY VALUES						
		RfD* Oral (mg/kg)/day	RfD Dermal (mg/kg)/day	RfD* Inhalation (mg/kg)/day	SF* Oral 1/(mg/kg)/day	SF Dermal 1/(mg/kg)/day	SF* Inhalation 1/(mg/kg)/day	Weight of Evidence
ISOPHORONE	1.00	2.00E-01	2.00E-01^^	-	9.50E-04	9.50E-04^^	-	C
N-NITROSODIPHENYLAMINE	0.50	-	-	-	4.90E-03	9.80E-03^^	-	B2
NAPHTHALENE	0.50	4.00E-02 W	2.00E-02^^	-	-	-	-	D
NITROBENZENE	1.00	5.00E-04	5.00E-04^^	5.71E-04 A	-	-	-	D
PHENANTHRENE	1.00	-	-	-	-	-	-	D
PHENOL	1.00	6.00E-01	6.00E-01^^	-	-	-	-	D
PYRENE	0.65	3.00E-02	1.95E-02^^	-	-	-	-	D
2,4,6-TRINITROTOLUENE	1.00	5.00E-04	5.00E-04^^	-	3.00E-02	3.00E-02^^	-	C
2,4-DINITROTOLUENE	1.00	2.00E-03	2.00E-03^^	-	-	-	-	B2
2-AMINO-4,6-DINITROTOLUENE	1.00	-	-	-	-	-	-	-
4-AMINO-2,6-DINITROTOLUENE	1.00	-	-	-	-	-	-	-
HMX	1.00	-	-	-	-	-	-	D
NITROBENZENE	1.00	5.00E-04^	-	5.71E-04^	-	-	-	B2
NITROCELLULOSE	1.00	-	-	-	-	-	-	-
RDX	1.00	-	-	-	-	-	-	C
ALUMINUM	0.05	1.00E+00 E	5.00E-02^^	-	-	-	-	-
ANTIMONY	0.05	4.00E-04	2.00E-05^^	-	-	-	-	D
ARSENIC, TOTAL	0.95	3.00E-04	2.85E-04	-	1.50E+00	1.58E+00	1.51E+01	A
BARIUM	0.04	7.00E-02	2.80E-03^^	1.43E-04 A	-	-	-	D
BERYLLIUM	0.01	5.00E-03	5.00E-05^^	-^	4.30E+02	4.30E+04^^	8.40E+00	B2
CADMIUM	0.10^	5.00E-04	5.00E-05^	5.71E-05 E	-	-	6.30E+00	D
CHROMIUM, TRIVALENT	0.02	1.00E+00	2.00E-02^^	5.71E-07 W	-	-	-	D
CHROMIUM, HEXAVALENT	0.02	5.00E-03	1.00E-04^^	-	-	-	4.20E+01	A
COBALT	0.05	6.00E-02 E	3.00E-03^^	-	-	-	-	-
COPPER	0.60	4.00E-02 E	2.40E-02^^	-	-	-	-	D
IRON	0.05	3.00E-01 E	1.50E-02^^	-	-	-	-	-
LEAD, TOTAL	0.50	-	-	-	-	-	-	B2
MANGANESE	0.03	5.00E-03	1.50E-04^^	1.43E-05	-	-	-	-
MERCURY, TOTAL	0.07	1.00E-04^ H	7.00E-06^^	8.57E-05 H	-	-	-	D
NICKEL (SOLUBLE SALTS)	0.15	2.00E-02	3.00E-03^^	-	-	-	-	D
SELENIUM, TOTAL	0.80	5.00E-03	4.00E-03^^	-	-	-	-	-
SILVER	0.20	5.00E-03	1.00E-03^^	-	-	-	-	D
THALLIUM	0.05	8.00E-05	4.00E-06^^	-	-	-	-	-
VANADIUM	0.01	7.00E-03 H	7.00E-05^^	-	-	-	-	D
ZINC	0.25	3.00E-01	7.50E-02^^	-	-	-	-	D

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* = All toxicity values are from Integrated Risk Information System (IRIS) unless otherwise noted
** = Modifying factor applied only to the dermal RfDs and SFs, from ATSDR
H = Health Effects Assessment Summary Tables (HEAST, 1995)
A = HEAST Alternative (HEAST, 1995)
E = EPA-NCEA Regional Support provisional service (EPA, 1995c)
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TABLE 2-12
EPA WEIGHT-OF EVIDENCE CARCINOGENIC CLASSIFICATIONS
NWS EARLE, COLTS NECK, NEW JERSEY

EPA Category	Description of Group	Description of Evidence
Group A	Human carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer.
Group B1	Probable human carcinogen	Limited evidence of carcinogenicity in humans from epidemiologic studies.
Group B2	Probable human carcinogen	Sufficient evidence of carcinogenicity in animals; inadequate evidence of carcinogenicity in humans.
Group C	Possible human carcinogen	Limited evidence of carcinogenicity in animals.
Group D	Not classified	Inadequate evidence of carcinogenicity in animals.
Group E	No evidence of carcinogenicity in humans	No evidence for carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies.

Source: EPA, 1992b

TABLE 2-13
TARGET ORGANS - CHEMICALS OF POTENTIAL CONCERN (ORGANICS)
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 1 OF 3

Substance	Target Organ																
	Cardiovascular System						Respiratory System			Digestive System							
	Blood	Hematopoietic System	Erythrocyte	Heart	Skin	Kidney	Respiratory Tract	Lung	Liver	Pancreas	Gastrointestinal Tract	Central Nervous System	Peripheral Nervous System	Eyes	Skeletal Muscle	Reproductive System	Thyroid
4,4'-DDD																	
4,4'-DDE																	
4,4'-DDT									X								
ALDRIN									X			X				X	
ALPHA-BHC																	
BETA-BHC																	
DELTA-BHC																	
GAMMA-BHC						X			X								
ALPHA-CHLORDANE									X			X				X	
GAMMA-CHLORDANE									X			X				X	
DIELDRIN									X			X				X	
HEPTACHLOR									X								
HEPTACHLOR EPOXIDE									X								
ENDOSULFAN I	X					X											
ENDOSULFAN II	X					X											
ENDOSULFAN SULFATE																	
ENDRIN									X			X				X	
ENDRIN KETONE																	
ENDRIN ALDEHYDE									X			X				X	
METHOXYCHLOR																X	
AROCLOR 1248					X				X							X	
AROCLOR 1254					X				X							X	
AROCLOR 1260					X				X							X	
1,1,1-TRICHLOROETHANE				I								I					
1,1,2-TRICHLOROETHANE																	
1,1-DICHLOROETHENE						X			X								
1,2-DICHLOROETHANE						X		I	X			I					
1,2-DICHLOROETHENE (TOTAL) a			X	I				I	X			I					
ACETONE						X											
2-BUTANONE							X					X				X	
4-METHYL-2-PENTANONE												X					
BENZENE		X										X					
BROMODICHLOROMETHANE						X			X								
CARBON DISULFIDE				X	X	X			X			X	X	X		X	
CHLOROETHANE																	
CHLOROBENZENE				I		X		X	X			I					
CHLOROFORM				I		X			X			I					
ETHYLBENZENE						X	I		X							X	
METHYLENE CHLORIDE									X								
STYRENE			X			X			X			I					
TETRACHLOROETHENE									X			I					

Blank - Target organ is not cited regarding chronic exposure, noncarcinogenic toxicity.
X - Value is applicable to oral route of exposure (and, where applicable RfD exists, inhalation or dermal route).
I - Value is applicable only to the inhalation route of exposure.
D - Value is applicable only to the dermal route of exposure.
a - Value represents all target organs for cis- and trans- isomers.

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TABLE 2-13
TARGET ORGANS - CHEMICALS OF POTENTIAL CONCERN (ORGANICS)
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 3

	Target Organ																
	Cardiovascular System						Respiratory System			Digestive System		Central	Peripheral				
Substance	Blood	Hematopoietic System	Erythrocyte	Heart	Skin	Kidney	Respiratory Tract	Lung	Liver	Pancreas	Gastrointestinal Tract	Nervous System	Nervous System	Eyes	Skeletal Muscle	Reproductive System	Thyroid
TOLUENE						X			X			I					
TRICHLOROETHENE				X								X					
VINYL CHLORIDE									X			X					
XYLENE (TOTAL)												X					
1,2,4-TRICHLOROBENZENE																	
1,2-DICHLOROBENZENE																	
1,3-DICHLOROBENZENE																	
1,4-DICHLOROBENZENE									X								
2,4-DICHLOROPHENOL																	
2,4-DIMETHYLPHENOL																	
2-METHYLNAPHTHALENE																	
2-METHYLPHENOL						X	X		X			X					
4-METHYLPHENOL						X	X		X			X					
ACENAPHTHENE						X			X								
ACENAPHTHYLENE																	
ANTHRACENE																	
BENZO(A)ANTHRACENE																	
BENZO(A)PYRENE																	
BENZO(B)FLUORANTHENE																	
BENZO(G,H,I)PERYLENE																	
BENZO(K)FLUORANTHENE																	
BIS(2-CHLOROETHYL)ETHER																	
BIS(2-ETHYLHEXYL)PHTHALATE									X							X	
BUTYLBENZYLPHTHALATE																	
CARBAZOLE																	
CHRYSENE																	
DI-N-BUTYLPHTHALATE																X	
DI-N-OCTYLPHTHALATE						X			X							X	
DIBENZ(A,H)ANTHRACENE																	
DIBENZOFURAN																	
DIETHYLPHTHALATE																	
FLUORANTHENE	X					X			X								
FLUORENE			X									X					
HEXACHLOROETHANE						X			X								
INDENO(1,2,3-CD)PYRENE																	
ISOPHORONE																	
N-NITROSODIPHENYLAMINE																	
NAPHTHALENE			X			X											
NITROBENZENE	X				X	X			X								
PHENANTHRENE																	
PHENOL						X										X	
PYRENE						X											

Blank - Target organ is not cited regarding chronic exposure, noncarcinogenic toxicity.
X - Value is applicable to oral route of exposure (and, where applicable RfD exists, inhalation or dermal route).
I - Value is applicable only to the inhalation route of exposure.
D - Value is applicable only to the dermal route of exposure.

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TABLE 2-13
TARGET ORGANS - CHEMICALS OF POTENTIAL CONCERN (EXPLOSIVES AND INORGANICS)
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3 OF 3

	Target Organ																
	Cardiovascular System						Respiratory System			Digestive System							
Substance	Blood	Hematopoietic System	Erythrocyte	Heart	Skin	Kidney	Respiratory Tract	Lung	Liver	Pancreas	Gastrointestinal Tract	Central Nervous System	Peripheral Nervous System	Eyes	Skeletal Muscle	Reproductive System	Thyroid
1,3,5-TRINITROBENZENE																	
2,4,6-TRINITROTOLUENE									X					X			
2,4-DINITROTOLUENE	X								X			X					
2-AMINO-4,6-DINITROTOLUENE																	
4-AMINO-2,6-DINITROTOLUENE																	
HMX						X			X								
NITROCELLULOSE																	
RDX						X			X			X		X			
ALUMINUM																	
ANTIMONY				X	D		I										
ARSENIC, TOTAL					X												
BARIUM				X							X				X	X	
BERYLLIUM								I									
CADMIUM						X	I										
CHROMIUM, TRIVALENT																	
CHROMIUM, HEXAVALENT					D	X	I										
COBALT			X	X	D		I	I									X
COPPER			X			X		I	X								
IRON							I		X	X							
LEAD, TOTAL			X									X					
MANGANESE							I					X					
MERCURY, TOTAL						X						X				X	
NICKEL (SOLUBLE SALTS)												X					
SELENIUM, TOTAL					X		I					I					
SILVER					X												
SODIUM																	
THALLIUM					X	X			X			X					
VANADIUM							I										
ZINC	X																

Blank - Target organ is not cited regarding chronic exposure, noncarcinogenic toxicity.
X - Value is applicable to oral route of exposure (and, where applicable RfD exists, inhalation or dermal route).
I - Value is applicable only to the inhalation route of exposure.
D - Value is applicable only to the dermal route of exposure.

Note: Chromium data were considered to be the hexavalent chromium (VI) form except for Site 2 (surface soil and groundwater) and Site 19 (subsurface soil), where speciation data were available. For Sites 2 and 19, percentages of chromium III and VI were calculated as in Section 2.4.1.1 and are presented in the tables for each risk assessment. The representative concentrations for chromium at these sites were multiplied by the appropriate percentage, and the risks for each chromium species are estimated.

2.4.2.1 Health Effects

An important component of the risk assessment process is the relationship between the intake of a compound (the amount of a chemical that is absorbed by a receptor) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts can be quantified. The published information of doses and responses is used in conjunction with information on the nature and magnitude of human exposure to develop an estimate of potential health risks.

Reference doses (RfDs) and slope factors (SFs) have been developed by EPA and other sources for many organics and inorganics. This section provides a brief description of these parameters.

Reference Doses (RfDs)

RfDs are developed by EPA for assessing chronic or subchronic human exposure to hazardous chemicals and are based solely on the noncarcinogenic effects of chemical substances. The subchronic RfD, which is the RfD used for human health risk assessment at NWS Earle sites, is defined as an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human

Population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (as a Superfund program guideline, 7 years to lifetime). The RfD is usually expressed as a dose (mg) per unit body weight (kg) per unit time (day).

The RfD is generally derived by dividing a No-Observed-(Adverse)-Effect-Level (NOAEL or NOEL) or a Lowest-Observed-Adverse-Effect-Level (LOAEL) by an appropriate uncertainty factor. NOAELs, etc. are determined from laboratory or epidemiological toxicity studies. EPA evaluates available studies to determine their scientific merit, to identify the animal model most relevant to humans, and to determine the critical toxic effect that occurs at the lowest administered dose. The NOAEL is selected based in part on the assumption that if the critical toxic effect is prevented, then all toxic effects are prevented. Thus, the RfD is derived in a manner that is protective against the most sensitive adverse effect(s); i.e., those that occur at the lowest levels of exposure.

Uncertainty factors are generally applied as multiples of 10 to represent specific areas of uncertainty in the available data. A factor of 10 is used to account for variations in the general population (to protect sensitive subpopulations), when test results from animals are extrapolated to humans (to account for interspecies variability), when a NOAEL derived from a subchronic study (instead of a chronic study) is used to develop the RfD, and when a LOAEL is used instead of a NOAEL. In addition, EPA reserves the use of a modifying factor of up to 10 for professional judgment of uncertainties in the data base not already accounted for. The default value of the modifying factor is 1.

The RfD incorporates the surety of the evidence for chronic human health effects. Even if applicable human data exist, the RfD (as diminished by the uncertainty factor) still maintains a margin of safety so that chronic human health effects are not underestimated. Thus, the RfD is an acceptable guideline for evaluation of noncarcinogenic risk, although the associated uncertainties preclude its use for precise risk quantitation. RfDs for NWS Earle site contaminants are provided in Table 2-11. RfDs for chemicals were generated following the hierarchy of references specified by EPA (EPA, 1989a). (Note that information sources for RfDs obtained from Heast alternative references are identified in the references at the end of this section.) For some chemicals that have no inhalation RfDs in IRIS, RfDs have been calculated by EPA based upon the reference concentration (RfC) with modifications to reflect specific exposure assumptions (70-kilogram adult, a 20 m^3/day inhalation rate, and an approporiate absorption factor) (EPA, 1995d).

Noncarcinogenic risks for lead were not quantitated and compared to RfDs, because EPA has implemented an approach to evaluating lead risks that goes beyond providing a single point estimate output. Instead, expected blood-lead increases were estimated, and a discussion of these results is presented in Section 2.4.3.5. In addition, soil screening values for lead were compared to the value of 400 ppm as discussed in OSWER directive 9355.4-12, and groundwater lead concentrations were compared to the 15 ug/L EPA action level (MCL).

Cancer Slope Factors (SFs)

SFs are applicable for estimating the lifetime probability (assumed 70-year lifespan) of human receptors developing cancer as a result of exposure to known or potential carcinogens. This factor is generally reported in units of 1/(mg/kg/day) and is derived through an assumed low-dosage linear relationship of extrapolation from high to low dose responses determined from animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit. SFs for NWS Earle site contaminants are provided in Table 2-11. SFs for chemicals were generated following the hierarchy of references specified by EPA (EPA, 1989a). (Note that information sources for SFs obtained from Heast alternative references are identified in the references at the end of this section.) In addition, SFs for PAHs were obtained from EPA provisional guidance that applies the toxicity equivalent factor (TEF) approach, based upon potency relative to benzo(a)pyrene (EPA, 1993b). Inhalation SFs for chemicals that have unit risk

values in IRIS are calculated by EPA based upon specific exposure assumptions (70-kilogram adult, a 20 m^3/day inhalation rate, and an approporiate absorption factor) (EPA, 1995d).

Carcinogenic risks for lead were not quantitated, because no EPA consensus currently exists with respect to an inorganic lead SF. Instead, potential lead exposures were calculated using a biokinetic model to estimate expected blood-lead increases, and a discussion of these results is presented in Section 2.4.3.5. In addition, soil screening values for lead were compared to the value of 400 ppm as discussed in OSWER directive 9355.4-12, and groundwater lead concentrations were compared to the 15 ug/L EPA action level.

EPA Weight-of-Evidence

The weight-of-evidence designations indicate the preponderance of evidence regarding carcinogenic effects in humans and animals. The categories are defined in Table 2-12 and are listed for each chemical in Table 2-11.

Adjustment of Dose-Response Parameters

In accordance with EPA (1989a, Appendix A), the dose-response parameters were adjusted when the estimated dose was dermally absorbed, but the original toxicity value was derived based on oral intake.

Dermal RfDs and SFs are obtained from oral RfDs and SFs via the following relationships:

$$RfD_{dermal} = RfD_{oral} \times GI_{adjusted}$$

and

$$SF_{dermal} = SF_{oral} / GI_{adjusted}$$

where: $GI_{adjusted}$ = Fraction of COPC absorbed in the gastrointestinal tract (same as the dermal modifying absorption factor)

The absorption factors for this adjustment are shown on Table 2-11 (ATSDR, 1996). If no absorption factor was available for organic chemicals, 100 percent absorption was assumed. For those inorganics for which no absorption factor is reported, a default value of five percent was used (EPA, 1989a).

2.4.2.2 Summary

The available dose-response parameters (carcinogenic and noncarcinogenic) and target organs for noncarcinogenic health effects for each COPC are presented on Table 2-11 and Table 2-13, respectively. If the concentration or intake of a chemical exceeds these standards or guidelines, the possibility exists that a potential receptor may experience adverse health effects. Expected intakes of each chemical are presented in Section 2.4.3.

2.4.3 Exposure Assessment

The purpose of this section is to evaluate the potential for human exposure to the chemicals detected in the environmental media at the NWS Earle sites investigated under this RI. This section presents a general site-conceptual model (Section 2.4.3.1), characterizes the exposed populations (Section 2.4.3.2), identifies actual or potential exposure routes (Section 2.4.3.3), and summarizes the methods used to generate exposure estimates (Section 2.4.3.4). The nature and extent of contamination upon which the exposures are based are presented in subsequent site-specific sections.

To determine whether there is an actual or potential exposure, the most likely pathways of contaminant release and transport, as well as the human and environmental activity patterns, must be considered. A complete exposure pathway has three components: a source, a route of transport, and an exposure point for receptors. These components are addressed in the following subsections.

2.4.3.1 Conceptual Site Model

The conceptual site model for NWS Earle incorporates information of the potential chemical sources, affected media, release mechanisms, routes of migration, and known or potential human receptors. The purpose of the conceptual site model is to provide a framework in which to identify potential exposure pathways occurring at the sites. Information provided on site characterization, chemical characterization, local land and water uses, and potential receptors is used to identify potential exposure pathways for the site. The general conceptual site model for NWS Earle is presented in Figure 2-1.

2.4.3.2 Potential Receptors

The receptors chosen for the sites are presented in this section. All of the receptors listed below are not applicable to every site. The receptors are chosen based on sampled media per site. Section 2.1 identifies the media sampled at each site.

- Current Industrial Employee

  A current industrial employee is an adult who currently works at NWS Earle. This receptor is potentially exposed via ingestion of, dermal contact with, and inhalation of COPCs in surface soil. Carcinogenic and noncarcinogenic risks are estimated for the current industrial employee receptor who does not engage in soil- or dust-contact-intensive activities on a regular basis. Examples of such activities include grass cutting, fertilizing, outdoor equipment repair (automotive, locomotive, and small equipment), loading and unloading of vehicles, surveying, outdoor painting, and above-ground utility repair. (This scenario does not include short-term activities categorized as soil contact-intensive, as discussed in Section 2.4.5.3.)

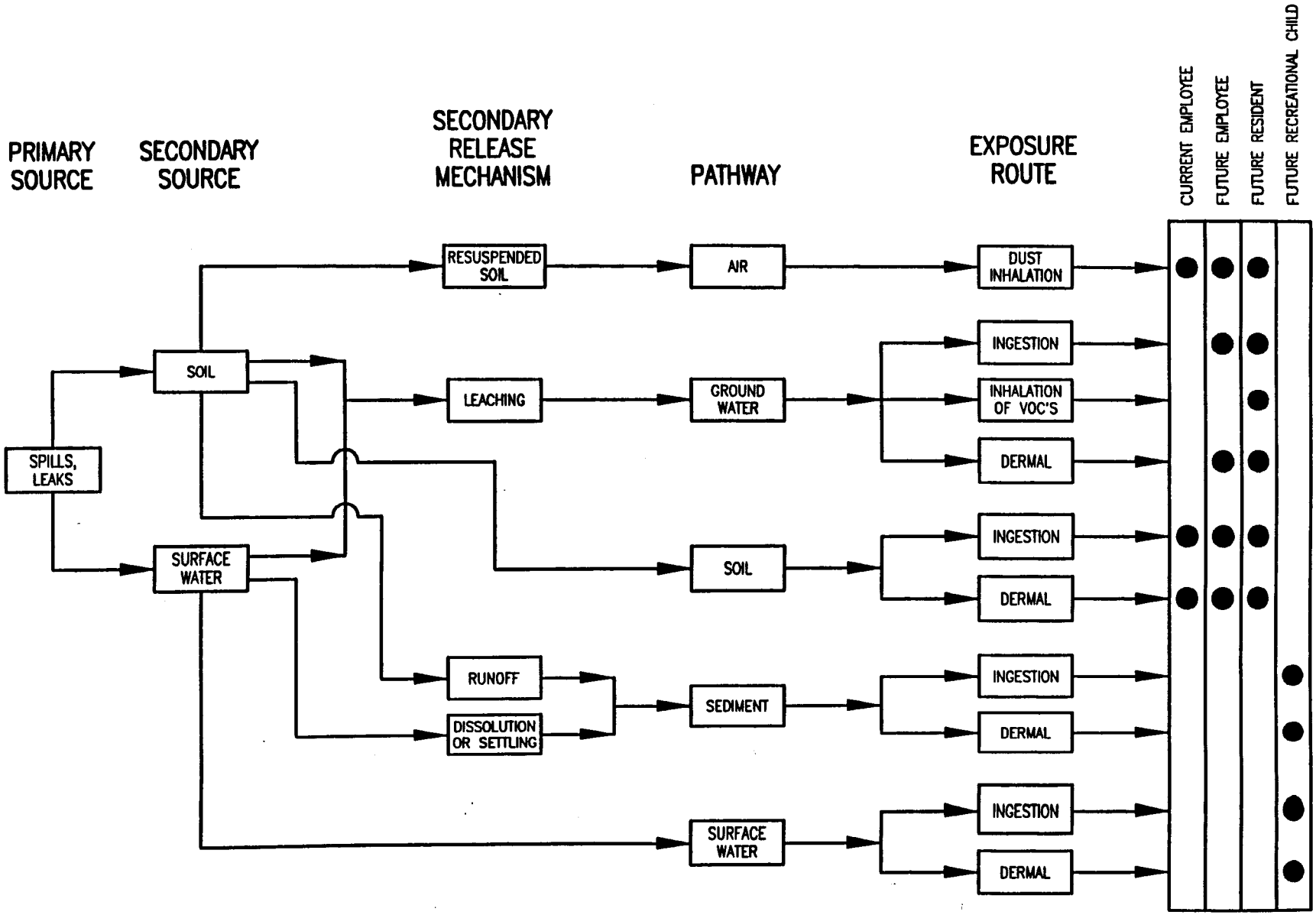

FIGURE 2-1 GENERAL CONCEPTUAL SITE MODEL FOR NWS EARLE

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- Future Industrial Employee

A future industrial employee is an adult who is assumed to work at NWS Earle in the future. This receptor is potentially exposed via ingestion of COPCs in subsurface soil (as future surface soil) and groundwater; dermal contact with COPCs in subsurface soil (as future surface soil) and groundwater (hand washing); and inhalation of COPCs in fugitive dust from subsurface soil (as future surface soil). Carcinogenic and noncarcinogenic risks are estimated for the future industrial employee receptor who does not engage in soil- or dust-contact-intensive activities on a regular basis. Examples of noncontact-intensive activities for the future industrial worker include grass cutting, fertilizing, outdoor equipment repair (automotive, locomotive, and small equipment), loading and unloading of vehicles, surveying, outdoor painting, and above-ground utility repair. (This scenario does not include temporary, short-term activities categorized as soil contact-intensive, as discussed in Section 2.4.5.6.)

- Future Resident

A future resident is a person who will live in a residence at or near NWS Earle in a hypothetical future scenario. This receptor resides at the residence for 30 years, 0 through 6 years as a child and the remaining 24 years as an adult. This receptor is potentially exposed via ingestion of COPCs in surface soil, subsurface soil (as future surface soil), and groundwater; dermal contact with COPCs in surface soil, subsurface soil (as future surface soil), and groundwater (child, during bathing; adult, during showering); inhalation of COPCs in fugitive dust from surface soil and subsurface soil (as future surface soil); and inhalation of COPCs present in groundwater vapors during showering (adult only, 24-year exposure).

Carcinogenic risks are estimated for a lifetime residential receptor. This exposure is based on the full 30 years as a resident at the site. Note that the showering scenario for carcinogenic risks is estimated using a residential adult over the 24-year span (children ages 0 through 6 years are not expected to bathe via showering).

Noncarcinogenic effects to future residents are estimated for a residential child (0 through 6 years) and residential adult (24 years). The residential child (0 through 6 years) lives in a future residence for 6 years (equal to the child receptor in the lifetime resident scenario presented above). This receptor is potentially exposed via ingestion of COPCs in surface soil, subsurface soil (as future surface soil), and groundwater; dermal contact with COPCs in surface soil, subsurface soil (as future surface soil), and groundwater (bathing); and inhalation of COPCs in fugitive dust from surface soil and subsurface soil

(as future surface soil). The residential adult lives in a future residence for 24 years. This receptor is potentially exposed via inhalation of COPCs present in groundwater vapors during showering.

- Future Recreational Child (age 6 to 12 years)

  The future recreational child will live in a future residence at or near NWS Earle. This receptor wades in surface water/sediment present at NWS Earle. This receptor is potentially exposed via ingestion of COPCs in sediment and surface water and dermal contact with COPCs in sediment and surface water. Noncarcinogenic and carcinogenic risks are estimated for the recreational child receptor.

- One receptor scenario that was considered, but not selected, was the "current hunter." The current hunter would spend several days each year in the wooded areas of the station, kill one deer annually, and eat the meat and other processed products, such as sausage. The current hunter would be exposed to two types of exposure pathways: direct contact to site media (air, surface soil, surface water, and sediments) while hunting, and ingestion of the deer meat.

  The direct contact to side media exposure scenario results in very little potential exposure for the hunter because the surface media capable of driving an appreciable health risk exist only at the industrial/commercial zones (where hunting is not permitted) or in groundwater at the industrial sites, to which the hunter has no access. The primary media of concern to which the hunter can be exposed, surface water and sediments, are of very low concern for human health (note that the future recreational child risk scenario, playing in streams/sediments, did not result in a health risk above the EPA target acceptable range).

  The ingestion of deer meat exposure pathway depends on the intake of compounds of concern by plants and a resultant bioaccumulation in the deer. Past experience and documented studies of this type in the past (e.g., Sierra Army Depot study of bioaccumulation in beef cattle) indicate that this risk will be two orders of magnitude (1×10^{-2}) or more, lower than other risk scenarios, such as direct soil and groundwater ingestion, which generally drive human health risk assessment.

  Considering these factors, it was concluded that the current hunter is not a reasonable risk scenario, and it was not pursued further in calculation of human health risks.

2.4.3.3 Exposure Routes by Medium

There are five environmental media at NWS Earle through which potential receptors (see previous section) can be either directly or indirectly exposed to site-related COPCs: surface soil, subsurface soil, sediment, groundwater, or surface water. All five media have not been sampled at all of the NWS Earle sites. Potential exposure routes include ingestion, dermal contact, and inhalation.

Surface Soil

Surface soil exposure routes include incidental ingestion, dermal contact, and inhalation of fugitive dust. All scenarios are based on current COPC concentrations in surface soils. All three exposure routes were evaluated using industrial employees (current scenario) and residential receptors (future scenario). These receptors were chosen because it is unknown whether NWS Earle will remain open to industrial employees only or whether NWS Earle (or a portion of it) might become a residential area in the future. For fugitive dust emissions under the current industrial scenario, the assumption of surface cover would resemble the type of vegetation, paving, and buildings that are currently in place. For fugitive dust emissions under a future residential scenario, the assumptions of vegetative cover would resemble a typical residential setting different from the current industrial setting. For surface soil, low levels of VOCs did not warrant full-scale modeling and an estimation of the exposure. VOCs were generally not detected in surface soil samples, with the exception of a single result for PCE at 3 ug/kg in one surface soil sample at Site 12. Therefore, exposure to volatilized chemicals is expected to be negligible at NWS Earle, and ingestion and dermal contact would contribute to the bulk of the risk.

Subsurface Soil

Because there is currently no direct contact with subsurface soil, only potential future incidental ingestion, dermal contact, or inhalation of fugitive dusts could be evaluated. All three exposure routes were evaluated using industrial employees (future scenario) and residential receptors (future scenario). The exposure scenarios for subsurface soil are based on the assumption that subsurface soil could eventually become surface soil if excavations, erosion, construction, or landscaping activities occurred. Exposure scenarios based on the concentrations in subsurface soil are conservative based on this assumption. The receptors were chosen because it is unknown whether NWS Earle will remain open to industrial employees only or whether it might become a residential area in the future. For fugitive dust emissions from subsurface soil under the future industrial scenario, the assumption of surface cover would be based on the type of vegetation, paving, and buildings that are currently in place. For fugitive dust emissions from subsurface soil under a future residential scenario, the assumptions of vegetative cover would be based on a typical residential setting, different from the current industrial setting.

Subsurface soil contamination may also have an impact upon future groundwater quality, especially for relatively mobile contaminants such as VOCs. This risk assessment does not take into account future loading of COPCs from subsurface soils to groundwater. It is assumed that loading of COPCs from subsurface soils to groundwater is currently occurring; therefore, groundwater exposure to potential receptors will adequately characterize this phenomenon.

Sediment

Sediment exposure routes include incidental ingestion and dermal contact. These exposure routes were evaluated using recreational child receptors. It was assumed that a child in this recreational scenario would be older than the standard 15-kilogram child (approximately 3 years old) used in residential soil scenarios. For sediment exposure, a 30-kilogram child (6 to 12 years old; represented by mean body weight and surface area for age 9 years) was used. Inhalation of chemicals in sediment was eliminated as a pathway because the sediment is not expected to be in a dry streambed frequently. Furthermore, the frequency of contact with surface water and sediment by the recreational children is expected to be low.

Groundwater

Groundwater beneath NWS Earle is not currently used for drinking purposes. The NWS Earle sites are all located within the boundaries of the New Jersey Coastal Plain Sole Source Aquifer, a groundwater protective designation conferred by Section 1424(e) of the Safe Drinking Water Act. Groundwater at the sites is therefore classified as at least Class IIA Current Source of Drinking Water. However, in order to evaluate groundwater quality, potential future groundwater exposure scenarios using current groundwater conditions were evaluated. It was assumed that the theoretical exposure to industrial employees would be via ingestion and dermal contact (hand washing) routes; exposure to adult residents would occur via ingestion, dermal contact (showering), and inhalation of vapors (showering) routes; and exposure to child residents would occur via ingestion and dermal contact (bathing) routes.

Future groundwater conditions were not evaluated for the risk assessment. Groundwater conditions at the site were not modeled. Migration of COPCs in groundwater to surface water was also not modeled. For this risk assessment, it is assumed that migration of COPCs in groundwater is currently occurring and current groundwater conditions adequately represent this phenomenon.

Surface Water

Surface water exposure routes include incidental ingestion and dermal contact. These exposure routes were evaluated using recreational child receptors. It was assumed that a child in this recreational scenario would be older than the standard 15-kilogram child (approximately 3 years old) used in residential

groundwater scenarios. For surface water exposure, a 30-kilogram child (approximately 9 years old) was used. Inhalation of VOCs in surface water was eliminated as a pathway because the VOCs were detected infrequently in surface water. Furthermore, the frequency of contact with surface water by the recreational child is expected to be low.

2.4.3.4 Exposure Estimates

The estimation methods and models used in this section are consistent with current EPA risk assessment guidance (EPA, 1989a; EPA, 1991a). Exposure estimates associated with each exposure route are presented below. All exposure scenarios incorporate the representative concentrations in the estimation of intakes.

Noncarcinogenic risks are estimated using the concept of an average annual exposure. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. This is used with the "averaging time," which converts the daily exposure frequency and duration to an annual exposure by dividing by 365 days per year of exposure. Noncarcinogenic risks for some exposure routes (e.g., soil) are generally greater for children than for adults because of the much lower body weights of children and their similar or higher ingestion rates. Carcinogenic risks, on the other hand, are calculated as an incremental lifetime risk and, therefore, incorporate terms to represent the exposure duration (years) over the course of a lifetime (70 years).

Surface Soil Exposure

Three potential exposure routes are associated with direct exposure to surface soil at the NWS Earle sites. These exposure routes include ingestion, dermal contact, and inhalation of fugitive dust. The methods used to assess these routes of exposure are discussed in the following text.

Incidental surface soil ingestion exposure is estimated from the following equation (EPA, 1989a):

$$IEX = (C \times IR \times FI \times EF \times ED)/(BW \times AT \times CF)$$

where:
- IEX = Ingestion exposure [mg/(kg-day)]
- C = Chemical concentration in soil (mg/kg soil)
- IR = Soil ingestion rate (mg soil/day)
- FI = Fraction ingested from contaminated source
- EF = Exposure frequency (days/yr)
- ED = Exposure duration (yrs)
- BW = Body weight (kg)

AT = Averaging time (days)
CF = Conversion factor (mg soil/kg soil: 1E+06)

A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-14. As discussed in Section 2.4.3, the potential receptors for this scenario were adult employees, adult residents, and child residents. EPA values were used for all input parameters.

Dermal exposure to surface soil is estimated from the following equation (EPA, 1989a; EPA, 1992f):

$$DEX = (C \times SA \times AF \times ABS \times EF \times ED \times CF)/(BW \times AT)$$

where: DEX = Dermal exposure dose (mg/kg/day)
C = Chemical concentration in soil (mg/kg soil)
SA = Skin surface area available for contact (cm^2/day)
AF = Soil-to-skin adherence factor (mg/cm^2)
ABS = Fraction from contaminated source
EF = Exposure frequency (days/yr)
ED = Exposure duration (yrs)
BW = Body weight (kg)
CF = Conversion factor (kg soil/mg soil: 1E-06)
AT = Averaging time (days)

A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-15. As discussed in Section 2.4.3, the potential receptors for this scenario were adult employees, adult residents, and child residents. EPA or conventional values were selected for most input parameters. It was assumed that the primary areas of skin available for contact would be the hands and arms of adult residents and employees and the arms, hands, and legs of residential children. For the initial baseline risk assessment, absorption factors were assumed to be as follows: 0.1 for VOCs, 0.05 for SVOCs/pesticides, 0.06 for PCBs, and 0.01 for metals (Feldman and Maibach, 1970; Wester and Maibach, 1985; EPA, 1984a). (Several of these values were modified during the amended risk assessment, as discussed in Section 2.4.6.)

Exposure to fugitive dust emissions can be estimated by first estimating the rate of distribution and COPC emission from the site and then relating this to the exposure rate for the receptors. For sites such as NWS Earle, considered to have unlimited erosion potential (generally sites with small particle size and low vegetative cover), emission factors can be estimated as follows:

TABLE 2-14
EXPOSURE INPUT PARAMETERS - SOIL INGESTION
NWS EARLE, COLTS NECK, NEW JERSEY

Incidental Ingestion of Soil				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed (EPA, 1989a, 1993)
IR	Ingestion rate	100 mg/day (industrial employee) 100 mg/day (residential adult) 200 mg/day (residential child)	50 mg/day (industrial employee) 50 mg/day (residential adult) 100 mg/day (residential child)	(EPA, 1991a; EPA, 1993)
FI	Fraction ingested from contaminated source	1.0	1.0	Professional judgement based on current and projected future land use and observed activity patterns
EF	Exposure frequency	250 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (recreational child)	234 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (recreational child)	(EPA, 1991a; EPA, 1993)
ED	Exposure duration	25 years (industrial employee) 24 years (residential adult) 6 years (residential child)	4.5 years (industrial employee) 7 years (residential adult) 2 years (residential child)	90th / 50th percentile time at one residence (EPA,1991a; EPA, 1989a; EPA, 1993) Ave.duration of employment, (Maguire, 1993)
BW	Body weight	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	(EPA, 1991a; EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

TABLE 2-15
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

Dermal Contact with Soil				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data (EPA, 1989a, 1993)
SA	Skin surface area available for contact	3,120 sq. cm/day (industrial employee) 3,120 sq. cm/day (residential adult) 3,910 sq. cm/day (residential child)	3,120 sq. cm/day (industrial employee) 3,120 sq. cm/day (residential adult) 3,910 sq. cm/day (residential child)	Industrial employee and adult: arms and hands Child: arms, hands, and legs (EPA, 1989a)
AF	Soil-to-skin adherence factor	1.0 mg/sq. cm	1.0 mg/sq. cm	(EPA, 1992f)
ABS	Absorption factor (Applied to initial risk evaluation - see text)	Inorganics = 0.01 Volatile Organic Chemicals = 0.1 Semivolatile Organic Chemicals = 0.05 Pesticides = 0.05 Polychlorinated Biphenyls = 0.06	Inorganics = 0.01 Volatile Organic Chemicals = 0.1 Semivolatile Organic Chemicals = 0.05 Pesticides = 0.05 Polychlorinated Biphenyls = 0.06	Feldman and Maibach (1970) Webster and Maibach (1985) EPA (1984a)
ABS	Absorption factor (Applied to sites with refined risk evaluation)	Arsenic = 0.03 Cadmium = 0.001 PCBs = 0.2 No other COPCs applicable	Arsenic = 0.03 Cadmium = 0.001 PCBs = 0.2 No other COPCs applicable	(Wester, 1993) (Wester, 1992) (EPA, 1993)
EF	Exposure frequency	250 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (residential child)	234 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (residential child)	(EPA, 1991a; EPA, 1993)
ED	Exposure duration	25 years (industrial employee) 24 years (residential adult) 6 years (residential child)	4.5 years (industrial employee) 7 years (residential adult) 2 years (residential child)	90th / 50th percentile time at one residence (EPA,1991a; EPA, 1989a; EPA, 1993) Ave.duration of employment, (Maguire, 1993)
BW	Body weight	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	(EPA, 1991a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

$E_{10} = (0.036) \times (1-V) \times (U/Ut)^3 \times F(x)$

where: E_{10} = PM_{10} emission factor (g/m^2 hr)
V = vegetative cover
U = mean annual wind speed (m/s)
Ut = threshold value of wind speed at 7 m (m/s)
F(x) = function based on x = 0.886 x Ut/U
Ut = U* x (1/0.4) x ln (z/z_0)
Ut = wind speed at height z (m/s)
z = height above surface (cm)
z_0 = roughness height (cm)
U* = friction velocity (m/s)

From the emission flux, the emission rates are as follows:

$R_{10} = \alpha \times E_{10} \times A \times CF$

where: R_{10} = Emission rate of a COPC (g/sec)
α = mass fraction of a COPC in soil
E_{10} = PM_{10} emission flux ($g/(m^2hr)$)
A = source area (m^2)
CF = conversion factor (1 hr/3,600 sec)

To estimate the annual average air concentration to receptors near the site, a screening air dispersion model was used, as described in detail in Appendix I. The screening model parameters were selected consistent with conservative assumptions (a 100-meter-squared source area and a receptor located 200 meters downwind located along the axis of most probable dispersion). Annual average air concentrations were estimated as follows:

$Q_I = R_{10} / P_R$

where: Q_I = wind erosion scaling factor (g/sec)
R_{10} = PM_{10} emission rate of a COPC (g/sec)
P_R = fraction of time wind erosion occurs (0.296)

$X = Q_I \times F_I \times CF$

where: X = average annual downwind respirable concentration (mg/m^3)

Q_I = wind erosion scaling factor (g/sec)

F_I = unscaled conc. due to unit erosion rate[3] [$(ug/m^3)/(g/sec)$]

CF = conversion factor (1 mg/1,000 ug)

From that concentration, exposure to fugitive dust was then estimated using the following equations:

IEXr = (X x IR x ET x EF x ED x IF-R)/(BW x AT)

and

IEXo = (X x IR x ET x EF x ED x IF-O)/(BW x AT)

where: IEXr = cancer dose from inhaled fraction retained in lungs for adult employee over 25-year period (mg/kg/day)

and

IEXo = cancer dose from inhaled fraction that is eventually swallowed for adult employee over 25-year period (mg/kg/day)

X = Downwind air concentration (mg/m^3)

IR = Inhalation rate (m^3/hr)

ET = Exposure time (hr/day)

EF = Exposure frequency (day/yr)

ED = Exposure duration (yr)

BW = Body weight (kg)

AT = Averaging time (days)

IF-R = inhaled fraction retained in lungs (0.125)

IF-O = inhaled fraction eventually swallowed (0.625)

A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-16. As discussed in Section 2.4.3, the potential receptors for this scenario were adult employees, adult residents, and child residents. The input parameters were generally those provided in the Cowherd model, which allows limited parameter choices for area and distance to the site. Conservative estimates used for all sites include an area of contamination of 10,000 m^2, terrain factors for a light industrial and suburban residential/institutional type setting, and meteorological factors for the local geographic area. The cover factor was conservatilvely estimated as approximately 80 percent (0.8). For all sites, a conservative model parameter was chosen: the nearest future residences were considered to be 200 m southeast (this is the prevailing wind direction; this parameter is used to derive the unscaled concentration from the erosion rate). For employees, the assumed distance from the site was zero (< 200 m), and therefore the strongest wind direction at 200 m was used to determine the unscaled concentration from the erosion rate. A median particle size of 0.25 mm was assumed for the study area (see Appendix I); this particle size was used to derive the threshold friction velocity.

TABLE 2-16
EXPOSURE INPUT PARAMETERS - SOIL DUST INHALATION
NWS EARLE, COLTS NECK, NEW JERSEY

Inhalation of Fugitive Dust Emissions				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed (EPA, 1989a, 1993)
V	Vegetative cover factor	0.8	0.8	Estimate from site visit, assuming future conditions would approximate present conditions.
A	Source surface area	10,000 sq. m	10,000 sq. m	Estimate from site visit.
IR	Inhalation rate	Adult: 0.83 cu. m/hour Child: 0.5 cu. m/hour	Adult: 0.83 cu. m/hour Child: 0.5 cu. m/hour	(EPA, 1989a)
ET	Exposure time	Industrial employee: 8 hours/day Residential adult: 24 hours/day Residential child: 24 hours/day	Industrial employee: 8 hours/day Residential adult: 24 hours/day Residential child: 24 hours/day	Conventional
EF	Exposure frequency	Industrial employee: 250 days/year Residential adult: 350 days/year Residential child: 350 days/year	234 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (residential child)	(EPA, 1991a; EPA, 1993)
ED	Exposure duration	Industrial employee: 25 years Residential adult: 24 years Residential child: 6 years	4.5 years (industrial employee) 7 years (residential adult) 2 years (residential child)	90th / 50th percentile time at one residence (EPA,1991a; EPA, 1989a; EPA, 1993) Average duration of employment, (Maguire, 1993)
BW	Body weight	Adult: 70 kg Child: 15 kg	Adult: 70 kg Child: 15 kg	(EPA, 1989a; EPA, 1991a)
LT	Lifetime	70 years	70 years	Conventional
AF	Absorption factor	GI tract: 0.625 Respiratory tract: 0.125	GI tract: 0.625 Respiratory tract: 0.125	(Cowherd et al, 1984) (ICRP, 1968)
U	Mean annual wind speed	2.01 m/sec	2.01 m/sec	(Cowherd et al, 1984, Table 4-1 for Baltimore, MD)
PR	Regional climate factor	0.296	0.296	(Cowherd et al, 1984 Figures 4-5 and 4-7, Region 7)
Fi	Unscaled concentration from erosion rate	3.837 (ug/cu. m) / (g/sec)	3.837 (ug/cu. m) / (g/sec)	(Cowherd et al, 1984, Appendix D for Region 7, 100m x 100m, 200m downwind of source)
U*t	Threshold friction velocity	35 cm/sec	35 cm/sec	(Cowherd et al, 1984, Figure 3-4, Median particle size 0.25 mm)
Z0	Roughness height	70 cm	70 cm	(Cowherd et al, 1984, Figure 3-6, suburban area, medium buildings)

Subsurface Soil Exposure

Three potential exposure routes are associated with direct exposure to subsurface soil (as future surface soils) at the NWS Earle sites: ingestion, dermal contact, and inhalation of fugitive dust. The methods used to assess these routes of exposure are the same as the assumptions and equations for surface soil presented in the previous section.

Sediment Exposure

Two potential exposure routes are associated with direct contact with sediment at the NWS Earle sites: ingestion and dermal contact during wading (swimming was determined not to be applicable in any of the streams at NWS Earle). The methods used to assess these routes of exposure are discussed in the following text. These scenarios were evaluated in the same way as ingestion and dermal exposures for surface soil, which were explained above.

Sample calculations are provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-17 (ingestion) and Table 2-18 (dermal). As discussed in Section 2.4.3, the potential receptors were children weighing 30 kilograms who play at the site. The input parameters for sediment are the same as those for soil, with notable exceptions. Children involved in wading activities would be expected to be older than the typical 15-kilogram child (approximately 3 years old). Therefore, the recreational child in the wading scenario was assumed to play at the site over a 6-year period (age 6 through 12 years, weighing 30 kilograms). Exposure to sediment during wading was expected to involve almost exclusively the feet; therefore, the exposed surface area for the feet of a 30-kilogram child was used.

Groundwater Exposure

Three potential exposure routes are associated with direct contact with groundwater at the NWS Earle sites: ingestion, dermal contact, and inhalation of vapors during showering. The methods used to assess these routes of exposure are discussed in the following text.

Ingestion of groundwater was evaluated using the following equation (EPA, 1989a):

$$IEX = (C \times IR \times EF \times ED)/(BW \times AT)$$

where: IEX = Ingestional exposure dose (mg/kg/day)
C = Water concentration (mg/L)
IR = Ingestion rate (L/day)

TABLE 2-17
EXPOSURE INPUT PARAMETERS - SEDIMENT INGESTION
NWS EARLE, COLTS NECK, NEW JERSEY

Incidental Ingestion of Sediment				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a; 1993)
IR	Ingestion rate	200 mg/day (recreational child	100 mg/day (recreational child	(EPA, 1991a; EPA, 1993)
FI	Fraction ingested from contaminated source	1.0	1.0	Professional judgement based on current and projected future land use and observed activity patterns
EF	Exposure frequency	7 days/year (recreational child)	7 days/year (recreational child)	(EPA, 1991a)
ED	Exposure duration	6 years (recreational child)	2 years (recreational child)	RME - (EPA, 1991a) Central tendency - prof. judgement
BW	Body weight	30 kg (recreational child)	30 kg (recreational child)	Child approximately 3 years old (15kg) usually used as a receptor; however, wading is expected to occur for older children (age 6 or older)(25 kg) (EPA, 1991a; EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

TABLE 2-18
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

Dermal Contact with Sediment				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a, 1993)
SA	Skin surface area available for contact	792 sq. cm/day	792 sq. cm/day	Feet only; child; sediment (EPA, 1991g)
AF	Soil-to-skin adherence factor	1.0 mg/sq. cm	1.0 mg/sq. cm	(EPA, 1992f)
ABS	Absorption factor (Applied to initial risk evaluation - see text)	Inorganics = 0.01 Volatile Organic Chemicals = 0.1 Semivolatile Organic Chemicals = 0.05 Pesticides = 0.05 Polychlorinated Biphenyls = 0.06	Inorganics = 0.01 Volatile Organic Chemicals = 0.1 Semivolatile Organic Chemicals = 0.05 Pesticides = 0.05 Polychlorinated Biphenyls = 0.06	Feldman and Maibach (1970) Webster and Maibach (1985) EPA (1984a)
ABS	Absorption factor (Applied to sites with refined risk evaluation)	Arsenic = 0.03 Cadmium = 0.001 PCBs = 0.2 No other COPCs applicable	Arsenic = 0.03 Cadmium = 0.001 PCBs = 0.2 No other COPCs applicable	(Wester, 1993) (Wester, 1992) (EPA, 1993)
EF	Exposure frequency	7 days/year (recreational child)	7 days/year (recreational child)	(EPA, 1991a)
ED	Exposure duration	6 years (recreational child)	2 years (recreational child)	RME - (EPA, 1991a) Central tendency - professional judgement
BW	Body weight	30 kg (recreational child)	30 kg (recreational child)	Wading is expected to occur for older children (age 6 through 12; weight - 25 kg) (EPA, 1991a; EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

EF = Exposure frequency (days/yr)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (days)

A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-19. As discussed in Section 2.4.3, the potential receptors for this scenario were adult employees, adult residents, and child residents. EPA values were used for all input parameters.

Dermal exposure to groundwater was evaluated using the following equations (EPA, 1992f):

$$DAD = (DA \times EV \times EF \times ED \times SA)/(BW \times AT)$$

where:
DAD = Dermally absorbed dose (mg/kg/day)
DA = Dose absorbed per event ($mg/cm^2/event$)
EV = Event frequency (events/day)
EF = Exposure frequency (days/yr)
ED = Exposure duration (yr)
SA = Skin surface area available for contact (cm^2)
BW = Body weight (kg)
AT = Averaging time (days)

$$DA = CF \times K \times Cv \times t \quad \text{for inorganics}$$

where:
DA = Dose absorbed per event ($mg/cm^2/event$)
CF = Conversion factor (L/cm^3: 1/1000)
K = Permeability coefficient from water (cm/hr)
Cv = Concentration in water (mg/L)
t = Duration of event (hr/event)

$$DA = 2 \times CF \times Kp \times Cv\ [((6 \times \tau \times t)/\pi)^{0.5}] \quad \text{for organics, } t < t^*$$
$$DA = Kp \times CF \times Cv\ [t/(1 + B) + [2 \times \tau\ ((1 + 3B)/(1 + B))]] \quad \text{for organics, } t > t^*$$

where:
DA = Dose absorbed per event ($mg/cm^2/event$)
CF = Conversion factor (L/cm^3: 1000)
Kp = Permeability coefficient from water (cm/hr)
Cv = Concentration in water (mg/L)
t = Duration of event (hr/event)

TABLE 2-19
EXPOSURE INPUT PARAMETERS - GROUNDWATER INGESTION
NWS EARLE, COLTS NECK, NEW JERSEY

Incidental Ingestion of Groundwater				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a; 1993)
IR	Ingestion rate	1 L/day (industrial employee) 2 L/day (residential adult) 1 L/day (residential child)	0.7 L/day (industrial employee) 1.4 L/day (residential adult) 0.7 L/day (residential child)	RME - (EPA, 1991a) Central tendcy., adult - (EPA, 1993) Central tendency - child / industrial - professional judgement
EF	Exposure frequency	250 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (residential child)	219 days/year (industrial employee) 234 days/year (residential adult) 234 days/year (residential child)	(EPA, 1991a; EPA, 1993)
ED	Exposure duration	25 years (industrial employee) 24 years (residential adult) 6 years (residential child)	4.5 years (industrial employee) 7 years (residential adult) 2 years (residential child)	90th / 50th percentile time at one residence (EPA,1991a; EPA, 1989a; EPA, 1993) ave.duration of employment. (Maguire, 1993)
BW	Body weight	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	70 kg (industrial employee) 70 kg (residential adult) 15 kg (residential child)	(EPA, 1991a; EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

t* = Compound specific, maximum duration of time for steady-state

τ = Lag time (hr)

B = Partition coefficient

π = mathematical constant, approximately 3.1416

This approach is based on the assumption that water contaminants are present in dilute solution and that percutaneous absorption is controlled by the flux of water. A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-20. As discussed in Section 2.4.3, the potential receptors for this scenario were adult employees (hand washing), adult residents (showering), and child residents (bathing). Adult and child residents were assumed to take daily showers and baths, respectively, and therefore their total body surface areas were used. Employees were assumed to wash their hands for approximately 30 minutes per day at the workplace, and the surface area of their hands and forearms was used. EPA values were used for most input parameters. K, Kp, B, τ, and t* were chemical-specific values obtained from EPA (1992e) or derived from the molecular weight and Kow as demonstrated therein. As recommended by the guidance, default K values of 1E-3 cm/hr were used for metals for which experimental values had not been obtained (EPA, 1992f).

Inhalation exposure to groundwater (during showering) was calculated for adult residents only using the following equations (EPA, 1989a; Foster and Chrostowski, 1987):

$$DI = D \times EF \times ED / AT$$

where: DI = Inhalation dose (mg/kg/day)

D = Inhalation dose (mg/kg/shower)

EF = Exposure frequency (showers/yr)

ED = Exposure duration (yrs)

AT = Averaging time (days)

Inhalation of vapors in groundwater was evaluated using the following equations (Foster and Chrostowski, 1987):

The term D is estimated as follows:

$$D = [(IR \times S) / (BW \times Ra \times CF)] \times Q$$

where: D = Inhalation dose (mg/kg/shower)

Q = Function of air exchange rate and time in shower and shower room (min)

IR = Inhalation rate (L/min)

TABLE 2-20
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

Dermal Contact with Groundwater				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentratio	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a; EPA, 1993)
SA	Skin surface area available for contact*	820 sq. cm/day (industrial employee 19,400 sq. cm/day (residential adult 5,910 sq. cm/day (residential child)	820 sq. cm/day (industrial employee 19,400 sq. cm/day (residential adult 5,910 sq. cm/day (residential child)	Industrial employee: hands Adult and child: body (EPA, 1989b)
ET	Exposure time*	0.5 hours/day (industrial employee) 0.25 hours/day (residential adult) 0.33 hours/day (residential child)	0.5 hours/day (industrial employee) 0.117 hours/day (residential adult) 0.33 hours/day (residential child)	Industrial employee: 30 minutes/day (Professional judgment) Adult: 15 min./day (7 - Central Tndcy.) Child: 20 minutes/day EPA (1991a)
EF	Exposure frequency	250 days/year (industrial employee) 350 days/year (residential adult) 350 days/year (residential child)	219 days/year (industrial employee) 234 days/year (residential adult) 234 days/year (residential child)	(EPA, 1991a; EPA, 1993)
ED	Exposure duration	25 years (industrial employee) 24 years (residential adult) 6 years (residential child)	4.5 years (industrial employee) 7 years (residential adult) 2 years (residential child)	90th / 50th percentile time at one residence (EPA,1991a; EPA, 1989a; EPA, 1993) Average duration of employment, (Maguire, 1993)
BW	Body weight	Adult: 70 kg Child: 15 kg	Adult: 70 kg Child: 15 kg	(EPA, 1991a; EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)
K, Kp	Permeability coefficients (cm/hour)	Contaminant-specific	Contaminant-specific	(EPA, 1992f)
τ	Lagtime (hours)	Contaminant-specific	Contaminant-specific	(EPA, 1992f)
B	Partition coefficient	Contaminant-specific	Contaminant-specific	(EPA, 1992f)

* Adult residents assumed to shower daily; child residents assumed to bathe daily; industrial employee assumed to wash hands daily.

S = Indoor VOC generation rate (ug/m^3/min)
BW = Body weight (kg)
Ra = Rate of air exchange (min^{-1})
CF = Conversion factor: 10^6 ug x L / (mg x m^3)

The term Q is calculated:

$$Q = Ds + [(\exp(-Ra \times Dt))/Ra] - [(\exp(Ra \times (Ds-Dt)))/Ra]$$

where:
Q = Function of air exchange rate and time in shower and shower room (min)
Ds = Duration of shower (min)
Dt = Total time in shower room (min)
Ra = Rate of air exchange (min^{-1})

The term S is estimated as follows:

$$S = Cwd \times FR / SV$$

where:
S = Indoor voc generation rate (ug/m^3/min)
Cwd = Concentration leaving water droplet (ug/L)
FR = Shower flow rate (L/min)
SV = Shower room air volume (m^3)

The term Cwd is calculated:

$$Cwd = C \times CF \times (1-\exp[(-KaL \times ts)/60d)])$$

where:
Cwd = Concentration leaving water droplet after time ts (ug/L)
C = Concentration in water (mg/L)
CF = Conversion factor (1000 ug/1 mg)
KaL = Adjusted overall mass transfer coefficient (cm/hr)
ts = Shower droplet time (sec)
d = Shower droplet diameter (mm)

The term KaL is calculated:

$$KaL = KL / [(T_1 \times \mu_S)/(T_s \times \mu_1)]^{0.5}$$

where: KaL = Adjusted overall mass transfer coefficient (cm/hr)

KL = Mass transfer coefficient (cm/hr)
T_1 = Calibration water temperature of KL °K)
Ts = Shower water temperature (°K)
$\mu 1$ = Water viscosity at T1 (centipoise)
μS = Water viscosity at Ts (centipoise)

The term KL is calculated as follows:

$$KL = 1/[(1/kl) + ((R \times T)/(H \times kg))]$$

where:
KL = Mass transfer coefficient (cm/hr)
R = Ideal gas law constant atm (m^3/mol/°K)
T = Absolute temperature (°K)
H = Henry's Law constant (atm-m^3/mole)
kg = Gas-film mass transfer coefficient (cm/hr)
kl = Liquid-film mass transfer coefficient (cm/hr)

The terms kg and kl are calculated:

$$kg = kH \times (MWH / MW)^{0.5}$$

where: $kl = kC \times (MWC / MW)^{0.5}$
kg = Gas-film mass transfer coefficient (cm/hr)
kl = Liquid-film mass transfer coefficient (cm/hr)
kH = kg for water (cm/hr)
kC = kl for carbon dioxide (cm/hr)
MWH = Molecular weight of water (g/mole)
MWC = Molecular weight of carbon dioxide (g/mole)
MW = Molecular weight of the chemical (g/mole)

The volatile chemical generation rate was estimated using the Foster and Chrostowski mass transfer model, which is based on two-phase film theory. The model employs contaminant-specific mass transfer coefficients, Henry's Law constants, droplet drop time, viscosity, temperature, etc. Specific details regarding the application of the mass transfer model can be found in the source documents (Foster and Chrostowski, 1987).

A sample calculation is provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-21. It was assumed that small children would take baths rather than showers and that employees would not shower at work; therefore, only adult residents were selected as potential receptors for this pathway. (The assumption that

TABLE 2-21
EXPOSURE INPUT PARAMETERS - GROUNDWATER INHALATION
NWS EARLE, COLTS NECK, NEW JERSEY

Inhalation of Volatile Emissions During Showering (Residential adults only)				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximu value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a, 1993) Used to calculate volatile chemical generation rate (ug/cu. m/min)
H	Henry's law constant	Contaminant-specific	Contaminant-specific	Required for model application
Kg, Kl	Gas and liquid phase mass transfer coefficients	Contaminant-specific	Contaminant-specific	Required for model application
Ds	Shower duration	15 minutes	7 minutes	(EPA,1991a)
Dt	Total time in bathroom	20 minutes	11 minutes	Professional judgement
Sv	Shower room air volume	6 cu. m	6 cu. m	Professional judgement
FR	Shower flow rate	20 L/min	20 L/min	Professional judgement
Ts	Shower water temperature	318 degrees Kelvin	318 degrees Kelvin	(Foster and Chrostowski, 1987)
Ra	Air exchange rate	0.01667/min	0.01667/min	(Foster and Chrostowski, 1987)
IR	Inhalation rate	14 L/min	14 L/min	(EPA, 1989a)
EF	Exposure frequency	0.96/day	0.96/day	One shower per day, 350 days/year (EPA, 1991a)
ED	Exposure duration	30 years	9 years	90th / 50th percentile at one residence (EPA, 1989a, 1993)
BW	Body weight	70 kg	70 kg	Conventional (EPA, 1989a)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

employees would not shower at the workplace on a frequent basis is consistent with the worker habits of the vast majority of the working population and with typical behavior patterns in the occupations listed in Section 2.4.3.2.) EPA input parameters were used.

Surface Water Exposure

Two potential exposure routes are associated with surface water exposure at the NWS Earle sites: ingestion and dermal contact during wading. The methods used to assess these routes of exposure are discussed in the following text. These scenarios were evaluated in the same way as ingestion and dermal exposures for groundwater, which were explained in the previous section.

Sample calculations are provided in Appendix I. The input parameters for this exposure route, along with the rationale for the selection of each value, are presented in Table 2-22 (ingestion) and Table 2-23 (dermal). As discussed in Section 2.4.3, the potential receptors were children weighing 30 kilograms who play at the site. The input parameters for surface water are the same as those for groundwater, with notable exceptions. Children involved in wading activities would be expected to be older than the typical 15-kilogram child (approximately 3 years old). Therefore, the recreational child in the wading scenario was assumed to play at the site over a 6-year period (age 6 through 12 years, weighing 30 kilograms). Exposure to sediment during wading was expected to involve the feet only.

Blood-Lead Modeling

As outlined in OSWER directive 9355.4-12, EPA has implemented an approach to evaluating lead risks that recognizes the multimedia nature of lead exposures, incorporating absorption and pharmacokinetic information. Research has been done concerning lead intake and resultant blood-lead levels. Determinations of lead uptake from soil, sediment, drinking water, and surface water were considered. For the purposes of this risk assessment, each pathway was evaluated separately so that the contribution of lead from each source and each exposure route could be evaluated. Potential blood-lead level increases were estimated and are discussed, along with the potential implications of blood-lead results for each NWS Earle site. The following paragraphs present information that is useful in estimating lead exposure.

No threshold has been defined for effects related to blood-lead increases. The estimated increases at this site are well below the concentrations at which effects such as anemia and neuropathy occur (40 ug/dL and above) (Doull et al., 1986). Effects below 10 ug/dL are difficult to define. Inhibition of certain enzymes involved in red blood cell metabolism has been reported to occur at 10 to 15 ug/dL and possibly lower (EPA, 1991e). Small increases in blood pressure have been related to adults with blood-lead levels down to 7 ug/dL (EPA, 1991e). Probably the most sensitive subpopulation to effects at the 3 to 7 ug/dL range (where the concentrations estimated for this study area would fall) would be infants, whose early neurological development can be affected by blood-lead concentrations reportedly down to 5 ug/dL (EPA,

TABLE 2-22
EXPOSURE INPUT PARAMETERS - SURFACE WATER INGESTION
NWS EARLE, COLTS NECK, NEW JERSEY

Incidental Ingestion of Surface Water (Recreational Children)				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a; 1993)
IR	Ingestion rate	0.2 L/day	0.2 L/day	(EPA, 1989a)
EF	Exposure frequency	7 days/year	7 days/year	(EPA, 1989a)
ED	Exposure duration	6 years	2 years	RME - (EPA, 1991a) Central tendcy. - prof. judgement
BW	Body weight	25 kg	25 kg	Professional judgement, child age 6 or older (EPA, 1989b)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)

TABLE 2-23
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

Dermal Contact with Surface Water				
Input Parameter	Description	Parameter Value		Rationale
		RME	Central Tendency	
C	Exposure concentration	Representative concentration (mg/kg) Upper 95% UCL or maximum value (whichever less)	Representative concentration (mg/kg) Upper 95% UCL or average value (whichever less)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a; 1993)
SA	Skin surface area available for contact	3,580 sq. cm/day	3,580 sq. cm/day	Wading: legs, feet, and hands (EPA, 1989b)
ET	Exposure time	2.6 hours/day	2.6 hours/day	(EPA, 1989a)
EF	Exposure frequency	7 days/year	7 days/year	(EPA, 1989a)
ED	Exposure duration	6 years	2 years	RME - (EPA, 1991a) Central tendcy. - prof. judgement
BW	Body weight	25 kg	25 kg	Professional judgement, child age 6 or older (EPA, 1989b)
AT	Averaging time	ED x 365 days/year	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	70 years x 365 days/year	Carcinogens (EPA, 1989a)
K, Kp	Permeability coefficients (cm/hour)	Contaminant-specific	Contaminant-specific	(EPA, 1992f)
TAU	Lagtime (hours)	Contaminant-specific	Contaminant-specific	(EPA, 1992f)
B	Partition coefficient	Contaminant-specific	Contaminant-specific	(EPA, 1992f)

1991e). Lead is also a fairly common environmental contaminant and, for this reason, typical blood-lead levels in the population at large may already exceed the concentrations discussed here.

For drinking water exposure, children 0 through 6 months old are expected to experience blood lead increases at the rate of 0.26 ug/dL per ug/L lead in water up to 15 ug/L and at the rate of 0.04 ug/dL for every ug/L lead in water above 15 ug/L (EPA, 1991e). For older children, the ratio is 0.12 ug/dL blood lead per ug/L lead in water up to 15 ug/L and 0.06 ug/dL for every ug/L lead in water above 15 ug/L (EPA, 1991e). For adults, the ratio is approximately 0.06 ug/dL blood lead per ug/L in water (EPA, 1991e).

Dietary intake of lead is assumed to produce increases of 0.02 to 0.04 ug/dL blood lead per ug/day ingested by adults and 0.16 ug/dL blood lead per ug/day ingested by infants (EPA, 1986a).

Blood-lead levels are estimated to increase by 0.6 to 6.8 ug/dL per 1,000 mg/kg lead in soil (EPA, 1986a).

Estimates of blood-lead levels in residential children (age 0 through 6 years) were made using the Integrated Exposure and Uptake Biokinetic (IEUBK) Model (version 0.99) developed by EPA. The model was applied to any site where at least one of the media (surface soil, subsurface soil, or groundwater) was sampled and at least one detection of lead was present. Note that the model was run more than once for a site whenever two distinct exposure scenarios were considered (e.g., future exposure to surface soil; future exposure to subsurface soil that becomes surface soil). If groundwater was not sampled at a site, then the concentration of lead in background groundwater samples was used as the input into the IEUBK Model. Conversely, the concentration of lead in background soil was used as input into the model when neither surface nor subsurface soil was sampled at a site. The output for each run of the IEUBK Model is a histogram that presents the estimated percentage of residential children (age 0 through 6 years) with a blood-lead level above 10 ug/dL (considered to be the significance cutoff level above which adverse effects cannot be ruled out). When the percentage of the population estimated to have blood-levels above 10 ug/dL is greater than five percent, then EPA considers the potential for adverse effects to be significant (EPA, OSWER 9355.4). These histograms, along with input information particular to each run of the IEUBK model, are presented in Appendix I. The estimated percentage of residential children (age 0 through 6 years) with a blood-lead level above 10 ug/dL is also presented in the site-specific text contained in subsequent sections of this report. Uncertainties associated with the IEUBK model are discussed in Section 2.4.4.3.

2.4.4 Risk Characterization

Potential human health risks resulting from the exposures outlined in the preceding sections are characterized on a quantitative and qualitative basis in this section. Quantitative risk estimates are generated based on risk assessment methods outlined in current EPA guidance (EPA, 1989a).

2.4.4.1 Determination of Risks

Noncarcinogenic risk estimates are presented in the form of Hazard Quotients (HQs) and Hazard Indices (HIs) that are determined through comparison of estimated intakes with published RfDs. Incremental cancer risk estimates are provided in the form of dimensionless probabilities based on SFs.

Estimated human intakes were developed for each of the specific exposure routes discussed in the preceding sections. Both carcinogenic and noncarcinogenic risks are summarized for each exposure route on a series of tables in this section.

Carcinogenic Risks

Incremental cancer risk estimates are generated for each of the exposure pathways using the estimated intakes and published SFs, as follows:

Risk = Intake x SF

If the above equation results in a risk greater than 0.01, the following equation is used:

Risk = 1 - [exp-(Intake x SF)]

The risk determined using these equations is a unitless expression of an individual's increased likelihood of developing cancer as a result of exposure to carcinogenic chemicals. An incremental cancer risk of 1E-06 indicates that the exposed receptor has a one in a million chance of developing cancer under the exposure assumptions defined for that receptor. These specific assumptions for exposure frequency, duration, and dose represent a reasonable maximum exposure (RME) estimate (defined as the highest exposure that is reasonably expected to occur at a site). The calculated cancer risks should therefore be recognized as upper-limit estimates. SFs are the upper 95 percent confidence limit of a dose-response curve generally derived from animal studies. Actual human risk, while not identifiable, is not expected to exceed the upper limit based on the SFs and may, in fact, be lower.

For each chemical, carcinogenic risks are calculated separately (using different SFs) for oral, inhalation, and dermal exposures. Carcinogenic risks for ingestion, inhalation, and dermal exposures are then summed for each receptor exposure pathway and compared to target risk ranges.

In the National Contingency Plan, EPA has defined risks in the range of 1E-04 to 1E-06 as being acceptable for most hazardous waste facilities addressed under CERCLA. For CERCLA activities, residual risks on the order of 1E-06 are the primary goal but are often modified by such regulatory requirements as MCLs or chemical-specific clean-up goals.

Noncarcinogenic Risks

Noncarcinogenic risk is assessed using the concept of HQs and HIs. The HQ is the ratio of the estimated intake and the RfD for a selected chemical of concern, as follows:

HQ = Intake/RfD

HIs are generated by summing the individual HQs for the COPCs. If the value of the HI exceeds unity (1.0), the potential for noncarcinogenic health risks associated with exposure to that particular chemical mixture cannot be ruled out (EPA, 1986b). In that case, particular attention should be paid to the critical effects (i.e., the most sensitive toxicity effects that were selected as the basis for the RfD) and the associated target organ(s) affected by each chemical. In particular, it should be noted that toxic effects for different organs are not truly additive. Thus, the HI is not a mathematical prediction of the severity of toxic effects; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

Lead Risks

EPA's approach to evaluating lead risks goes beyond providing a single point estimate output and incorporates absorption and pharmacokinetic properties. Section 2.4.3.4 discusses background information related to blood-lead estimation methods. Soil concentrations for lead were compared to the value of 400 ppm as discussed in OSWER directive 9355.4-12, and groundwater results were compared to the 15 ug/L EPA action level. Results above these guidelines are assessed for each applicable NWS Earle site.

2.4.4.2 Receptor Risks

Receptor risks are presented for each NWS Earle site in the form of tables and summary text. Each of these sections includes summaries of risks estimated by the exposure scenarios. It should be noted that, in each risk summary table where HQs are reported as "N/A," the HQs were not calculable because no RfD has been established. Usually in such cases, carcinogenicity is considered to be more important, since carcinogenicity will generally be seen at lower doses than noncarcinogenic effects. Cancer risks of zero or "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed. Non-cancer risks which have been grouped according to target organ indicate "N/A" for cases where the literature indicates a potential toxic effect for that organ but no RfD has been established.

2.4.5 Risk Assessment Uncertainties

As discussed in EPA (1989a), the risk measures used in Superfund site risk assessments are not fully probabilistic estimates of risk but rather are conditional estimates based on a considerable number of assumptions about exposure and toxicity. There are uncertainties associated with each aspect of risk

assessment, from environmental data collection through risk characterization. To support decision-making processes, significant uncertainties in the risk assessment for NWS Earle are noted in the following sections.

2.4.5.1 Uncertainties in the Physical Setting and Receptor Exposure Pathways

Land Use Designation

Reliable information on current land uses at NWS Earle sites (discussed in Section 1.3 and in each site evaluation) was gathered from previous investigations and from communications with Navy personnel. Many areas are within explosive safety zones that prohibit offices or residential dwellings, but eight NWS Earle sites are within areas allowing administrative or housing land uses. Although future residential and future industrial land use scenarios were both considered in the risk assessment for each NWS Earle site, the Navy believes it is unlikely that future land use would vary significantly from current descriptions unless a major base realignment were to occur.

Receptor Pathways and Activity Patterns

Sections 2.4.3.2 and 2.4.3.3 discuss the rationale for including specific potential receptors and exposure routes by medium. Based on known and projected activity patterns, current and future receptors in the NWS Earle setting were considered to engage in a range of activities adequately approximated by default exposure parameter assumptions. For the future industrial worker, a separate exposure pathway was not included for workers engaged in soil-contact-intensive activities (this scenario is compared to the soil noncontact-intensive scenario as part of the discussion of intake parameter uncertainties). In addition, a separate hunter scenario was not considered, for the reasons discussed in Section 2.4.3.2.

2.4.5.2 Environmental Data Collection Uncertainties

Selection of Locations and Number of Samples

For each site, the areal extent of the samples (including the number collected and location of the sampling points) in a particular medium impacts the calculation of representative concentrations. Every effort was made to collect samples that reflect actual site conditions and to include areas thought to contain the most significant contamination or exposure problems. Therefore, the magnitude of this uncertainty on risks is expected to be low because, during the planning stages of the RI, the quantities of samples to be collected were selected to allow a reasonable characterization of site-related contamination.

Focused, Nonrandom Sampling

At certain NWS Earle sites, areas of concern were previously identified that are currently slated to undergo remediation/removal. The use of biased sampling in the 1995 RI allows the risk assessment calculations to focus not on these areas but on data gaps and other surrounding potentially affected areas. This does not increase the uncertainty in the risk assessment per se but instead makes the risk assessment conditional on the assumptions of a planned clean-up action.

Selection of Samples with Naturally Occurring Background Levels

As discussed in Section 31, background samples were collected in order to measure the range of concentrations of substances in each medium that are associated with non-site-related sources within the vicinity of NWS Earle. The diversity and abundance of inorganics in soil and sediment samples are determined by the soil's content in bedrock or other deposits, the effects of climatic and biological factors, and agricultural and industrial influences. However, if native soil types are encountered in site-related samples that are unlike those of background samples, then the evaluation of naturally occurring levels could be biased and might lead to overestimation of the amount of contamination attributable to NWS Earle activities.

The abundance of inorganics in groundwater is determined by, among other things, the particular geological formation in which the well is screened. If monitoring well results from a particular NWS Earle site are compared to background wells situated in a different formation, then this could lead to an over- or underestimation of the amount of contamination attributable to NWS Earle activities. The amended risk assessment (Section 2.4.6) provides an evaluation of background groundwater samples grouped by formation in order to minimize the chances of this type of bias.

2.4.5.3 Analytical Data Uncertainties

Incorporation of Data from Different Investigations

Analytical data were evaluated from the 1992 RI and the 1995 RI. The impact of including both data sets in fate and transport evaluations at many sites and of using the older 1992 RI data for risk assessment at one site is considered to be minimal because analytical methods were generally similar and both data sets were subjected to laboratory QC review and data validation processes.

Analytical Data Usability

Established data validation procedures were applied to define analytical uncertainties in terms of qualifying data as inaccurate or imprecise and to eliminate data points that are unusable for risk assessment. This treatment does not eliminate all uncertainty but focuses attention on potential areas of concern regarding

accuracy, precision, and data gaps. As discussed in Section 2.5, the overall percentages of rejected data points were acceptably low on a site-by-site basis, and data rejection was limited to substances that were neither associated with site activities nor present at high levels.

2.4.5.4 Data Evaluation Uncertainties

Accuracy of Upper Tolerance Limits Used in Background Comparisons

When a limited number of points are sampled, reduced accuracy is expected for the upper 95 percent tolerance limit. In such cases, this statistic is still expected to, on the average, estimate the upper 95 percentile of the population. However, for an individual case, the true percentage of the population that exceeds the calculated tolerance limit will be more likely to differ markedly from the predicted five percent when too few samples are collected. In the event that the upper 95 percent tolerance limit for background samples is overestimated, this could defeat the attempt to identify site-related samples with levels greater than naturally occurring background and may lead to an underestimate of the risk attributable to a site. To avoid this consequence, the amended risk assessment restricted the application of the upper tolerance limit approach when there were only two or three background samples and the tolerance limits were computed to be inappropriately large.

Statistically Representative Exposure Concentrations

Uncertainties exist regarding selection of a concentration for input into the quantitative risk assessment. The use of the representative concentration to estimate risk is generally regarded as a conservative estimate since this entails using either the upper 95 percent confidence limit on the arithmetic mean (based on normal or log-transformed data distribution) or the maximum concentration. The choice of the representative concentration as the value for input into the risk assessment generally lowers the chances of under estimation of the actual risk present in a pathway at a particular site to a potential receptor. However, the use of the representative concentration may overestimate the actual risk present in an exposure pathway at a particular site. To help avoid this problem, the maximum value was used in place of the upper 95 percent limit when the latter was larger. As an additional step, if the initial risk calculation yielded a borderline high risk, the amended risk assessment provided a supplemental risk calculation using a central tendency approach, which utilizes the arithmetic average rather than the maximum value as the alternative to the statistically derived exposure concentration.

Distributional Shape of the Sample Population

The ability (power) of the W test to be able to correctly identify genuine differences between the shape of a sample population versus a reference normal or lognormal population is reduced when too few samples are collected. If an incorrect distributional assumption is made based on this test, this could lead to an over- or underestimate of the upper 95 percent concentration, which in turn would create some

additional uncertainty as to whether the calculated risk is a reasonable approximation of high end exposure. To help avoid potentially overestimating risk, the maximum value was used in place of the upper 95 percent limit when the latter was larger.

2.4.5.5 Exposure Model Applicability and Assumptions

Uncertainties in Chemical Specific Properties

The chemical-specific parameters such as Koc were literature-derived values that are measured under conditions that may or may not be representative of on-site conditions. Parameters such as vapor pressure and solubility were not always obtainable at the desired temperature.

Groundwater Concentration Uncertainties

Uncertainties associated with the lack of groundwater modeling at the site include the assumption that current conditions are indicative of future concentrations of contaminants. Contaminants may increase (due to migration, loading, or chemical transformation) or decrease (due to migration or transformation) over time and vary from site to site and within the mixing zone.

The use of unfiltered monitoring well data for the evaluation of groundwater inorganics provides in all probability an overestimation of exposure and risk. Comparison with the filtered data reveals how many of the metals may have been attributable to suspended sediment.

Fugitive Dust Emissions Model Assumptions

Exposure to fugitive dust emissions conservatively assumes that residents and workers will be exposed to the same concentration indoors as outdoors (a very conservative assumption), that soils within an area have unlimited erosion potential, that emissions can be estimated from mean annual windspeed and vegetative cover, and that dispersion concentrations can be estimated from source area, downwind distance to receptors, and region-wide meteorological factors. For receptors exposed to fugitive dust emissions, it was assumed that future conditions would approximate present conditions in terms of the estimated fraction vegetative cover. If future vegetative cover changes, then dust exposures could be lower or higher than estimated by the model. However, the impact of this error would not be significant because a worst-case (no vegetative cover) scenario would only increase exposures calculated by the model by a factor of 5, while inhalation exposures at NWS Earle sites were estimated as several orders of magnitude below levels of concern.

Future Subsurface Soil Disturbance and Exposure

For the future industrial and future residential receptors, the use of current subsurface soil concentrations to represent future surface soil concentrations assumes two things that add to the uncertainty of this risk assessment: that soil would erode or be excavated to the sampling depth that, once the soil is eroded or excavated to the subsurface soil sampling depth, no degradation of the chemicals in the future surface soil would take place. These uncertainties may cause overestimation of the exposure at a particular site.

Soil Dermal Absorption Model Applicability

The model for dermal exposure to soil and sediment assumes that only a very thin, constant thickness layer of soil is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil concentration, will be absorbed per unit area of skin and per exposure event. However, adherence to skin varies with such factors as particle size, soil type, and organic carbon content. As estimated by EPA (1992e), the absorbed dermal dose could vary by as much as a factor of 50 from the model estimates, even assuming that activity patterns lead to the exposure duration applied in the experimental trials used to develop absorption factors. Because of the lack of reliable data regarding dermal absorption factors, the amended risk assessment provides dermal soil exposure estimates only for three chemicals for which well documented absorption factors are available (arsenic, cadmium, and PCBs). Even so, considerable uncertainty exists with the accuracy of estimates applied for these three chemicals. For other chemicals, the initial risk assessment calculations included estimates of dermal exposure using chemical class-specific absorption factors that are to be considered even more uncertain and useful primarily for a qualitative assessment of dermal exposure.

Dermal Absorption from Contaminant Exposures in Aqueous Media

Prediction of absorption rates for lipophilic compounds is difficult due to, among other reasons, the possibility of a second absorption pathway that depends on the lipid content of the stratum corneum at the application site. Experimental determination of absorption rates indicates that interspecies differences are considerable, which, along with other variabilities related to condition and age of skin, differences in lag time, and site of application effects, yields appreciable uncertainty in estimated dermal exposures by using published chemical-specific permeation functions. In addition, literature data indicate a variation by as much as a factor of 300 in chemical absorption rates for skin in different anatomical areas of the body. It should also be noted that children generally have greater absorption rates than adults.

Model Assumptions for Inhalation of VOCs During Showering

Uncertainties exist in the exposure model for the inhalation of volatiles during showering such as chemical-specific rates of volatilization, droplet size, and droplet residence time in the shower. Most of the inputs into the models were considered conservative; therefore, the output may overestimate the exposure for this route.

2.4.5.6 Exposure Intake Parameter Uncertainties

Standard Default Exposure Assumptions

Exposure assumptions can add uncertainty into the risk assessment process based on input values selected for each exposure route. For example, not all people weigh 70 kilograms, drink 2 liters of water per day, and live at the same residence for 30 years. The rationale for each assumption was provided in each table of input parameters. Receptor characteristics, such as age and body weight, were based on published values. Conservative values (based on reasonable maximum exposure or professional judgment) were used in most exposure equations, except where average values were expected to better correspond to actual site conditions.

Soil Ingestion Rates

In the case of current and future occupational workers, soil ingestion rates were based on noncontact-intensive activities described in Section 2.4.3.2. A higher level of short-term incidental soil ingestion by NWS Earle workers could occur as a result of soil-contact-intensive activities such as excavation, underground utility work, road repair/construction, and heavy landscaping (tree and shrub planting, drainage routing, land re-sloping, or embankment construction). However, contact-intensive activities are typically event driven or seasonal and so should average out to less than 6 months duration per year for a given worker. Assuming that exposures that are equal in terms of total dose over time are equivalent in their potential to cause an effect (i.e., Haber's Rule), a noncontact intensive, 100 mg/day incidental soil ingestion rate averaged over 250 days per year might provide an order-of-magnitude similar risk as an annual exposure comprised of 6 months at a 100 mg/day ingestion rate plus 6 months at a higher (480 mg/day) soil ingestion rate (EPA, 1991i; EPA, 1992i).

2.4.5.7 Toxicity Assessment Uncertainty

There is uncertainty associated with the RfDs and SFs. The uncertainty results from the extrapolation of animal data to humans, the extrapolation of carcinogenic effects from the laboratory high-dose to the environmental low-dose scenarios, and interspecies and intraspecies variations in toxicological endpoints caused by chemical exposure. The use of EPA SF values is generally considered to be conservative

because the doses are based on no-effect or lowest-observed-effect levels and then further reduced with uncertainty factors to increase the margin of safety by a factor in the neighborhood of 10 to 1,000-fold. The RfDs and SFs of some chemicals have not been established, and therefore toxicity could not be quantitatively assessed. In most cases, where RfDs were unavailable for carcinogens, the carcinogenic risk is considered to be much more significant since carcinogenic effects usually occur at much lower doses.

Additional uncertainties were associated with the adjustment of oral dose-response parameters for dermally absorbed doses. As noted, when absorption factors were not available, the chemical was assumed to be 100 percent absorbed during the RfD or SF study. While this is likely to be realistic for volatile compounds, the assumption could be underprotective for chemicals absorbed less than 100 percent.

For six chemicals (coded with a "W" in Table 2-11), toxicity constants were utilized that have been withdrawn from IRIS, pending further agency review. In these cases, there may be additional uncertainty in the associated SFs or RfDs, based on the original or new studies that were the basis for considering a reevaluation of toxicological properties. If the uncertainty related to using a withdrawn toxicity constant is critical (i.e., found to drive a significant risk at a site), then additional information be can obtained on the exact reasons for withdrawl from the EPA Environmental Criteria and Assessment Office (ECAO), Cincinnati, Ohio.

2.4.5.8 Risk Characterization Uncertainty

From a toxicological standpoint, it is not strictly correct to add HQs for a total HI, because RfDs are based on effects to various target organs. However, if the HI is less than 1.0, this demonstrates that, even when this conservative calculation is performed, the noncarcinogenic HI does not indicate a hazard for a particular exposure pathway. This is a conservative approach that will generally overestimate the HI for a particular pathway. To reduce the extent of overestimation when significant risks occurred at a site, a less conservative approach was used in the amended risk assessment wherein noncancer risks were grouped and summed together for only those chemicals affecting the same target organ/organ system. One additional source of uncertainty in the HI approach is that these models assumed that chemicals did not interact synergistically (a possible underestimate of the actual risk) or antagonistically (a possible overestimate of the actual risk).

2.4.5.9 IEUBK Modeling Uncertainty

The IEUBK model accounts for the multimedia nature of lead exposure, incorporates absorption and pharmacokinetic information, and allows the risk manager to consider the potential distributions of exposure and risk likely to occur at a site (the model goes beyond providing a single point estimate output). Although uncertainties are associated with blood lead modeling using the IEUBK model, these uncertainties are considered lower than those that conceivably would result from similar lead evaluations

performed using a traditional toxicity slope-based approach. Important uncertainties and limitations in the use of the IEUBK model are as follows:

The IEUBK model is predictive of blood lead for residential children in the range of 6 months to 7 years of age, which typically is considered to be a more sensitive subpopulation than adults. The model does not apply to adults in either residential or occupational settings. In addition, the IEUBK model does not predict the blood lead levels of pregnant women and does not include an exposure component based on the transfer of lead from the mother's blood to the fetus before birth, although a significant potential exists for adverse effects of prenatal lead exposure on neurobehavioral and physical development (EPA, 1994a).

The IEUBK model uses a default of 30 percent lead absorption from soil. However, the bioavailability of lead from different sources may be variable due to differences in lead speciation, particle size, and mineral matrix and may also vary as a function of physiological parameters such as age, nutritional status, gastric pH, and transit time. For example, lead absorption from paint chips in soil may be different than lead absorption from other chemical forms.

Blood lead variability in the IEUBK model is characterized by a single number, the geometric standard deviation, which is set to a default value of 1.6. This value represents the aggregate uncertainty in all sources of population variability, including biological, uptake, exposure, sampling, and analytical components.

Child blood lead level predictions obtained using the IEUBK model reflect only the contributions of sources entered into the model and do not take into account any existing body burden that may be the result of prior exposures or any exposures that may have taken place at alternate locations away from the household or neighborhood level, such as parks or daycare centers.

2.4.6 Amended Risk Assessment

In some cases, if the result of the conservative baseline risk was in excess of the guideline range (1×10^{-4}) for cancer risk or a value of one for noncancer risk for any receptor pathway, additional analysis was performed according to EPA Region II guidance in order to refine the site-specific risk estimate. This refinement was carried out in three discrete steps, consisting of comparisons to background, consideration of modified dermal absorption and target organ grouping, and application of central tendencies guidance. As explained below, the results of each step were evaluated sequentially before a decision was made to proceed to the following step for a site. Table 2-24 summarizes the decision sequence applied to each receptor, for each exposure medium, and Table 2-25 presents a matrix showing the additional risk assessment steps applied to each NWS Earle site.

Table 2-24

Decision Sequence for the Amended Risk Assessment

Decision Criteria for Each Receptor	Actions Taken
Is the sum of risks from all exposure routes for one medium (e.g., groundwater) > target range? (cancer risk sum > 1E-04 or 1.0 HIs sum > 1.0)	All risks will be revised for that receptor/medium combination (e.g., industrial receptor, groundwater ingestion, dermal, and inhalation)
Is any COPC metal concentration less than twice background or < background UTL?	Eliminate COPC from consideration in cancer and non-cancer calculations unless compound is Class A carcinogen
Are cadmium, arsenic, or PCBs present?	Revise soil-to-skin dermal absorption factors and GI absorption factor (cadmium, dermal). Delete all other dermal COPCs in soil/sediment
After the above steps, is the sum of the HIs from all exposure routes for one medium > 1.0?	Group HIs by target organ for the exposure route (e.g., ingestion) that contributes to the exceedance of sum of HIs
Is the revised sum of cancer risks from all exposure routes for one medium > 1E-04?	Perform central tendency calculation of cancer risk for that receptor/medium combination for all exposure routes
Is the revised sum of HIs from all exposure routes for one medium > 1.0?	Perform central tendency calculation of non-cancer HIs for that receptor/medium combination for all exposure routes

Table 2-25
Components of the Amended Risk Assessment for Each Site
CTO 231, NWS Earle

Site Number	Groundwater				Surface Water				Subsurface Soil				Surface Soil				Sediment			
	COPC Background Tests	Modified Dermal Absorption	Target Organ Grouping	Central Tendency Risk	COPC Background Tests	Modified Dermal Absorption	Target Organ Grouping	Central Tendency Risk	COPC Background Tests	Modified Dermal Absorption	Target Organ Grouping	Central Tendency Risk	COPC Background Tests	Modified Dermal Absorption	Target Organ Grouping	Central Tendency Risk	COPC Background Tests	Modified Dermal Absorption	Target Organ Grouping	Central Tendency Risk
01	R,I	R,I	R,I	Rcn, In					R	R	R	NA								
02	R,I	NA	R,I	Rn, In									NA	NA	NA	NA				
03	R,I	R,I	R,I	Rn													NA	NA	NA	NA
04	R	NA	R	Rcn	NA	NA	NA	NA									NA	NA	NA	NA
05	R,I	R,I	R,I	Rcn																
06	R,I	NA	R	Rcn, Ic	NA	NA	NA	NA									NA	NA	NA	NA
07	R	NA	R	Rn													NA	NA	NA	NA
10	R	NA	NA	NA																
11	R	NA	NA	NA																
12													R,I	R,I	R	Rn	NA	NA	NA	NA
13	R,I	R,I	R,I	Rcn, Icn	NA	NA	NA	NA									NA	NA	NA	NA
15					NA	NA	NA	NA	R	R	R	Rn	R	R	R	Rn	NA	NA	NA	NA
16	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	R,I	R,I	R	Rcn, In	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA	NA
19	R,I	R,I	R,I	Rcn, In	NA	NA	NA	NA	R	R	NA	NA					NA	NA	NA	NA
20									NA	NA	NA	NA	R,I	R,I	R	NA	NA	NA	NA	NA
22									R,I	R,I	NA	Rc					NA	NA	NA	NA
23	R,I	R,I	R,I	Rcn, Icn	NA	NA	NA	NA	R,I	R,I	R	Rcn, Ic					NA	NA	NA	NA
24									NA	NA	NA	NA								
25									NA	NA	NA	NA								
26	R,I	NA	R,I	Rcn, In					R	R	NA	Rc								
27									R,I	R,I	NA	Rc								
29	R,I	NA	R,I	Rn, In					NA	NA	NA	NA								
WS					NA	NA	NA	NA									NA	NA	NA	NA
_L													R	R	NA	Rc				
_Q	NA	NA	NA	NA					NA	NA	NA	NA					NA	NA	NA	NA

NOTE: This table includes only sampling media used for quantitative risk calculations at NWS Earle Sites.

R - *Amended risk component* applies to residential receptor.

I - Amended risk component applies to industrial receptor.

c - Amended risk component applies to cancer risk.

n - Amended risk component applies to non-cancer hazard index.

NA - Amended risk component not required for this receptor/medium

2.4.6.1 Comparison to Background

To further eliminate naturally occurring metals from consideration in the human health risk assessment, two types of background comparisons were applied to eliminate COPCs (with the exception of arsenic, which could not be excluded from risk calculations because this metal is considered a Class A carcinogen). Nondetected results were replaced by one-half the detection limit before conducting background comparison tests.

Monitoring well results for a particular NWS Earle site were compared to data from the corresponding background well group. For the groundwater pathway, monitoring wells that are upgradient from individual NWS Earle sites were grouped according to interpreted aquifer (see Section 31.2). This resulted in three background groundwater groups, comprising the following formations: Cohansey Sand, Kirkwood Formation, and Vincentown Formation; Red Bank Sand and Navesink Formation; and fill and Englishtown Formation. Site related results from other media (soil, surface water, etc.) were compared to the established base-wide background sample results from the same media.

Comparison of Site Mean to Background Mean

Using a background comparison test recommended by EPA Region II, a metal was excluded from further consideration as a COPC if the arithmetic mean of the site data was not greater than twice the arithmetic mean of the background. (Unlike the parametric statistical test of means discussed in Section 2.4.1.2, the Region II test criterion is not dependent on the number of sampling points.) The results of these comparisons are presented in the tables of inorganic occurrence and distribution data for each site.

Comparison of Site Maximum Result to Background Upper Tolerance Limit (UTL)

A second comparison was also performed in which additional metals were eliminated as COPCs if the maximum of the site results was not greater than the upper 95 percent tolerance limit (UTL) on the background data. The 95 percent UTL is defined as the calculated upper limit which, on the average, will be expected to include 95 percent of the background population. This limit was calculated using the t-distribution and assumed a lognormal population (geometric mean and log standard deviation), except in cases where the background data acceptably fit a normal distribution and had a distributional shape that more closely matched a normal rather than lognormal population (based on the W-test). The 95 percent UTL statistical evaluations of the three groundwater data groups are presented in Section 31.2. For two of the background groundwater groups, the number of points was too small to allow a powerful statistical test. The 95 percent UTL comparison was also performed on background subsurface and surface soil samples.

2.4.6.2 Consideration of Modified Dermal Absorption and Target Organ Grouping

If, after the evaluation of background data, the baseline risk was in excess of the guideline range (1×10^{-4}) for cancer risk or a value of one for noncancer risk for any receptor pathway, two additional risk assessment procedures were conducted, involving modification of dermal absorption calculations and grouping of noncancer risks for summation by target organ.

Modified Dermal Absorption

Based upon evaluation of recent EPA guidance and memoranda (EPA, 1992f; EPA, 1993e), EPA Region II recommends quantitative evaluation of dermal exposure to soil/sediment only for five chemicals. Of these chemicals, only arsenic, cadmium, and PCBs were detected at NWS Earle sites. Therefore, cancer and noncancer risks for the dermal soil/sediment pathways were recalculated to exclude COPCs other than these three chemicals. In addition, the soil-to-skin absorption factors for the above three chemicals were modified (EPA, 1993e) and a revised value was applied to cadmium for the gastrointestinal (GI) absorption fraction, which is used to extrapolate dermal toxicity constants from oral toxicity constants. In general, this resulted in lowered risk estimates for the soil and sediment dermal pathways.

Grouping of Noncancer Risks for Summation by Target Organ

To account for the potential additivity of exposures to multiple chemicals, noncancer risks were grouped and summed together by target organ/organ system. Summed noncancer risks with HI greater than one are identified and discussed in the amended risk assessment. Note that, for target organs belonging to the same organ system (for example, heart and hematopoietic system are both part of the cardiovascular system), effects were considered as additive for the purposes of this amended baseline risk assessment.

The target organ approach is less conservative than an initial screening approach that would assume that all noncancer exposures are additive.

Table 2-13 presents available data for the principle target organs affected by chronic exposure to each substance detected at NWS Earle. These data have been extracted from the toxicological profiles presented in Appendix I and from IRIS and Heast. Only the target organs considered to be affected by chronic (as opposed to acute) exposures have been included in this table. The table distinguishes effects that are cited only for one route of exposure (for example, inhalation) when RfDs exist for more than one route of entry. When multiple target organs may be affected, the critical effect that is the basis of the RfD can be examined for that chemical (see Appendix I).

2.4.6.3 Application of Central Tendencies Guidance

If, after application of the above steps, 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, then a further calculation of risk was performed using central tendency assumptions (EPA, 1993a). 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 can be considered alongside the RME risk and used in the decision-making process to help evaluate the need for remedial actions. The default exposure assumptions used for evaluation of central tendency risks are presented in Tables 2-14 through 2-23 alongside the counterpart exposure assumptions that were used for the initial RME risk evaluation.

2.5 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

The objective of this section is to evaluate data quality of field quality control blanks, field duplicate precision, laboratory quality control analyses and precision, accuracy, representatives, comparability, and completeness (PARCC).

2.5.1 Field Quality Control Blanks

Field quality control blanks are generally used to measure success of the program to avoid extraneous contamination during sample collection, storage, and transport. Possible contaminant sources within the field sampling process may include bottleware, sampling equipment, rinsate water, solvent vapors, and items (e.g., gloves) that may contact samples or sample containers.

Field Blanks

Field blanks were obtained to estimate incidental or accidental contamination from field sampling techniques and to determine if cross-contamination of samples had occurred. Field blanks were taken separately from each source of equipment decontamination water (potable water and bottled deionized water) and analyzed for TCL volatiles, semivolatiles, and pesticides/PCBs; selected explosives; TAL metals and cyanide; hexavalent chromium; and other miscellaneous (wet chemistry) parameters in accordance with NFESC guidelines.

Trip Blanks

Trip blanks were used to determine if contamination was introduced during sample storage and transport. Trip blanks were prepared in the field each morning from analyte-free water provided by the laboratory and preserved with hydrochloric acid (HCl) (no longer than 24 hours prior to each sampling event). Trip blanks remained with the sample containers in the field at all times, were returned unopened at the conclusion of each day's field activities, and were included in each cooler of VOC samples shipped to the laboratory. Trip blanks were analyzed for TCL VOCs only.

Rinsate Blanks

The equipment rinsate blank was utilized to determine if contamination had been introduced through contact with the sampling equipment. Equipment rinsate blanks were prepared by running analyte-free water provided by the laboratory through sample collection equipment (bailer, split-spoon, hand auger bucket, etc.) after decontamination. Rinsate blanks were generated for each type of non-dedicated sampling equipment at a frequency of one per day per medium for each day of sampling and were analyzed every other day per medium. Equipment rinsate blanks were analyzed for the same suite of parameters as the associated environmental samples.

2.5.2 Discussion of Field Quality Control Blank Impact

Table 2-26 summarizes the frequency and concentration of contaminants detected in each type of field quality control blank collected at NWS Earle. In nearly all cases, blank contamination occurred at very low frequencies and was restricted to concentration ranges near the detection or quantitation limits. During data validation, the concentrations of compounds detected in laboratory and field quality control blanks were compared to concentrations found in the corresponding environmental samples to determine potential impacts on the analytical data. Organic compound results from environmental samples were qualified as "non-detected" if the compound was not found at a concentration of at least five times (10 times for certain common laboratory contaminants) the concentration in the associated blank. Inorganics were qualified as "rejected" if the analyte was found at a concentration greater than the contract-required detection limit (CRDL) and at least five times greater than the associated field blank concentration or 10 times greater than the associated laboratory blank concentration.

Metals and trihalomethanes detected in the potable water source (local tap water) field blank included calcium, iron, magnesium, sodium, chloroform, bromodichloromethane, and dibromochloromethane, among other compounds. The detected metals mentioned are common "hard water" contaminants and the trihalomethanes are common by-products from disinfection water treatment.

Aluminum, iron, and magnesium are elements found naturally in soils and sediments and in the potable water used in the first step of equipment decontamination. Therefore, it cannot be determined whether

Table 2-26
Summary of Field Quality Control Blank Results
NWS Earle,Colts Neck, New Jersey

Analyte	Rinsate Blanks		Field Blanks (DI Water)		Field Blanks (Potable Water)		Trip Blanks	
	Frequency of Detection	Maximum Concentration	Frequency of Detection	Maximum Concentration	Frequency of Detection	Maximum Concentration	Frequency of Detection	Maximum Concentration
Metals		ug/L		ug/L		ug/L		N/A
Aluminum	6/22	51.1			1/1	23.7		
Arsenic	1/22	3.8						
Barium	1/22	0.19			1/1	39.3		
Beryllium	10/22	1.2	1/1	0.97	1/1	0.7		
Calcium	18/22	109	1/1	31.7	1/1	19600		
Chromium	1/22	0.87						
Cobalt	2/22	1.2			1/1	0.6		
Copper	5/22	11.1	1/1	2.7	1/1	11.2		
Iron	6/22	41.7			1/1	1390		
Lead	2/22	2.7			1/1	2.4		
Magnesium	14/22	137	1/1	47.5	1/1	2120		
Manganese	7/22	56.1	1/1	0.27	1/1	32.4		
Mercury	17/22	0.11	1/1	0.094	1/1	0.11		
Nickel	5/22	1.5			1/1	1.4		
Potassium	1/22	162			1/1	2160		
Selenium	1/22	3						
Sodium	8/22	5660			1/1	13500		
Thallium	2/22	6.5						
Vanadium	1/22	0.49						
Zinc	2/22	8			1/1	288		
Volatiles		ug/L		ug/L		ug/L		ug/L
Acetone	3/22	11					4/66	6
Methylene chloride	1/22	1					4/66	2
2-Butanone	1/22	4						
Chloroform					1/1	44		
Toluene	1/22	4						
Bromodichloromethane					1/1	17		
Dibromochloromethane					1/1	4		
Pesticides		ug/L		ug/L		ug/L		N/A
Alpha-BHC	1/15	0.0016						
4,4'-DDT	1/15	0.001			1/1	0.0021		
Dieldrin			1/1	0.0009				
Endrin	1/15	0.0018						
Gamma-BHC	1/15	0.0005						
Explosives		ug/L		ug/L		ug/L		N/A
Gamma-chlordane	1/15	0.0006						
Nitrobenzene	1/13	2.1						
RDX	1/13	0.4						
Miscellaneous Parameters		mg/L		mg/L		mg/L		N/A
BOD	6/8	3	1/1	4	1/1	4		
COD	1/13	2	1/1	3	1/1	2		
Chloride	7/13	2			1/1	22		
Nitrate	1/14	0.13			1/1	0.16		
Sulfate					1/1	19		
TOC	4/12	0.9			1/1	1		
Phosphate	5/13	0.4	1/1	0.3	1/1	1		
TPH	1/14	0.1						

detection of these compounds in the rinsate blank is associated with the first-step cleaning solution (potable water) or with residual soil materials left after completion of decontamination.

Methylene chloride and acetone were detected in several trip blanks and rinsate blanks at concentrations below or near the contract-required quantitation limit (CRQL). These compounds are common laboratory contaminants and were detected more frequently in laboratory blanks than in field quality control blanks. This caused many of the positive field quality control blank results for acetone and methylene chloride to be qualified as not detected due to laboratory blank contamination. The positive results in Table 2-26 represent only those compounds remaining after data validation. Methylene chloride and acetone were not used in the field; therefore, laboratory sources are likely to be responsible for the sporadic detection of low levels of these compounds in field quality control blanks.

2.5.3 Field Duplicate Precision

Field duplicate pairs were analyzed in order to assess the overall precision of the sampling and analysis process. Field duplicate pairs consisted of two field samples of identical media sampled at the same field location using the same sampling process. Duplicate pairs were stored and transported together to the laboratory for analyses. The relative percent differences (RPDs) for the duplicate pairs were calculated and reported by the laboratory and evaluated by the data validator in order to quantitate any imprecision.

In a few cases, inorganic duplicate pair results were qualified as estimated because of field duplicate imprecision. No qualifiers were required for organic field duplicates. In general, the majority of the field duplicate results exhibited acceptable precision and there were no consistent trends to indicate improper sampling technique.

Twenty-three field duplicates for VOCs, 20 for SVOCs, 12 for pesticides, 10 for PCBs, eight for explosives, and 19 field duplicates for miscellaneous parameters were collected and submitted for laboratory analysis. Seven of the 24 duplicate pairs for metals and two of the 19 duplicate pairs for miscellaneous parameters resulted in qualification of individual analytes as "J" (estimated) due to exceedance of control limits. Thirteen of 552 (2.4 percent) individual metals results and three of 111 (2.7 percent) miscellaneous parameter results were qualified "J."

2.5.4 Laboratory Quality Control Analyses

Laboratory quality control samples were analyzed as required by each specific analytical protocol and NFESC requirements. Quality control data from organic analyses included laboratory blank results, surrogate, matrix spike, and matrix spike duplicate recoveries, internal standard recoveries, initial calibration relative standard deviations and minimum response factors, continuing calibration percent differences and response factors, laboratory control spikes, mass spectral tuning ratios, clean-up column recoveries, pesticide performance evaluation recoveries, pesticide analyte degradation percentages, and

compound identification criteria (mass ratios, retention time windows, and two-column percent differences). In general, the frequency of analytical problems in each of these areas was very low and indicated overall acceptable method performance for each type of analysis. Organic analysis laboratory blanks revealed limited contamination, with low concentrations (near or below the CRQL) of common laboratory contaminants such as methylene chloride, acetone, 2-butanone, and selected phthalate esters. Sample-matrix-related interferences caused high percent differences for a few pesticide results, resulting in data qualified as estimated or rejected based upon Region II validation protocols. Analytical results were qualified as estimated for a limited number of results based upon calibration relative standard deviations or percent differences and internal standard, matrix spike, or surrogate recoveries.

Quality control data from inorganic analyses included laboratory blank results, matrix spike recoveries, laboratory duplicate RPDs, serial dilution percent differences, initial calibration, continuing calibration, and CRDL standard percent accuracies, laboratory control sample recoveries, and interference check standard accuracies. The frequency of analytical problems in each of these areas was low and indicated overall acceptable method performance for each type of analysis. Inorganic analysis laboratory blanks revealed low frequencies of contamination generally restricted to concentrations below the CRDL, which do not require qualification based on Region II guidelines. Several serial dilution results exceeded maximum percent difference criteria and resulted in the qualification of data as estimated or rejected. These problems are typically attributed to sample matrix interference effects caused by high background levels of other minerals in the sample. A few results were qualified as estimated because of CRDL standard recoveries above or below Region II control limits. Very few problems occurred in other areas.

Quality control data from explosive analyses were generally acceptable, except for a limited number of analytical problems. Picric acid matrix spike recoveries were consistently low (less than 10 percent) for several matrix spikes performed on subsurface soil samples, which resulted in rejection of data for picric acid in the subsurface soil matrix. Surrogate recoveries were slightly low in certain samples, yielding data qualified as estimated and biased low. Data were also qualified as estimated in a limited number of cases for high calibration percent differences.

Miscellaneous parameters quality control data were acceptable in nearly all sample delivery groups. A limited number of results were qualified as estimated due to out-of-control matrix spike recoveries, laboratory duplicate RPDs, or, in two cases, slightly exceeded holding times.

2.5.5 Parameters

The quality of the data set is measured by certain characteristics of the data, namely the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. Precision and accuracy are expressed quantitatively, and the others are expressed qualitatively.

Precision

Precision characterizes the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for a sample under the same or similar conditions. Precision is expressed as a range (the difference between two measurements of the same parameter) or as an RPD (the range relative to the mean, expressed as a percent). Precision is measured quantitatively. Range and RPD values are calculated as follows:

Range = OR - DR

RPD = (OR - DR) / [(OR + DR) / 2] x 100%

where: OR = original sample result
DR = duplicate sample result

The internal laboratory control limits for precision are three times the standard deviation of a series of RPD or range values. RPD values are also calculated for field duplicates and are compared to the control limits as a QA check. Data validation field duplicate control limits and actions required as a result of exceedances are discussed in Section 2.5.3.

Accuracy

Accuracy is the comparison between experimental and known or calculated values expressed as a percent recovery (%R). Percent recoveries are derived from analysis of standards spiked into deionized water (standard recovery) or into actual samples (matrix spike or surrogate spike. recovery). Recovery is calculated as follows:

For a surrogate spike or laboratory control spike or standard

%R = E / T x 100%

where: E = experimental result
T = true value (theoretical result)

For a sample matrix spike

%R = (SSR - SR) / SA x 100%
where: SSR = sample spike result
SR = sample result (unspiked)

SA = spike concentration added

and

SA = (spike aliquot)(spike concentration)/(sample aliquot + spike aliquot)

Internal laboratory control limits for accuracy are set at the mean plus or minus three times the standard deviation of a series of %R values. Organic %R values are set at the mean plus or minus two times the standard deviation. Accuracy for aqueous and solid samples was evaluated by use of surrogate and matrix spikes at the CLP-required frequencies. CLP acceptance criteria and corrective actions were applied. Out-of-criteria results were reviewed in accordance with EPA Region II data validation guidelines to determine the need for qualification or rejection.

Representativeness

All data obtained should be representative of actual conditions at the sampling location. The work plan was designed so that the samples taken present an accurate representation of actual site conditions. The rationale discussed in the work plan were designed to ensure this. All sampling activities conformed to the protocols given in Section 4.0 of the work plan. The use of CLP analytical protocols and data deliverables ensured that analytical procedures were consistently performed to generate results that are considered representative.

The use of low-flow dedicated sampling pumps in conjunction with monitoring of turbidity and other parameters ensured that monitoring well data were as representative of the formation as possible. Despite efforts such as installation of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure, at some wells, low turbidity samples could not be collected. Where use of the EPA Region II low-flow purge method did not result in stabilized turbidity readings, filtered results were obtained from the same location. Filtered and unfiltered metals results were then compared to achieve a more accurate perspective of contaminant fate and transport.

Comparability

Comparability is achieved by using standardized sampling and analysis methods and data reporting procedures. The use of standard analytical procedures and sample collection techniques maximized the comparability of new data. Additionally, consideration was given to field environmental conditions that could influence analytical results.

Completeness

Completeness is a measure of the amount of valid data obtained from the measurement program, compared to the total amount collected. For relatively clean, homogeneous matrices, 100 percent completeness is expected. However, as matrix complexity and heterogeneity increase, completeness may

decrease. Where analysis is precluded or where DQOs are compromised, effects on the overall investigation must be considered. Whether any particular sample is critical to the investigation is evaluated in terms of the sample location, the parameter in question, the intended data use, and the risk associated with the error.

Critical data points were not evaluated until all the analytical results were evaluated. If in the evaluation of results it becomes apparent that the data for a specific medium are of insufficient quality (for example, completeness less than 95 percent), either with respect to the number of samples or an individual analysis, resampling of the deficient data point(s) may be necessary. The site- and medium-specific completeness percentages are summarized in Table 2-27.

The overall percentages of rejected data points in Table 2-27 were generally low and within acceptable ranges. Most of the rejected data were attributed to sample matrix effects in either pesticides or metals analysis. Imprecision between dual-column pesticide results (greater than the 90 RPD allowed by Region II protocol) occurred in the analysis of some soil samples. This problem occurs when a variety of compounds remain in the pesticide sample extract (despite proper analytical clean-up efforts) and interferences graphically overlap or obscure the measurement region assigned to a particular pesticide. Rejected pesticide results are considered unreliable and may be biased low or biased high or may be false positives.

The other main cause of data rejection was imprecision in serial dilutions for metals. This problem occurs when very high levels of common minerals or certain anions remain in the sample after digestion and the measurement signal for a given metal is suppressed or biased. In such cases, a one-to-five dilution of the sample can yield a response that differs from the predicted value (one-fifth of the original result). Serial dilution results that disagreed from the expected results by more than 90 percent difference were considered unreliable and were rejected according to Region II protocol. Depending upon whether the sample concentration is close to the detection limit, this may be interpreted as indicating that the metal in question is present but the reported value is associated with poor accuracy.

2.5.6 Summary of the Data Validation Process

The preceding discussion of field quality control blanks, field duplicate precision, laboratory quality control analyses, and PARCC parameters was based upon the findings from a comprehensive validation of all NWS Earle sample data packages following the protocols of EPA Region II and the National Functional Guidelines. An overview of the data validation process is presented as follows:

- Each data package is validated using the EPA Region II checklist review procedure. A separate checklist is used for each sample delivery group (SDG) package and for each type of data (TCL organics, TAL inorganics, explosives, or miscellaneous parameters).

Table 2-27
Summary of Rejected Data
CTO 231, NWS Earle

Site Number	Groundwater Samples			Surface Water Samples			Aqueous Waste Samples			Subsurface Soil Samples			Surface Soil Samples			Sediment Samples			Floor Sweeping Sample		
	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data	No. of Rejected Results	Total No. of Results	Percent Rejected Data
01	4	1007	0.40							37	1617	2.29									
02	1	988	0.10										7	848	0.83						
03	1	624	0.16													6	141	4.26			
04	0	774	0.00	10	607	1.65										0	128	0.00			
05	6	527	1.14																		
06	1	672	0.15	1	260	0.39										8	576	1.39			
07	0	330	0.00													0	65	0.00			
10	6	528	1.14																		
11	1	280	0.36																		
12													21	564	3.72	2	423	0.47			
13	4	951	0.42	21	346	6.07										5	539	0.93			
14																			0	2	0.00
15				1	298	0.34				0	755	0.00	1	302	0.33	8	453	1.77			
16	0	1091	0.00							18	4739	0.38	4	453	0.88	1	758	0.13			
17	2	539	0.37	0	390	0.00							1	148	0.68	10	597	1.68			
19	1	337	0.30	1	148	0.68				5	537	0.93				5	143	3.50			
20							1	120	0.83	0	360	0.00	3	722	0.42	0	121	0.00			
22										0	453	0.00				0	251	0.00			
23	8	520	1.54	1	632	0.16				6	1118	0.54				6	948	0.63			
24										2	130	1.54									
25										2	104	1.92									
26	1	436	0.23				0	33	0.00	6	506	1.19									
27										8	1350	0.59									
29	0	254	0.00							1	61	1.64									
86										2	28	7.14	1	28	3.57						
BG	5	877	0.57	9	522	1.72				11	1591	0.69				10	516	1.94			
WS				19	2893	0.66										18	2685	0.67			
_L													10	1207	0.83						
_Q	0	294	0.00							0	295	0.00				0	99	0.00			

NOTE: This table includes only analytical data generated for use in RI/FS decision making (unvalidated hydropunch screening samples were excluded).

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Before beginning the review of a particular package, laboratory deliverables are first examined for completeness by comparison with field chain of custody (COC) records.

- The organic checklist is divided into sections for volatiles, semivolatiles, and pesticides/PCBs. Within each section, the reviewer evaluates adherence to sample holding times and preservation requirements; system monitoring compound and surrogate recoveries; matrix spike recoveries; method blank and field quality control blank contamination; instrument performance checks such as mass spectral tuning ratios and gas chromatographic (GC) performance evaluation mixture degradation; target compound results (Form I, chromatograms, mass spectral identification criteria, retention time matching against standards, and instrument quantitation list calculations); tentatively identified compound results; compound quantitation limits; initial calibration data (minimum response factors and relative standard deviation); continuing calibration data (minimum response factors and percent differences); internal standard area recoveries and retention time control; field duplicate precision; pesticide analytical sequence verification, and pesticide cleanup efficiency recoveries.

- The inorganic checklist is divided into sections for COC forms and laboratory cover page; comparison of sample results (Form Is) to raw data; evaluation of preparation logs and measurement readout records for each type of analysis; holding times and sample preservation; calibration (initial calibration verification and continuing calibration recoveries); laboratory initial calibration blank, continuing calibration blank, and preparation blank contamination; inductively coupled plasma (ICP) interference check sample recoveries; matrix spike recoveries; laboratory control sample recoveries; laboratory and field duplicate precision; laboratory control sample recoveries; ICP serial dilution accuracy; furnace atomic absorption post digestion spike recoveries, duplicate burn precision, and standard addition linearity; comparison of dissolved versus total analyses; field quality control blank contamination; verification of instrumental parameters (instrument detection limits, linear ranges, and ICP interelement correction factors); and percent solids of sediments.

- After completion of the data review and checklist, the data validator completes and signs an attached data assessment summary, which contains a summary of quality control deficiencies and the corresponding sample results affected. The completed validation report consists of qualified analytical results with attached qualifier code definitions, Form I results as reported by the laboratory, a Region II data validation checklist and data assessment summary, and photocopies of field COC forms, laboratory narrative, and deficient quality control results from the laboratory data package. After completion of the

data review, all data validation reports are reviewed and approved by a senior validation chemist.

2.6 ECOLOGICAL RISK ASSESSMENT APPROACH

Ecological receptors, such as aquatic and terrestrial biota, may be at risk from environmental contamination at NWS Earle. Accordingly, an Ecological Risk Assessment (ERA) was performed to characterize the potential risks from NWS Earle contaminants to ecological receptors that inhabit the installation. This section provides an outline of the general approach that was taken to assess the impacts of site contamination on aquatic biota, terrestrial biota, and the habitats that support these organisms. This assessment generally followed a two-step process, as follows:

Step 1: Preliminary Problem Formulation and Ecological Effects Characterization (Section 2.6.1)

- Preliminary Problem Formulation - This is the first phase of an ERA, which discusses the goals, breadth, and focus of the assessment. It includes general descriptions of NWS Earle RI sites with emphasis on the habitats and ecological receptors present. This phase also involves characterization of contaminant sources and migration routes, evaluation of routes of contaminant exposure, and selection of preliminary contaminants of potential concern (COPCs). Assessment and measurement endpoints that will be evaluated are also selected. Finally, a conceptual model is developed that describes how contaminants associated with the RI sites may come into contact with ecological receptors.

- Ecological Effects Characterization - In this component, medium-specific ecotox threshold screening levels (ETs) for each preliminary COPC (i.e., concentrations of each contaminant above which adverse effects to ecological receptors may occur) are identified. This step is undertaken concurrently with the exposure assessment described below.

Step 2: Preliminary Exposure Assessment and Risk Characterization (Section 2.6.2)

- Preliminary Exposure Assessment - This portion of the ERA includes the identification of the data used to represent concentrations of contaminants to which ecological receptors may be exposed in various media and the actual selection of exposure point concentrations from those data.

- Risk Characterization - In this step, exposure concentrations are compared to ETs in order to characterize potential risk to ecological receptors of concern from contaminant exposure. Preliminary COPCs found to pose potential risk after these comparisons are

placed on a list of final COPCs. Toxicity profiles are established that summarize the toxic effects and environmental fate of all final COPCs.

When these two steps are completed, the results can be interpreted and the uncertainties associated with the ERA can be addressed. The above process, described in further detail below, represents the first two steps in an eight-step approach outlined in USEPA guidance (USEPA, 1994c), which served as the basis for the ERA methodology (Figure 2-2). The ERA was conducted in accordance with other available ERA guidance documents (EPA, 1992e; Wentsel et al., 1994), and recent publications (Suter, 1993; Calabrese and Baldwin, 1993). These two steps are considered the first "tier" in a three-tiered ERA approach recommended by USEPA (1994d). Due to the potential complexity of ERAs, they are often conducted using a tiered approach and punctuated with Scientific/Management Decision Points (SMDPs; Figure 2-2), which are meetings involving the risk assessors, risk managers, and client to control costs, prevent unnecessary analyses, and ensure that the ERA is proceeding in an efficient, timely manner. Information analyzed in one tier is evaluated to determine whether the objectives of the study have been met and then may be used to identify the data required for the next tier, if necessary. Tier 1, the level of this assessment, can also be viewed as a "screening-level assessment," since the conclusions are based on a preliminary contaminant level screening in various media and may warrant further ecological study in successive tiers on the effects of contaminants from NWS Earle activities on ecological receptors. Tiers 2 and 3 would be more focused studies that incorporate the initial screening but may also encompass more detailed laboratory and field studies or extensive modeling.

2.6.1 Preliminary Problem Formulation and Ecological Effects Characterization

Section 2.6.1.1 discusses the components of preliminary problem formulation and Section 2.6.1.2 discusses the components of ecological effects characterization.

2.6.1.1 Preliminary Problem Formulation

Ecological Setting

The first step in preliminary problem formulation is a general NWS Earle ecological description, or site characterization, specifically detailing the ecological setting and natural resources on NWS Earle. This includes a physiographic description of NWS Earle as it relates to the overall ecological setting on the installation. This description of the NWS Earle ecological setting is provided in Section 3.9.

1. Preliminary Problem Formulation and Ecological Effects Evaluation

2. Preliminary Exposure Assessment and Risk Characterization

SMDP

3. Problem Formulation: Assessment Endpoint Refinement and Testable Hypothesis

SMDP

4. Conceptual Model Refinement: Final Measurement Endpoint Selection and Study Design

SMDP

5. Site Assessment to Confirm Ecological Sampling and Analysis Plan

SMDP

6. Site Field Investigation

7. Final Risk Characterization

8. Risk Management

SMDP

Figure 2–2. Steps in the Ecological Risk Assessment Process (adapted from USEPA, 1994a)
NWS Earle
Colts Neck, New Jersey

Habitat Types and Ecological Receptors

ERAs were conducted for each contaminated site identified during previous RI efforts at NWS Earle by B&R Environmental. As a result, site-specific descriptions of habitat types and ecological receptors were composed. These encompass aquatic and terrestrial habitats at each site, where applicable. An evaluation of threatened and endangered species and wetlands on and around each RI site is also provided, in accordance with Endangered Species Act (ESA) and Clean Water Act (CWA) requirements, which are applicable or relevant and appropriate requirements (ARARs). ARARs pertinent to this assessment are listed below:

- Executive Order 11988, Protection of Floodplains
- Executive Order 11990, Protection of Wetlands
- Clean Water Act (Section 404 40 CFR 230.10)
- Migratory Bird Treaty Act (16 USC 703 et seq.)
- Fish and Wildlife Coordination Act (16 USC 661 et seq.)/Endangered Species Act (16 USC 1531 et seq.)
- Federal Water Quality Criteria (described in Section 2.6.1.2.1)

Contaminant Sources, Release Mechanisms, and Migration Pathways

The various sites on NWS Earle present several different contaminant sources, release mechanisms, and migration pathways. These items were investigated on a site-specific basis. In general, release pathways that were evaluated on the installation include combustion, volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in the site soil may volatilize from surficial material or become airborne via resuspension. Contaminated fugitive dust may also be generated during ground-disturbing activities, such as construction or excavation. These contaminants are dispersed in the surrounding environment and transported to downwind locations where they may re-partition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition.

Precipitation runoff may carry constituents to nearby surface waters, sediments, and soils. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Contaminants with a stronger tendency to adsorb to organic matter in a soil are expected to migrate at a slower rate. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of

groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms.

Exposure Routes

The variety of NWS Earle RI sites results in the presence of several possible contaminant exposure routes. A brief description of general exposure routes that were investigated on a site-specific basis on NWS Earle is provided below.

Terrestrial receptors at NWS Earle (e.g., terrestrial plants and animals) may be exposed to soil contaminants via incidental ingestion of soil and ingestion of contaminated food items. Terrestrial vegetation may be exposed to contaminants via direct aerial deposition and root translocation. Terrestrial receptors may also come into contact with contaminants in surface water by using surface water for drinking water, although this exposure route represents a negligible portion of total exposure for most receptors. Exposure to contaminants in the soil via dermal contact may occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize transfer of contaminants across dermal tissue.

Volatile constituents are present in some site soils, soil-bound contaminant resuspension may occur, and combustion may release chemicals into the air on some RI sites. However, inhalation does not represent a significant exposure pathway because air contaminant concentrations are assumed to be quite low, even for burrowing wildlife. In addition, the inhalation pathway is generally insignificant for ecological receptors, and inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors.

Aquatic and terrestrial organisms inhabiting the NWS Earle area may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

Selection of Preliminary Contaminants of Potential Concern

Preliminary COPCs were those contaminants identified in previous environmental investigations at each RI site on the installation. However, some RI sites at NWS Earle were concluded to be of marginal "ecological relevance" after the evaluation described in the steps above and after evaluation of the nature and extent of the site-specific contamination determined from previous sampling activities. For these sites, lack of "ecological relevance" mitigated the need for quantitative evaluation. Sites were considered

ecologically irrelevant and excluded from quantitative ecological risk assessment process if they did not meet one or more of the following criteria:

- The presence of viable ecological habitat (note that viable ecological habitat may be absent due to contaminants or habitat alteration, which was considered).

- The presence of ecological receptor populations.

- The presence of contaminant migration pathways. Although a site may contain no or marginal ecological habitat, it was assessed if site-related contaminants have the potential to migrate to areas containing more extensive or more viable habitat. A site of this nature may contribute to overall contamination in the watershed in which it exists (Section 2.6.2.1.1).

- The existence of complete exposure routes.

These criteria were applied with caution. Sites were only excluded from quantitative assessment if risk numbers were severely mitigated by these criteria, and, therefore, concluded to be misleading or meaningless. In addition, surface water and sediment sampling was performed in each watershed on the base. Constituents detected in these samples were also considered preliminary COPCs.

Assessment and Measurement Endpoints

As discussed in USEPA (1994a) and Wentsel et al. (1994), one of the major tasks in problem definition is the selection of assessment and measurement endpoints. An assessment endpoint is defined as "an explicit expression of actual environmental values that are to be protected" (USEPA, 1994c). Measurement endpoints are "measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint" (USEPA, 1994c). For this ERA, the most appropriate assessment endpoint was the maintenance of receptor populations that NWS Earle. Therefore, the specific objectives of this assessment were to determine if exposure to contaminants present in the surface water, sediment, and soil on and near the installation are likely to result in declines in ecological receptor populations. Declines in populations could result in a shift in community structure and possible elimination of resident species.

As indicated above, measurement endpoints are related to assessment endpoints, but these endpoints are more easily quantified or observed. In essence, measurement endpoints serve as surrogates for assessment endpoints. While declines in populations and shifts in community structure can be quantified, studies of this nature are generally time-consuming and difficult to interpret. However, measurement

endpoints indicative of observed adverse effects on individuals are relatively easy to measure in toxicity studies and can be related to the assessment endpoint. For example, contaminant concentrations that lead to decreased reproductive success or increased mortality of individuals in toxicity tests could, if found in the environment, result in shifts in population structure, potentially altering the community composition associated with RI sites. Therefore, for this ERA, the lowest contaminant concentrations likely to result in adverse effects on individuals were tentatively selected as measurement endpoints.

Conceptual Site Model

The conceptual model is designed to identify potentially exposed receptor populations and applicable exposure pathways, based on the physical nature of the site and the potential contaminant source areas. Actual or potential exposures of ecological receptors associated with RI sites were determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. Figure 2-3 presents a comprehensive facility-wide conceptual model.

2.6.1.2 Ecological Effects Assessment

For this ERA, ecological screening levels, concentrations of contaminants in various media protective of ecological receptors, were selected to screen exposure point concentrations of preliminary COPCs in surface water, sediment, and soil to determine if they qualify as final COPCs. USEPA (1996) has recently titled these screening levels "ecotox thresholds" (ETs). Methods used for the selection of media-specific ETs are provided below.

Selection of Surface Water ETs

Actual exposures of NWS Earle aquatic receptors to COPCs were assumed to be primarily chronic (long-term) exposures, usually at sublethal concentrations. For this ERA, ET values used to identify final surface water COPCs were chronic screening values, primarily federal AWQCs (USEPA, 1996). These ETs are ARARs and are protective of a wide variety of sensitive species. When AWQCs were not available for some contaminants, surrogate values were obtained, including USEPA Tier II values (USEPA, 1996), and USEPA Region IV screening values (USEPA, 1994e). Although a tidal marsh is located next to some Waterfront sites, 1995 RI salinity measurements in surface water samples collected at the edge of the marsh were low at those sites. As a result, freshwater-based surface water screening levels were used for those sites. Surface water ETs used in this ERA and their sources are presented in Table 2-28.

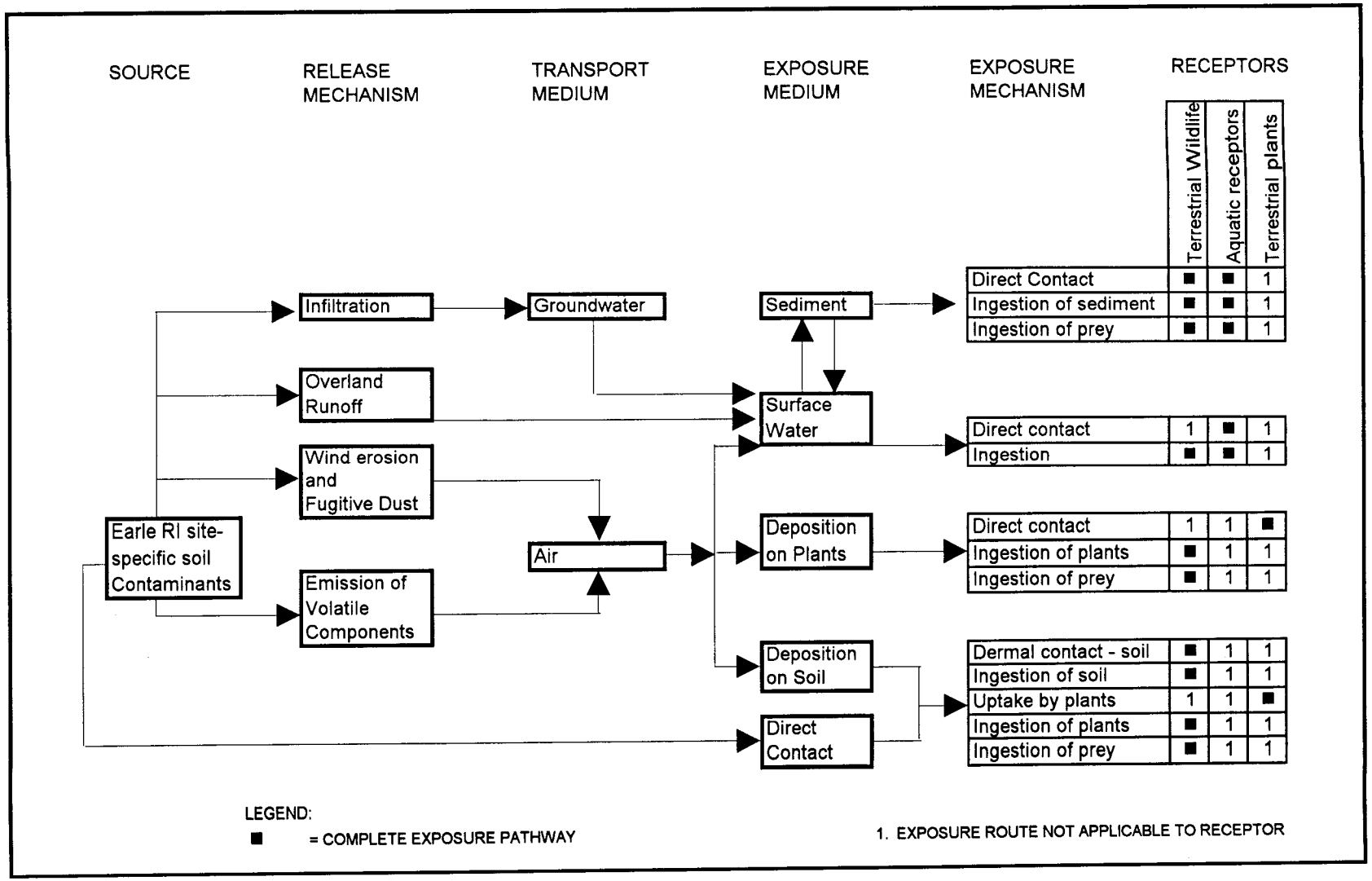

Figure 2-3. Conceptual Site Model
NWS Earle
Colts Neck, New Jersey

TABLE 2-28
SURFACE WATER ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern	Ecotox Threshold (µg/L)	Source
Inorganics		
Aluminum	87	USEPA (1988)
Antimony	160	USEPA Region IV screening value (USEPA, 1994e)
Arsenic	190	AWQC (USEPA, 1996)
Barium	3.9	Tier II value (USEPA, 1996)
Beryllium	5.1	Tier II value (USEPA, 1996)
Cadmium	1.0	AWQC (USEPA, 1996)
Chromium	10	AWQC (USEPA, 1996)
Cobalt	3	Tier II value (USEPA, 1996)
Copper	11	AWQC (USEPA, 1996)
Lead	2.5	AWQC (USEPA, 1996)
Manganese	80	Tier II value (USEPA, 1996)
Mercury	1.3	AWQC (USEPA, 1996)
Nickel	160	AWQC (USEPA, 1996)
Selenium	5.0	AWQC (USEPA, 1996)
Silver	0.01	USEPA Region IV screening value (USEPA, 1994e)
Thallium	4	USEPA Region IV screening value (USEPA, 1994e)
Vanadium	19	AWQC (USEPA, 1996)
Zinc	100	AWQC (USEPA, 1996)
Organics		
4,4'-DDD	0.013	Tier II value (USEPA, 1996)
Aldrin	0.3	USEPA Region IV screening value (USEPA, 1994e)
Bis(2-ethylhexyl)phthalate	32	Tier II value (USEPA, 1996)
Dieldrin	0.06	AWQC (USEPA, 1996)
Gamma-BHC (Lindane)	0.08	AWQC (USEPA, 1996)
Heptachlor	0.007	Tier II value (USEPA, 1996)
Phenol	256.0	USEPA Region IV screening value (USEPA, 1994e)

Selection of Sediment ETs

Ecological screening levels for sediment-dwelling organisms were gathered from the most widely accepted guidance. For Mainside sediments, ETs provided in most recent USEPA guidance (1996) were preferentially used. These are comprised of USEPA sediment quality criteria (SQC), USEPA sediment quality benchmarks (SQB) calculated using equilibrium partitioning methods (USEPA, 1993c), and Effects-Range Low (ER-L) values from NOAA guidance (Long et al., 1995; Long and Morgan, 1991). When these values were not available for a contaminant, values were obtained from Ontario Ministry of the Environment sediment quality screening levels (OME, 1992). If no values were available from any of the sources listed above, USEPA Region IV values (USEPA, 1994e) and Oak Ridge National Laboratory values (Hull and Suter, 1994) were utilized. Some RI sites in the Waterfront area are located adjacent to a tidal saltwater marsh. Despite the tidal marsh adjacent to some Waterfront site and potential saltwater influence, salinity measurements from 1995 RI surface water samples at the edge of the marsh were quite low. Therefore, saltwater- or estuarine-based sediment ETs were not used at those sites.

Most sediment criteria and screening levels are designed to be protective of at least 90 percent of benthic genera or species and subsequently are inherently, and at times excessively, conservative. Therefore, a risk range was established using less conservative ETs when sediment contaminant concentrations exceeded the most conservative ETs available. For example, Effects Range-Low (ER-L) screening levels obtained from Long et al. (1995) as presented by USEPA Region III (USEPA, 1995c) were used as most conservative ET values, when available. However, an ER-L is defined as the concentration below which adverse ecological "effects would rarely be observed" (Long et al., 1995). The Effects Range-Medium (ER-M) is the point below which adverse effects "would occasionally occur" (Long et al., 1995). Therefore, ascribing risk to a sediment contaminant detected in a concentration which exceeds the ER-L but is below the ER-M can be misleading. Hence, as stated above, when contaminant concentrations exceed the most conservative ETs available, concentrations were also compared to less conservative ETs, such as ER-Ms, when available, to obtain a risk range.

Site-specific sediment ETs can also be calculated from surface water ETs using site-specific total organic carbon measurements and organic carbon partitioning coefficients (USEPA, 1993c; USEPA, 1996).

However, calculation of site-specific sediment ETs was beyond the scope of this screening-level assessment. Any potential more focused Tier 2 ecological work at NWS Earle should incorporate total organic carbon into the chemical sampling program and derivation of sediment ETs. Sediment ETs used in this ERA and their sources are presented in Table 2-29.

TABLE 2-29
SEDIMENT ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Ecotox Threshold	Source
Inorganics (mg/kg)		
Antimony	2.0	ER-L (Long and Morgan, 1991)
Arsenic	8.2/70	ER-L/ER-M (Long et al., 1995)
Barium	40	Baudo et al. (1990)
Cadmium	1.2/9.6	ER-L/ER-M (Long et al., 1995)
Chromium	81/370	ER-L/ER-M (Long et al., 1995)
Cobalt	50	Threshold for soils (Direction des Substances Dangerous (1988)
Copper	34/270	ER-L/ER-M (Long et al., 1995)
Cyanide	0.1/0.25	USEPA Region V polluted classification (Hull and Suter, 1994)
Lead	47/218	ER-L/ER-M (Long et al., 1995)
Manganese	460	Ontario screening level (OME, 1992)
Mercury	0.15/0.71	ER-L/ER-M (Long et al., 1995)
Nickel	21/51.6	ER-L/ER-M (Long et al., 1995)
Silver	1.0/3.7	ER-L/ER-M (Long and Morgan, 1991)
Zinc	150/410	ER-L/ER-M (Long et al., 1995)
Organics (µg/kg)		
1,2,4-Trichlorobenzene	9200	Sediment quality benchmark using EqP (USEPA, 1996)
2-Methylnapthalene	330	USEPA Region IV (1994e)
4,4'-DDD	1.6/46	ER-L/ER-M for DDT (Long et al., 1995)
4,4'-DDE	2.2/27	ER-L/ER-M (Long et al., 1995)
4,4'-DDT	1.6/46	ER-L/ER-M (Long et al., 1995)
Acenapthene	620	Sediment Quality Criterion (USEPA, 1996)
Acenapthylene	44/640	ER-L/ER-M (Long et al., 1995)
Acetone	64	Oak Ridge sediment screening benchmark (Hull and Suter, 1994)
Alpha-BHC	3.70	Oak Ridge sediment screening benchmark (Hull and Suter, 1994)
Alpha-Chlordane	7	Ontario screening level (OME, 1992)
Anthracene	330/1700	USEPA Region IV (1994e)/ER-L for high mw PAHs (Long et al., 1995)
Aroclor (PCBs)	22.7/180	ER-L/ER-M for total PCBs (Long et al., 1995)
Benzo(a)anthracene	330/1600	USEPA Region IV (1994e)/ER-M (Long et al., 1995)
Benzo(a)pyrene	430/1600	ER-L/ER-M (Long et al., 1995)
Benzo(b)fluoranthene	330/1700	USEPA Region IV (1994e)/ER-L for high mw PAHs (Long et al., 1995)
Benzo(g,h,i)perylene	330/1700	USEPA Region IV (1994e)/ER-L for high mw PAHs (Long et al., 1995)
Benzo(k)fluoranthene	330/1700	USEPA Region IV (1994e)/ER-L for high mw PAHs (Long et al., 1995)
Bis(2-ethylhexyl)phthalate	8.90E+08	Oak Ridge sediment screening benchmark (Hull and Suter, 1994)
Butylbenzylphthalate	11000	Sediment quality benchmark using EqP (USEPA, 1996)
Carbazole	330/1700	USEPA Region IV (1994c)/ER-L for high mw PAHs (Long et al., 1995)
Chrysene	330/2800	USEPA Region IV (1994c)/ER-M (Long et al., 1995)
Dibenzo(a,h)anthracene	330/5100	USEPA Region IV (1994c)/ER-M (Long et al., 1995)
Dibenzofuran	2000	Sediment quality benchmark using EqP (USEPA, 1996)
Dieldrin	52	Sediment quality criterion (USEPA, 1996)
Diethylphthalate	630	Sediment quality benchmark using EqP (USEPA, 1996)

TABLE 2-29
SEDIMENT ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Ecotox Threshold	Source
Di-n-butylphthalate	11000	Sediment quality benchmark using EqP (USEPA, 1996)
Endosulfan II	5.4	Sediment quality benchmark using EqP (USEPA, 1996)
Endosulfan sulfate	5.4	Sediment quality benchmark using EqP (USEPA, 1996)
Endrin	20	Sediment quality criterion (USEPA, 1996)
Endrin ketone	20	Sediment quality criterion (USEPA, 1996)
Endrin aldehyde	20	Sediment quality criterion (USEPA, 1996)
Ethylbenzene	3600	Sediment quality benchmark using EqP (USEPA, 1996)
Fluoranthene	2900	Sediment quality criterion (USEPA, 1996)
Fluorene	540	Sediment quality benchmark using EqP (USEPA, 1996)
Gamma-Chlordane	7	Ontario screening level (OME, 1992)
Heptachlor	5	Ontario screening level (OME, 1992)
Heptachlor epoxide	5	Ontario screening level (OME, 1992)
Hexachloroethane	1000	Sediment quality benchmark using EqP (USEPA, 1996)
Indeno(1,2,3-cd)pyrene	330/1700	USEPA Region IV (1994e)/ER-L for high mw PAHs (Long et al., 1995)
Methoxychlor	19	Sediment quality benchmark using EqP (USEPA, 1996)
Methylene Chloride	427	Oak Ridge sediment screening benchmark (Hull and Suter, 1994)
Napthalene	480	Sediment quality benchmark using EqP (USEPA, 1996)
Nitrobenzene	8.0	Screening value for wet soil (Will and Suter, 1994)
Phenanthrene	850/1500	Sediment quality criterion (USEPA, 1996)/ER-M (Long et al, 1995)
Pyrene	660/2600	ER-L/ER-M (Long et al., 1995)
Toluene	670	Sediment quality benchmark using EqP (USEPA, 1996)
Tetrachloroethene	530	Sediment quality benchmark using EqP (USEPA, 1996)
Xylene	25	Sediment quality benchmark using EqP (USEPA, 1996)

Selection of Surface Soil ETs

Widely accepted and comprehensive ET values for screening risk to terrestrial receptors from surface soil contaminants do not exist. While many sources have identified conservative, "safe" soil contaminant levels from a human health perspective, only a few have developed soil threshold values with protection of ecological receptors as a goal. When available, soil threshold values that consider impacts to ecological receptors were used. The primary source of surface soil ET values for inorganics used in this assessment was Oak Ridge National Laboratory surface soil screening levels for soil invertebrates (Will and Suter, 1994). Surface soil ET values for organics were primarily USEPA Region III BTAG screening levels for terrestrial fauna (USEPA, 1995f). Surface soil ETs utilized in this ERA are presented in Table 2-30.

Selection of Terrestrial Plant ETs

ET values for initial screening of risk from soil contaminants to terrestrial plants were obtained from Will and Suter (1994), when available. However, terrestrial plant screening levels for several organics were not available from any source. The terrestrial plant ETs used in this ERA are presented in Table 2-31.

2.6.2 Preliminary Exposure Assessment and Risk Characterization

Section 2.6.2.1 describes the components of preliminary exposure assessment and Section 2.6.2.2 describes the components of risk characterization.

2.6.2.1 Preliminary Exposure Assessment

Exposure Point Contaminant Concentrations

Data used to obtain contaminant concentrations in environmental media used for this screening were those generated from 1993 RI, 1993 RI/FS, and 1995 RI sampling activities. All data available for each site were evaluated for use in this assessment. Data that were most applicable for the assessment of potential risks at each site were utilized for quantitative assessment. Data at each site that were not used for quantitative assessment, such as groundwater or subsurface soil contaminant data, were discussed qualitatively in each individual site assessment and augmented quantitative evaluation of potential ecological risks. In addition, individual watersheds were designated on the installation. Surface water and sediment samples were taken in waterways on each watershed to determine potential contaminant impacts to watersheds on the base from individual and multiple RI sites. The maximum concentrations detected at each site and watershed in each applicable medium were used as conservative representative exposure point concentrations. Background data are presented for comparative purposes, and were obtained from facility-

TABLE 2-30
SURFACE SOIL ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Ecotox Threshold	Source
Inorganics (mg/kg)		
Aluminum	600	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Arsenic	60	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Barium	3000	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Cadmium	20	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Chromium	0.4	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Cobalt	1000	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Copper	50	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Lead	500	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Manganese	100	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Mercury	0.1	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Nickel	200	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Selenium	70	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Silver	50	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Vanadium	20	Soil threshold for toxicity to soil microorganisms (Will and Suter, 1994)
Zinc	200	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Organics (μg/kg)		
1,3-Dichlorobenzene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
1,4-Dichlorobenzene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
1,1,1-Trichloroethane	300	USEPA Region III BTAG soil screening level (USEPA, 1995f)
4,4'-DDE	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)

TABLE 2-30
SURFACE SOIL ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

Contaminant of Potential Concern (COPC)	Ecotox Threshold	Source
4,4'-DDD	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
4,4'-DDT	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Alpha-BHC	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Acenapthene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Acenaphthalene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Anthracene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Benzo(a)anthracene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Benzo(a)pyrene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Benzo(b)fluoranthene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Benzo(g,h,i)perylene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Benzo(k)fluoranthene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Chrysene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Dibenzo(a,h)anthracene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Dieldrin	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Ethylbenzene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Fluoranthene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Fluorene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Gamma-Chlordane	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Heptachlor	100	USEPA Region III BTAG soil screening level for Heptachlor Epoxide (USEPA, 1995f)
Heptachlor Epoxide	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Indeno(1,2,3-cd)pyrene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Methoxychlor	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)

TABLE 2-30
SURFACE SOIL ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Ecotox Threshold	Source
Methylene Chloride	300	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Napthalene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Phenanthrene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Phenol	30	Soil threshold for toxicity to earthworms (Will and Suter, 1994)
Pyrene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Toluene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)
Xylene	100	USEPA Region III BTAG soil screening level (USEPA, 1995f)

TABLE 2-31
TERRESTRIAL PLANT ECOTOX THRESHOLD VALUES
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Ecotox Threshold (mg/kg)	Source
Inorganics		
Aluminum	50	Will and Suter (1994)
Antimony	5	Will and Suter (1994)
Arsenic	10	Will and Suter (1994)
Barium	500	Will and Suter (1994)
Beryllium	10	Will and Suter (1994)
Cadmium	3	Will and Suter (1994)
Chromium	1	Will and Suter (1994)
Cobalt	20	Will and Suter (1994)
Copper	100	Will and Suter (1994)
Lead	50	Will and Suter (1994)
Manganese	500	Will and Suter (1994)
Mercury	0.3	Will and Suter (1994)
Nickel	30	Will and Suter (1994)
Silver	2	Will and Suter (1994)
Thallium	1	Will and Suter (1994)
Vanadium	2	Will and Suter (1994)
Zinc	50	Will and Suter (1994)

wide background sampling. Section 2.4.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

2.6.2.2 Risk Characterization

As identified by USEPA (1994a), the second step in the ecological risk assessment process compares representative exposure point contaminant concentrations with contaminant concentrations that are protective of ecological receptors (ETs). Once this step was completed for this study, the results were reviewed to determine whether little or no ecological risk is associated with activities at NWS Earle RI sites or additional information must be generated to verify that ecological receptors are at risk. The ratio of the exposure point contaminant concentration to the ET value is called the hazard quotient (HQ), and is defined as follows:

$$HQ_i = EPC_i/ET_i$$

where: HQ_i = Hazard Quotient for contaminant "i" (unitless)
EPC_i = Exposure Point Concentration for contaminant "i" (mg/l or mg/kg)
ET_i = Ecotox Threshold screening level for contaminant "i" (mg/l or mg/kg)

When the ratio of the exposure point concentration to its respective ET value exceeded 1.0, potential adverse impacts were considered possible, and the contaminant was retained as a final COPC. The HQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an exposure point concentration exceeds or is less than a screening level. When HQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most ETs are conservatively derived, as discussed in Section 2.6.1.2, Selection of Sediment ETs. Furthermore, other factors, such as low frequency of detection, may mitigate potential risks for a final COPC with an elevated HQ value. As a result of the conservatism inherent in most ET derivation, USEPA Region III (1994b) has suggested that HQs greater than one are indicative of low to moderate potential risk; HQs greater than 10 are indicative of moderately high potential risk; and HQs greater than 100 are indicative of high potential risk.

The use of HQs is probably the most common method used for risk characterization in ERAs. Advantages of this method, according to Barnthouse et al. (1986), include the following:

- The HQ method is relatively easy to use, is generally accepted, and can be applied to any data.

- The method is useful when a large number of contaminants must be screened.

This method of risk characterization has some inherent limitations. One primary limitation is that it is a "yes/maybe" method for relating toxicity to exposure. That is, it uses single values for exposure concentrations and ET values and does not account for the variability in both these parameters nor for incremental or cumulative toxicity.

The comparisons described above are presented in site-specific screening tables to select final COPCs in each individual RI site assessment section and watershed assessment section. Screening tables are presented for each applicable medium at each site and watershed. Sediment screening tables present most and less conservative ET comparisons to exposure point concentrations if the most conservative value was exceeded and a less conservative value was available. As a result, two HQ values are presented in these instances. Due to the heavy conservatism in most ETs initially utilized, preliminary COPCs were retained as final COPCs if the most conservative ET values were exceeded but, as mentioned above, a less conservative ET (e.g., an ER-M for sediment) was provided for comparison, if available. When only one ET was available, only one HQ is presented. Background values are also presented for comparative purposes on screening tables. These values need to be taken into account when making risk management decisions, since concentrations of inorganic contaminants can be naturally elevated and exceed screening values. In these instances toxic effects may be ameliorated by site-specific physical or chemical conditions. Although contaminants were not screened out based on background concentrations in this ERA, qualitative discussion is provided when inorganic contaminants that were retained as final COPCs were present in concentrations comparable to background.

Some contaminants were present in some media for which no suitable ET values were available. In these instances, these contaminants were conservatively retained as final COPCs and qualitatively assessed. Since calcium, iron, magnesium, potassium, and sodium are essential nutrients and only toxic at extremely high doses, they were initially excluded as COPCs in all media. Also, toxicity profiles describing the environmental fate, transport, and toxicities of all final COPCs in all media were developed, and are presented in Appendix M.

2.6.3 Uncertainties Analysis

Uncertainty is associated with all aspects of the ERA process. This section provides a summary of those uncertainties, with a discussion of how they may affect the final risk values. Once an ERA is complete, the results must be reviewed and evaluated to identify the types and magnitudes of uncertainties involved. Relying on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. If numerous conservative assumptions are

combined in the ERA process, the resulting calculations will propagate the uncertainties associated with each of those assumptions. The resulting bias is toward overpredicting risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

Generally, risk assessments carry two types of uncertainty: measurement and informational. Measurement uncertainty refers to the variability inherent in measured data. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty stems from the limited availability of necessary information. Often the gap between what is needed and what is available is significant; information regarding the effects of some contaminants on wildlife receptors, the biological mechanism of a contaminant, the impact of physiological differences on exposure pathways, or the behavior of a contaminant in various environmental media is often absent.

Uncertainty is associated with each of the steps of the risk assessment process:

- Uncertainty in preliminary problem formulation can result from limited information regarding contaminant sources, release mechanisms, and exposure routes.

- Uncertainty in the ecological effects characterization arises from the quality of the existing toxicity data to support a determination of potential adverse impacts to ecological receptors.

- Uncertainty associated with the exposure assessment includes the methods used and the assumptions made to determine exposure point concentrations.

- Uncertainty in risk characterization includes that associated with the potential effects of exposure to multiple contaminants and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

2.6.3.1 Uncertainty in the Preliminary Problem Formulation

Many sites investigated in this ERA receive contaminant inputs from more than one source, although initially contaminants are assumed to stem directly from RI site-related activities. Since contaminant concentrations may reflect inputs from many sources, uncertainties exist regarding whether risk characterized at a discrete site stems from site-related contaminants. This was of particular importance while assessing impacts to each watershed on the base. Surface water and sediment samples were taken downgradient of RI sites in all watersheds on the installation to investigate off-site contaminant migration

into the watershed. Although contaminants detected in watershed samples were evaluated to ascertain whether they correlated with contaminant detected at upgradient RI sites, other contaminant sources exist throughout the base that may introduce contaminants into the environment. Roadways, runoff from administrative and support buildings, bunker complexes, and other developed areas may also contribute contaminants to the watershed, introducing uncertainty into cause-and-effect assumptions made between contaminants in the watersheds and specific RI sites.

Uncertainty also arises when different release mechanisms are present. Contaminants at several RI sites are released from their sources only during specific events (e.g., contaminants may be released and migrate from a dry ditch only during periods of extreme rainfall). As a result, risks may be over- or underestimated if the information regarding these parameters is scarce or unknown. Also, different sites and their contaminants may possess different contaminant exposure routes for ecological receptors. Difficulties and limitations exist in trying to obtain exposure routes for individual sites for individual receptors. Since exposure routes may be quite different for different species, risk may be over- or underestimated if this information is not known.

2.6.3.2 Uncertainty in the Ecological Effects Characterization

A great deal of uncertainty in this risk assessment arises from the nature and quality of the available toxicity data used to derive ET values. This uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; when postulated mechanisms of toxicity are similar for laboratory and wildlife species; and when the contaminant of concern is structurally similar to other contaminants for which the toxicity is more completely characterized. In particular, screening values are scarce for assessing potential risk to terrestrial receptors from surface soil contaminants. USEPA Region III BTAG surface soil screening values were utilized in this assessment, mainly for organic contaminants, and were often the only values available in the literature for assessing surface soil-related risks. However, many Region III BTAG screening levels are based on one or a few toxicity studies for a given contaminant. Also, these values are based on the most conservative assumptions possible. As such, though an inherent level of conservatism is needed in a screening-level assessment, these screening levels may grossly overestimate potential risks and the resulting HQ values may be misleading. As discussed earlier, both AWQC and most sediment screening values used in this assessment are based on laboratory studies that do not take into account mitigating physical and chemical properties in the environment. Therefore, uncertainty is introduced into the assessment, and the results tend to overestimate potential risks. To account for this, less conservative sediment ET values were presented, when available, but they cannot fully reduce the associated uncertainty.

In addition, ERAs, unlike human health risk assessments, must consider risks to many different species. However, calculation of risk values for each potential receptor species is not possible. For this ERA, conservative screening values protective of a wide range of ecological receptors were sought. The underlying assumption associated with the use of these ETs is that contaminant concentrations in excess of these screening levels are indicative of potential impacts to actual receptors inhabiting the area. However, species-specific physiological differences that may influence an organism's response to a contaminant or subtle behavioral differences that may increase/decrease a receptor's contact with a contaminant are seldom known. Also, some contaminants were present in some media for which no suitable screening levels were available, such as terrestrial plant ETs for organics. For these reasons, the use of screening values, while necessary, will introduce error into the results of an assessment.

2.6.3.3 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises mainly in the methods used to obtain exposure point concentrations. The maximum detected contaminant concentration was used to represent contaminant concentrations to which ecological receptors might be exposed. If the samples evaluated in this ERA are representative of contaminant concentrations associated with NWS Earle, then this approach is conservative and should overestimate potential risks to ecological receptors. The maximum concentration of a contaminant in a given medium may have been collected in a "hot spot" of contamination, and may be much higher than the remaining values in the data set. This was the case for contaminants in various media at several sites. Again, although use of maximum values is appropriate for a screening-level assessment, they may grossly overpredict potential risks.

2.6.3.4 Uncertainty in the Risk Characterization

Uncertainty in the risk characterization is affected by all aspects of the ERA process described in the above sections. Uncertainty in risk characterization also stems, in part, from the fact that this process does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the contaminants evaluated. Therefore, this uncertainty cannot be discussed in terms of its impact on the risk assessment, since it may either underestimate or overestimate potential ecological risk.

2.6.4 Summary

The maximum exposure point concentrations for contaminants in surface water, sediment, and surface soil were compared to ecological screening values that are protective of ecological receptors to assess potential risk to aquatic and terrestrial organisms. Preliminary COPCs were retained as final COPCs if

exposure point contaminant concentrations exceeded screening values, and ratio of the two values is defined as the hazard quotient. Results are summarized for each individual RI site in each individual site-specific section, and for each installation watershed evaluated. Interpretation of the results and recommendations for remedial action or further ecological study based on ecological risk concerns are also presented in those sections.

2.7 Applicable or Relevant and Appropriate Requirements (ARARs) or Criteria To Be Considered (TBCs)

This section presents available regulatory standards or guidelines for the COPCs selected in subsequent sections on a site-specific basis. Currently, the only enforceable regulatory standards for exposure to groundwater contaminants are the MCLs. However, MCLs have not been specified for many of the COPCs. Therefore, other regulatory guidelines may be used for comparative purposes to determine health risks and environmental impacts. Federal relevant regulatory guidelines include MCLGs, AWQCs, and EPA Drinking Water Health Advisories (DWHAs). State (New Jersey) relevant regulatory guidelines include Residential Direct Contact Soil Cleanup Criteria, Non-Residential Direct Contact Soil Cleanup Criteria, Impact to Groundwater Soil Cleanup Criteria, Groundwater Quality Standard, and Surface Water Quality Criteria. Federal and state ARARs and TBCs are presented in Table 2-32. These criteria are discussed briefly below.

Maximum Contaminant Levels (MCLs)

MCLs are enforceable standards promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCLs are based on laboratory or epidemiologic studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with lifetime exposure (70 years) of an average adult (weighing 70 kilograms) consuming 2 liters of water per day, but they also reflect technical limits on removing the contaminant from water. These enforceable standards are also based upon the fraction of toxicant expected to be absorbed by the gastrointestinal tract.

Maximum Contaminant Level Goals (MCLGs)

MCLGs are generally specified as zero for carcinogenic substances (although exceptions, such as beryllium, do exist) and do not consider the technical or economic feasibility of achieving these goals. MCLGs are nonenforceable guidelines based entirely on health effects. MCLs have been set as close to the MCLGs as technologically and economically feasible.

TABLE 2-32

ARARS - CHEMICALS OF POTENTIAL CONCERN (ORGANICS)

NWS EARLE, COLTS NECK, NEW JERSEY

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	FEDERAL STANDARDS											NEW JERSEY STATE STANDARDS			
	STANDARDS			HEALTH ADVISORIES					AWQC						
Substance	Maximum Contaminant Level (MCL) (ug/L)	Contaminant Level Level Goal (MCLG) (ug/L)	Secondary Maximum Contaminant Levels (SMCL) (ug/L)	Lifetime Adult (ug/L)	Longer Term Adult (ug/L)	One Day Child (ug/L)	Ten Day Child (ug/L)	Longer Term Child (ug/L)	Freshwater Chronic Aquatic Life (ug/L)	Ingestion Water and Fish (ug/L)	Ingestion Fish Only (ug/L)	Residential Direct Contact Soil Cleanup Criteria (mg/kg)	Non-residential Direct Contact Soil Cleanup Criteria (mg/kg)	Impact to Groundwater Soil Cleanup Criteria (mg/kg)	Groundwater Quality Standard (ug/L)
4,4'-DDD	-	-	-	-	-	-	-	-	-	8.30E-04	8.40E-04	3.00E+00	1.20E+01	5.00E+01	1.00E-01
4,4'-DDE	-	-	-	-	-	-	-	-	-	5.90E-04	5.90E-04	2.00E+00	9.00E+00	5.00E+01	1.00E-01
4,4'-DDT	-	-	-	-	-	-	-	-	1.00E-03	5.90E-04	5.90E-04	2.00E+00	9.00E+00	5.00E+02	1.00E-01
ALDRIN	-	-	-	1.00E+00	3.00E-01	3.00E-01	3.00E-01	3.00E-01	-	1.30E-04	1.40E-04	4.00E-02	1.70E-01	5.00E+01	4.00E-02
ALPHA-BHC	-	-	-	-	-	-	-	-	-	3.90E-03	1.30E-02	-	-	-	2.00E-02
BETA-BHC	-	-	-	-	-	-	-	-	-	1.40E-02	4.60E-02	-	-	-	2.00E-01
DELTA-BHC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMA-BHC	2.00E-01	2.00E-01	-	2.00E-01	1.00E+02	1.00E+03	1.00E+03	3.00E+01	8.00E-02	1.90E-02	6.30E-02	5.20E-01	2.20E+00	5.00E+01	2.00E-01
ALPHA-CHLORDANE	2.00E+00	0.00E+00	-	2.00E+00	-	6.00E+01	6.00E+01	-	4.30E-03	5.70E-04	5.90E-04	-	-	-	5.00E-01
GAMMA-CHLORDANE	2.00E+00	0.00E+00	-	2.00E+00	-	6.00E+01	6.00E+01	-	4.30E-03	5.70E-04	5.90E-04	-	-	-	5.00E-01
DIELDRIN	-	-	-	-	2.00E+00	5.00E-01	5.00E-01	5.00E-01	-	-	-	4.20E-02	1.80E-01	5.00E+01	3.00E-02
HEPTACHLOR	4.00E-01	0.00E+00	-	-	5.00E+00	1.00E+01	1.00E+01	5.00E+00	3.80E-03	2.10E-04	2.10E-04	1.50E-01	6.50E-01	5.00E+01	4.00E-01
HEPTACHLOR EPOXIDE	2.00E-01	0.00E+00	-	-	1.00E-01	1.00E+01	-	1.00E-01	3.80E-03	1.00E-04	1.10E-04	-	-	-	2.00E-01
ENDOSULFAN I	-	-	-	-	-	-	-	-	5.60E-02	9.30E-01	2.00E+00	3.40E+02	6.20E+03	5.00E+01	4.00E-01
ENDOSULFAN II	-	-	-	-	-	-	-	-	5.60E-02	9.30E-01	2.00E+00	3.40E+02	6.20E+03	5.00E+01	4.00E-01
ENDOSULFAN SULFATE	-	-	-	-	-	-	-	-	-	9.50E-01	2.00E+00	3.40E+02	6.20E+03	5.00E+01	4.00E-01
ENDRIN	2.00E+00	2.00E+00	-	2.00E+00	1.00E+01	2.00E+01	2.00E+01	3.00E+00	2.30E-03	7.60E-01	8.10E-01	1.70E+01	3.10E+02	5.00E+01	2.00E+00
ENDRIN KETONE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ENDRIN ALDEHYDE	-	-	-	-	-	-	-	-	-	7.60E-01	8.10E-01	-	-	-	-
METHOXYCHLOR	4.00E+01	4.00E+01	-	4.00E+01	2.00E+02	5.00E+01	5.00E+01	5.00E+01	3.00E+01	1.00E+02	-	2.80E+02	5.20E+03	5.00E+01	4.00E+01
AROCLOR 1248	5.00E-01	0.00E+00	-	-	-	-	-	-	1.40E-02	4.40E-05	4.50E-05	4.90E-01	2.00E+00	5.00E+01	5.00E-01
AROCLOR 1254	5.00E-01	0.00E+00	-	-	-	-	-	-	1.40E-02	4.40E-05	4.50E-05	4.90E-01	2.00E+00	5.00E+01	5.00E-01
AROCLOR 1260	5.00E-01	0.00E+00	-	-	-	-	-	-	1.40E-02	4.40E-05	4.50E-05	4.90E-01	2.00E+00	5.00E+01	5.00E-01
1,1,1-TRICHLOROETHANE	2.00E+02	2.00E+02	-	2.00E+02	1.00E+05	1.00E+05	4.00E+04	4.00E+04	3.12E+04	3.10E+03	1.70E+05	2.10E+02	1.00E+03	5.00E+01	3.00E+01
1,1,2-TRICHLOROETHANE	3.00E+00	5.00E+00	-	3.00E+00	1.00E+03	6.00E+02	4.00E+02	4.00E+02	-	6.00E-01	4.20E+01	2.20E+01	4.20E+02	1.00E+00	3.00E+00
1,1-DICHLOROETHENE	7.00E+00	7.00E+00	-	7.00E+00	4.00E+03	2.00E+03	1.00E+03	1.00E+03	1.16E+04	5.70E-02	3.20E+00	-	1.50E+02	1.00E+01	2.00E+00
1,2-DICHLOROETHANE	5.00E+00	0.00E+00	-	-	2.60E+03	7.00E+02	7.00E+02	7.00E+02	2.00E+04	3.80E-01	9.90E+01	6.00E+00	2.40E+01	1.00E+00	2.00E+00
1,2-DICHLOROETHENE (TOTAL) a	7.00E+01	7.00E+01	-	7.00E+01	6.00E+03	4.00E+03	3.00E+03	3.00E+03	1.16E+04	-	-	7.90E+01	1.00E+03	1.00E+00	1.00E+01
ACETONE	-	-	-	-	-	-	-	-	-	-	-	1.00E+03	1.00E+03	1.00E+02	7.00E+02
2-BUTANONE	-	-	-	-	-	-	-	-	-	-	-	1.00E+03	1.00E+03	5.00E+01	3.00E+02
4-METHYL-2-PENTANONE	-	-	-	-	-	-	-	-	-	-	-	1.00E+03	1.00E+03	5.00E+01	4.00E+02
BENZENE	5.00E+00	0.00E+00	-	-	-	2.00E+02	2.00E+02	-	5.30E+03	1.20E+00	7.10E+01	3.00E+00	1.30E+01	1.00E+00	1.00E+00
BROMODICHLOROMETHANE	1.00E+02	0.00E+00	-	-	6.00E+03	5.00E+03	2.00E+03	2.00E+03	-	2.70E-01	2.20E+01	1.10E+01	4.60E+01	1.00E+00	1.00E+00
CARBON DISULFIDE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHLOROETHANE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHLOROBENZENE	-	-	-	-	-	-	-	-	-	4.88E+02	-	3.70E+01	6.80E+02	1.00E+00	4.00E+00
CHLOROFORM	1.00E+02	0.00E+00	-	-	4.00E+02	4.00E+03	4.00E+03	1.00E+02	1.24E+03	5.70E+00	4.70E+02	1.90E+01	2.80E+01	1.00E+00	6.00E+00
ETHYLBENZENE	7.00E+02	7.00E+02	-	7.00E+02	3.00E+03	3.00E+04	3.00E+03	1.00E+03	3.20E+04	3.10E+03	2.90E+04	1.00E+03	1.00E+03	1.00E+02	7.00E+02
METHYLENE CHLORIDE	5.00E+00	0.00E+00	-	-	-	1.00E+04	2.00E+03	-	-	4.70E+00	1.60E+03	4.90E+01	2.10E+02	1.00E+00	2.00E+00
STYRENE	1.00E+02	1.00E+02	-	1.00E+02	7.00E+03	2.00E+04	2.00E+03	2.00E+03	-	-	-	2.30E+01	9.70E+01	1.00E+02	1.00E+02
TETRACHLOROETHENE	5.00E+00	0.00E+00	-	-	5.00E+03	2.00E+03	2.00E+03	1.00E+03	8.40E+02	8.00E-01	8.85E+00	4.00E+00	6.00E+00	1.00E+00	1.00E+00
TOLUENE	1.00E+03	1.00E+03	-	1.00E+03	7.00E+03	2.00E+04	2.00E+03	2.00E+03	1.75E+04	1.00E+04	3.00E+05	1.00E+03	1.00E+03	5.00E+02	1.00E+03

- = No standard is available for this chemical in this classification

a = Value represents the more conservative of criteria for cis- and trans- isomers, where applicable

TABLE 2-32

ARARS - CHEMICALS OF POTENTIAL CONCERN (ORGANICS)

NWS EARLE, COLTS NECK, NEW JERSEY

	FEDERAL STANDARDS											NEW JERSEY STATE STANDARDS			
	STANDARDS			HEALTH ADVISORIES					AWQC						
Substance	Maximum Contaminant Level (MCL) (ug/L)	Contaminant Level Level Goal (MCLG) (ug/L)	Secondary Maximum Contaminant Levels (SMCL) (ug/L)	Lifetime Adult (ug/L)	Longer Term Adult (ug/L)	One Day Child (ug/L)	Ten Day Child (ug/L)	Longer Term Child (ug/L)	Freshwater Chronic Aquatic Life (ug/L)	Ingestion Water and Fish (ug/L)	Ingestion Fish Only (ug/L)	Residential Direct Contact Soil Cleanup Criteria (mg/kg)	Non-residential Direct Contact Soil Cleanup Criteria (mg/kg)	Impact to Groundwater Soil Cleanup Criteria (mg/kg)	Groundwater Quality Standard (ug/L)
TRICHLOROETHENE	5.00E+00	0.00E+00	-	-	-	-	-	-	2.19E+04	2.70E+00	8.10E+01	2.30E+01	5.40E+01	1.00E+00	1.00E+00
VINYL CHLORIDE	2.00E+00	0.00E+00	-	-	5.00E+01	3.00E+03	3.00E+03	1.00E+01	-	2.00E+00	5.25E+02	2.00E+00	7.00E+00	1.00E+01	5.00E+00
XYLENE (TOTAL)	1.00E+04	1.00E+04	-	1.00E+04	1.00E+05	4.00E+04	4.00E+04	4.00E+04	-	-	-	4.10E+02	1.00E+03	1.00E+01	4.00E+01
1,2,4-TRICHLOROBENZENE	7.00E+01	7.00E+01	-	4.00E+01	5.00E+02	1.00E+02	1.00E+02	1.00E+02	-	-	-	6.80E+01	1.20E+03	1.00E+02	8.00E+00
1,2-DICHLOROBENZENE	6.00E+02	6.00E+02	-	3.00E+03	3.00E+04	9.00E+03	9.00E+03	9.00E+03	7.63E+02	2.70E+03	1.70E+04	5.10E+03	1.00E+04	5.00E+01	6.00E+02
1,3-DICHLOROBENZENE	6.00E+02	6.00E+02	-	6.00E+02	3.00E+04	9.00E+03	9.00E+03	9.00E+03	7.63E+02	4.00E+02	2.60E+03	5.10E+03	1.00E+04	1.00E+02	6.00E+02
1,4-DICHLOROBENZENE	7.50E+01	7.50E+01	-	4.00E+03	4.00E+04	1.00E+04	1.00E+04	1.00E+04	7.63E+02	4.00E+02	2.60E+03	5.70E+02	1.00E+04	1.00E+02	7.50E+01
2,4-DICHLOROPHENOL	-	-	-	1.00E+02	1.00E+02	3.00E+01	3.00E+01	3.00E+01	-	9.30E+01	7.90E+02	1.70E+02	3.10E+03	1.00E+01	2.00E+01
2,4-DIMETHYLPHENOL	-	-	-	-	-	-	-	-	-	-	-	1.10E+03	1.00E+04	1.00E+01	1.00E+02
2-METHYLNAPHTHALENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	-	-	-	-
2-METHYLPHENOL	-	-	-	1.00E+02	7.00E+03	2.00E+03	2.00E+03	2.00E+03	-	-	-	2.80E+03	1.00E+04	-	-
4-METHYLPHENOL	-	-	-	1.00E+02	7.00E+03	2.00E+03	2.00E+03	2.00E+03	-	-	-	2.80E+03	1.00E+04	-	-
ACENAPHTHENE	-	-	-	-	-	-	-	-	5.20E+02	1.20E+03	2.70E+03	3.40E+03	1.00E+04	1.00E+02	4.00E+02
ACENAPHTHYLENE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANTHRACENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	1.00E+04	1.00E+04	1.00E+02	2.00E+03
BENZO(A)ANTHRACENE	-	-	-	-	-	-	-	-	-	2.80E-03	3.11E-02	9.00E-01	4.00E+00	5.00E+02	-
BENZO(A)PYRENE	2.00E+00	0.00E+00	-	-	-	-	-	-	-	2.80E-03	3.11E-02	6.60E-01	6.60E-01	1.00E+02	-
BENZO(B)FLUORANTHENE	-	-	-	-	-	-	-	-	-	2.80E-03	3.11E-02	9.00E-01	4.00E+00	5.00E+01	-
BENZO(G,H,I)PERYLENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	-	-	-	-
BENZO(K)FLUORANTHENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-02	3.11E-02	9.00E-01	4.00E+00	5.00E+02	-
BIS(2-CHLOROETHYL)ETHER	-	-	-	-	-	-	-	-	-	3.00E-02	1.36E+00	6.60E-01	3.00E+00	1.00E+01	1.00E+01
BIS(2-ETHYLHEXYL)PHTHALATE	-	-	-	-	-	-	-	-	3.00E+00	1.80E+00	5.90E+00	4.90E+01	2.10E+02	1.00E+02	3.00E+01
BUTYLBENZYLPHTHALATE	-	-	-	-	-	-	-	-	3.00E+00	3.00E+03	5.20E+03	1.10E+03	1.00E+04	1.00E+02	1.00E+02
CARBAZOLE	-	-	-	-	-	-	-	-	3.00E+02	-	-	-	-	-	-
CHRYSENE	-	-	-	-	-	-	-	-	-	2.80E-03	3.11E-02	9.00E+00	4.00E+01	5.00E+02	-
DI-N-BUTYLPHTHALATE	-	-	-	-	-	-	-	-	3.00E+00	2.70E+03	1.20E+04	5.70E+03	1.00E+04	1.00E+02	9.00E+02
DI-N-OCTYLPHTHALATE	-	-	-	-	-	-	-	-	3.00E+00	-	-	1.10E+03	1.00E+04	1.00E+02	1.00E+02
DIBENZ(A,H)ANTHRACENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	6.60E-01	6.60E-01	1.00E+02	-
DIBENZOFURAN	-	-	-	-	-	-	-	-	3.00E+02	-	-	-	-	-	-
DIETHYLPHTHALATE	-	-	-	5.00E+03	-	-	-	-	3.00E+00	2.30E+04	1.20E+05	1.00E+04	1.00E+04	5.00E+01	-
FLUORANTHENE	-	-	-	-	-	-	-	-	3.98E+03	4.20E+01	5.40E+01	2.30E+03	1.00E+04	1.00E+02	3.00E+02
FLUORENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	2.30E+03	1.00E+04	1.00E+02	3.00E+02
HEXACHLOROETHANE	-	-	-	1.00E+00	5.00E+02	5.00E+03	5.00E+03	1.00E+02	-	1.90E+00	8.90E+00	6.00E+00	1.00E+02	1.00E+02	1.00E+01
INDENO(1,2,3-CD)PYRENE	-	-	-	-	-	-	-	-	3.00E+02	2.80E-03	3.11E-02	9.00E-01	4.00E+00	5.00E+02	-
ISOPHORONE	-	-	-	1.00E+02	1.50E+04	1.50E+04	1.50E+04	1.50E+04	-	8.40E+00	6.00E+02	1.10E+03	1.00E+04	5.00E+01	1.00E+02
N-NITROSODIPHENYLAMINE	-	-	-	2.00E+02	1.00E+03	1.00E+03	1.00E+03	3.00E+02	-	5.00E+00	1.60E+01	1.40E+02	6.00E+02	1.00E+02	2.00E+01
NAPHTHALENE	-	-	-	2.00E+01	1.00E+03	5.00E+02	5.00E+02	4.00E+02	6.20E+02	-	-	2.30E+02	4.20E+03	1.00E+02	-
NITROBENZENE	-	-	-	-	-	-	-	-	-	1.70E+01	1.90E+03	2.80E+01	1.00E+01	5.00E+01	1.00E+01
PHENANTHRENE	-	-	-	-	-	-	-	-	-	2.80E-03	3.11E-02	-	-	-	-
PHENOL	-	-	-	4.00E+03	2.00E+04	6.00E+03	6.00E+03	6.00E+03	-	2.10E+04	4.60E+06	1.00E+04	1.00E+04	5.00E+01	4.00E+03
PYRENE	-	-	-	-	-	-	-	-	-	2.80E-03	3.11E-02	1.70E+03	1.00E+04	1.00E+02	2.00E+02

- = No standard is available for this chemical in this classification

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TABLE 2-32

ARARS - CHEMICALS OF POTENTIAL CONCERN (EXPLOSIVES AND INORGANICS)

NWS EARLE, COLTS NECK, NEW JERSEY

	FEDERAL STANDARDS											NEW JERSEY STATE STANDARDS			
	STANDARDS			HEALTH ADVISORIES					AWQC						
Substance	Maximum Contaminant Level (MCL) (ug/L)	Contaminant Level Level Goal (MCLG) (ug/L)	Secondary Maximum Contaminant Levels (SMCL) (ug/L)	Lifetime Adult (ug/L)	Longer Term Adult (ug/L)	One Day Child (ug/L)	Ten Day Child (ug/L)	Longer Term Child (ug/L)	Freshwater Chronic Aquatic Life (ug/L)	Ingestion Water and Fish (ug/L)	Ingestion Fish Only (ug/L)	Residential Direct Contact Soil Cleanup Criteria (mg/kg)	Non-residential Direct Contact Soil Cleanup Criteria (mg/kg)	Impact to Groundwater Soil Cleanup Criteria (mg/kg)	Groundwater Quality Standard (ug/L)
1,3,5-TRINITROBENZENE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,6-TRINITROTOLUENE	-	-	-	2.00E+00	2.00E+01	2.00E+01	2.00E+01	2.00E+01	-	-	-	-	-	-	-
2,4-DINITROTOLUENE	-	-	-	-	1.00E+03	5.00E+02	5.00E+02	3.00E+02	-	1.10E-01	7.10E+00	1.00E+00	4.00E+00	1.00E+01	1.00E+01
2-AMINO-4,6-DINITROTOLUENE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-AMINO-2,6-DINITROTOLUENE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HMX	-	-	-	4.00E+02	2.00E+04	5.00E+03	5.00E+03	5.00E+03	-	-	-	-	-	-	-
NITROCELLULOSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RDX	-	-	-	2.00E+00	4.00E+02	1.00E+02	1.00E+02	1.00E+02	-	-	-	-	-	-	-
ALUMINUM	-	-	2.00E+02	-	-	-	-	-	-	-	-	-	-	-	2.00E+02
ANTIMONY	6.00E+00	6.00E+00	-	3.00E+00	1.50E+01	1.00E+01	1.00E+01	1.00E+01	-	1.40E+01	4.30E+03	1.40E+01	3.40E+02	-	2.00E+01
ARSENIC, TOTAL	5.00E+01	-	-	-	-	-	-	-	1.89E+02	1.80E-02	1.40E-01	2.00E+01	2.00E+01	-	8.00E+00
BARIUM	2.00E+03	2.00E+03	-	2.00E+03	-	-	-	-	-	-	-	7.00E+02	4.70E+04	-	2.00E+03
BERYLLIUM	4.00E+00	4.00E+00	-	-	2.00E+04	3.00E+04	3.00E+04	4.00E+03	-	-	-	1.00E+00	1.00E+00	-	2.00E+01
CADMIUM	5.00E+00	5.00E+00	-	5.00E+00	2.00E+01	4.00E+01	4.00E+01	5.00E+00	1.1E+00+	-	-	1.00E+00	1.00E+02	-	4.00E+00
CHROMIUM, TOTAL	1.0E+02*	1.0E+02*	-	1.0E+02*	8.0E+02*	1.0E+03*	1.0E+03*	2.0E+02*	2.09E+02+	-	-	-	5.00E+02	-	1.00E+02
CHROMIUM, HEXAVALENT	1.0E+02*	1.0E+02*	-	1.0E+02*	8.0E+02*	1.0E+03*	1.0E+03*	2.0E+02*	1.00E+01	-	-	-	1.00E+01	-	-
COBALT	-	-	-	-	-	-	-	-	-	-	-				
COPPER	1.3E+03**	1.30E+03	1.00E+03	-	-	-	-	-	1.1E+01+		-	6.00E+02	6.00E+02	-	1.00E+03
IRON	-	-	3.00E+02	-	-	-	-	-	-	-	-	-	-	-	3.00E+02
LEAD, TOTAL	1.5E+01***	0.00E+00	-	-	-	-	-	-	3.2E+00+		-	4.00E+02	6.00E+02	-	1.00E+01
MANGANESE	-	-	5.00E+01	-	-	-	-	-	-	-	-	-	-	-	5.00E+01
MERCURY, TOTAL	2.00E+00	2.00E+00	-	2.00E+00	2.00E+00	-	-	-	1.20E-02	1.40E-01	1.50E-01	1.40E+01	2.70E+02	-	2.00E+00
NICKEL (SOLUBLE SALTS)	1.00E+02	1.00E+02	-	1.00E+02	1.70E+03	1.00E+03	1.00E+03	5.00E+02	1.6E+02+	6.10E+02	4.60E+03	2.50E+02	2.40E+03	-	1.00E+02
SELENIUM, TOTAL	5.00E+01	5.00E+01	-	-	-	-	-	-	5.00E+00	-	-	6.30E+01	3.10E+03	-	5.00E+01
SILVER	-	-	1.00E+02	1.00E+02	2.00E+02	2.00E+02	2.00E+02	2.00E+02	1.90E+00	-	-	1.10E+02	4.10E+03	-	-
SODIUM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.00E+04
THALLIUM	2.00E+00	5.00E-01	-	4.00E-01	2.00E+01	7.00E+00	7.00E+00	7.00E+00	-	1.70E+00	6.30E+00	2.00E+00	2.00E+00	-	1.00E+01
VANADIUM	-	-	-	-	-	-	-	-	-	-	-	3.70E+02	7.10E+03	-	-
ZINC	-	-	5.00E+03	2.00E+03	1.00E+04	6.00E+03	6.00E+03	3.00E+03	1.01E+02+	-	-	1.50E+03	1.50E+03	-	5.00E+03

- = No standard is available for this chemical in this classification

* = Total Chromium

** = Action level 1300 ug/l

*** = Action level 15 ug/l

Ambient Water Quality Criteria (AWQCs)

AWQCs were developed under the Clean Water Act and are not enforceable federal regulatory guidelines but are of primary utility in assessing the potential for toxic effects in aquatic organisms as well as human receptors. AWQCs consider acute and chronic human health effects from ingestion of both water (2 liters per day) and aquatic organisms (6.5 grams per day). The AWQC may also be adjusted to consider ingestion of water alone (2 liters per day). The AWQC for protection of human health for carcinogenic substances is based on EPA's specified incremental cancer risk range of one additional case of cancer in an exposed population of 100,000 to 10,000,000 persons and is generally based on older toxicological data.

Drinking Water Health Advisories (DWHAs)

DWHAs are guidelines developed by the EPA Office of Drinking Water for non-regulated contaminants in drinking water. These guidelines are designed to consider both acute and chronic toxic effects in children (with an assumed body weight of 10 kilograms) who consume 1 liter of water per day and in adults (assumed body weight of 70 kilograms) who consume 2 liters of water per day. Health Advisories are generally available for acute (1-day), subchronic (10-day), and chronic (longer-term or lifetime) exposure scenarios. These guidelines are designed to consider only threshold effects and, as such, are not used to set acceptable levels for known or probable human carcinogens.

Values of the available regulatory standards and guidelines are presented in Table 2-32. This table presents values for the COPCs that are human, probable human, or possible human carcinogens, for chemicals having only noncarcinogenic effects, and for chemicals having both carcinogenic and noncarcinogenic effects.

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3.0 FACILITY-WIDE ENVIRONMENTAL SETTING

3.1 CLIMATE AND METEOROLOGY

The Mainside and Waterfront areas are characterized by a predominantly continental climate. NWS Earle's proximity to the Atlantic Ocean and Sandy Hook Bay results in maritime climatic influences. The average annual temperature for Freehold, New Jersey, which is located approximately 6 miles west of the Mainside area and 16 miles southwest of the Waterfront area, is 52.7°F. The average monthly temperatures range from 22° to 39°F in January and 63° to 85°F in July. The average annual precipitation, 45 inches, is generally evenly distributed throughout the year. The mean annual lake evaporation for the area of the site is approximately 32 inches. The net annual precipitation is approximately 13 inches. A 2-year, 24-hour rainfall will produce approximately 3.4 inches of rain [National Oceanic and Atmospheric Administration (NOAA), 1982]. The prevailing wind direction is from the south during the warm seasons and from the northwest during the winter. The growing season in this area ranges from 140 to 160 days.

3.2 TOPOGRAPHY

NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Mainside area lies in the outer Coastal Plain, approximately 9 miles inland from the Atlantic Ocean. The Mainside area is relatively flat, with elevations ranging from approximately 100 to 300 feet above mean sea level (MSL). The most significant topographic relief within the Mainside area is Hominy Hills, a northeast-southwest-trending group of low hills located near the center of the station.

The 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 averages approximately 10 feet above MSL.

The ammunition depot occupies a somewhat circular plot of land connected to the Waterfront by the thin strip of property described above. This portion of the station, known as the Chapel Hill area, lies within the Highland/Mount Pleasant Hills. These hills form the drainage divide between the inner and outer Coastal Plains.

3.3 SURFACE WATER HYDROLOGY

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

Surface water drainage from the Waterfront 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 in these areas follows topographic gradients to storm drains and drainage ditches or occurs as overland flow that discharges to local surface water bodies.

3.4 GENERAL GEOLOGY

3.4.1 Regional Geologic Setting

NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine environments. The sediments generally strike northeast-southwest and dip to the southeast at a rate of 10 to 60 feet per mile. The approximate thickness of these sediments beneath NWS Earle is 900 feet. The pre-Cretaceous complex consists mainly of PreCambrian and lower Paleozoic crystalline rocks and metamorphic schists and gneisses.

The Cretaceous to Miocene Coastal Plain Formations are either exposed at the surface or subcrop in a banded pattern that roughly parallels the shoreline. The outcrop pattern is caused by the erosional truncation of the dipping sedimentary wedge. Where these formations are not exposed, they are covered by essentially flat-lying post-Miocene surficial deposits. The formations are discussed below in reverse chronostratigraphic order to reflect the order that the geologic materials are encountered by both the drill

bit and by water infiltrating from the surface into the aquifer system. Table 3-1 summarizes the geologic units present in the New Jersey Coastal Plain. The geologic formations that crop out at the Mainside, Waterfront, and Chapel Hill sites are summarized in Table 3-2.

Site-specific geology for each site is discussed in Sections 4 through 29.

3.4.2 Surficial Deposits

Tertiary [late Miocene(?)-early Pleistocene(?)] and Quaternary surficial deposits have been mapped in a portion of the Mainside area. Quaternary surficial deposits, consisting of alluvium, swamp deposits, upper terrace deposits, and upper colluvium, occur in floodplains, terraces, wetlands, and along the bases of slopes within modern valleys. Late Miocene(?)-early Pleistocene(?) surficial deposits, consisting of upland gravel and upland colluvium and gravel, undivided, occur as erosional remnants that cap hilltops and divide areas. The erosional surface upon which the upland deposits rest is unrelated to modern valleys and drainage patterns. The surficial deposits are described in The Surficial Geology of the Marlboro Quadrangle, Monmouth County, New Jersey (S.D. Stanford, 1992). Fourteen sites (Sites 1, 4, 10, 11, 13, 14, 16/F, 20, 22, 23, 24, 25, 29, and L) are located on the Marlboro Quadrangle (Figure 3-1). The surficial deposits mapped at the Mainside sites are summarized in Table 3-2. Surficial deposits are absent or very thin at Mainside Sites 1 and 20. Quaternary swamp deposits and eolian deposits are assumed to be present in the Waterfront area, and a colluvium and alluvium unit, undivided, is assumed to be present in the Chapel Hill Area.

Quaternary alluvium consists of sand, silt, and pebble gravel with minor clay and peat and variable amounts of organic matter. Generally, several feet of bedded sand and silt overbank deposits overlie lag or a thin layer of pebble-gravel channel or bar deposits. The lag deposits rest on older Coastal Plain formations. The alluvium has a maximum thickness of 15 feet.

Swamp deposits consist of peat with minor organic-rich silt and clay. The swamp deposits have a maximum thickness of 6 feet and lie along the stream courses at NWS Earle.

Upper terrace deposits consist of sand, silt, and pebble gravel. The upper terrace deposits have a maximum thickness of 20 feet and cap erosional terraces with bases at elevations of 20 to 40 feet above the modern valley bottoms.

Upper colluvium consists of massive sand and silty sand and may contain quartz and ironstone pebbles or overlie a pebble lag. The upper colluvium has a maximum thickness of 10 feet and rests on erosional surfaces 20 to 40 feet above the modern valley floor bottoms. Eight of the Mainside sites (Sites 10, 11, 14, 16/F, 22, 23, 29, and L) are located in areas mapped as upper colluvium.

Table 3-1

New Jersey Coastal Plain Geologic and Hydrogeologic Units
NWS Earle, Colts Neck, New Jersey

SYSTEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	HYDROGEOLOGIC UNIT		HYDROLOGIC CHARACTERISTICS
Quaternary	Holocene	Surficial deposits	Highly variable lithology: sand, silt, pebble gravel with minor amounts of clay and peat.	Undifferentiated		Surficial deposits often hydraulically connected to underlying aquifers. Locally units may act as confining beds. Thicker sands are capable of yielding large quantities of water.
	Pleistocene					
Tertiary	Miocene			Kirkwood-Cohansey aquifer system		A major aquifer system. Groundwater occurs generally under water-table conditions. In Cape May County, the Cohansey Sand is under artesian conditions.
		Cohansey Sand	Sand, quartz, light-colored, medium- to coarse-grained, pebbly; local clay beds.			
		Kirkwood Formation	Sand, quartz, gray and tan, very fine- to medium-grained, micaceous, and dark-colored diatomaceous clay.	confining bed		Thick diatomaceous clay bed occurs along coast and for a short distance inland. A thin water-bearing sand occurs within the middle of this unit.
				Rio Grande water-bearing zone		
				confining bed		
				Atlantic City 800-foot sand		A major aquifer along the coast.
				Composite confining beds		Alloway Clay member or equivalent.
	Eocene	Piney Point Formation	Sand, quartz and glauconite, fine- to coarse-grained.		Piney Point aquifer	Yields moderate quantities of water locally.
		Shark River Formation	Clay, silty and sandy, glauconitic, green, gray and brown, fine-grained quartz sand.			Poorly permeable sediments.
		Manasquan Formation				
	Paleocene	Vincentown Formation	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.		Vincentown aquifer	Yields small to moderate quantities of water in and near its outcrop area.
		Hornerstown Sand	Sand, clayey, glauconitic, dark green, fine- to coarse-grained.			Poorly permeable sediments.
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous.			
		Red Bank Sand			Red Bank Sand	Yields small quantities of water in and near its outcrop area.
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium- to coarse-grained.			Poorly permeable sediments.
		Mount Laurel Sand	Sand, quartz, brown and gray, fine- to coarse-grained, slightly glauconitic.	Wenonah-Mount Laurel aquifer		A major aquifer.
		Wenonah Formation	Sand, very fine- to fine-grained, gray and brown, silty, slightly glauconitic.			
		Marshalltown Formation	Clay, silty, dark greenish gray, glauconitic quartz sand.	Marshalltown-Wenonah confining bed		A leaky confining bed.
		Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.	Englishtown aquifer system		A major aquifer. Two sand units in Monmouth and Ocean Counties.
		Woodbury Clay	Clay, gray and black, micaceous silt.	Merchantville-Woodbury confining bed		A major confining bed. Locally, the Merchantville Formation may contain a thin water-bearing sand.
		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine-grained quartz and glauconitic sand.			
		Magothy Formation	Sand, quartz, light gray, fine- to coarse-grained; local beds of dark gray lignitic clay.	Potomac-Raritan-Magothy aquifer system	upper aquifer	A major aquifer system. In the northern Coastal Plain, the upper aquifer is equivalent to the Old Bridge aquifer and the middle aquifer is the equivalent of the Farrington aquifer. In the Delaware River Valley, three aquifers are recognized. In the deeper subsurface, units below the upper aquifer are undifferentiated.
		Raritan Formation	Sand, quartz, light gray, fine- to coarse-grained, pebbly, arkosic, red, white, and variegated clay.		confining bed	
					middle aquifer	
	Lower Cretaceous	Potomac Group	Alternating clay, silt, sand, and gravel.		confining bed	
					lower aquifer	
Pre-Cretaceous		Bedrock	Precambrian and lower Paleozoic crystalline rocks, metamorphic schist and gneiss; locally Triassic basalt, sandstone and shale.	Bedrock confining bed		No wells obtain water from these consolidated rocks, except along the Fall Line.

Modified from: Zapecza, Otto S. Hydrogeologic Framework of the New Jersey Coastal Plain. USGS Open-File Report 84-730, Regional Aquifer-System Analysis. 1984.

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Table 3-2
Site-Specific Geologic Formations
NWS Earle, Colts Neck, New Jersey

Site	Cretaceous to Miocene Formation at Surface	Tertiary to Quaternary Surficial Deposits
1	Paleocene Vincentown Formation	surficial deposits absent
2	Paleocene Vincentown Formation	outside of mapped area
3	Miocene Kirkwood Formation	outside of mapped area
4	Miocene Cohansey Sand	artificial fill
5	Miocene Kirkwood Formation	outside of mapped area
6	Upper Cretaceous Englishtown Formation	outside of mapped area
7	Upper Cretaceous Red Bank Sand	outside of mapped area
9	Upper Cretaceous Wenonah Formation and Mt. Laurel Sand	outside of mapped area
10	Miocene Kirkwood Formation	upper colluvium
11	Paleocene Vincentown Formation	upper colluvium
12	Upper Cretaceous Englishtown Formation	outside of mapped area
13	Paleocene Vincentown Formation	artificial fill
14	Miocene Kirkwood Formation	upper colluvium
15	Upper Cretaceous Englishtown Formation	outside of mapped area
16/F	Paleocene Vincentown Formation	upper colluvium
17	Upper Cretaceous Englishtown Formation	outside of mapped area
19	Miocene Kirkwood Formation	outside of mapped area
20	Miocene Kirkwood Formation	surficial deposits absent
22	Miocene Kirkwood Formation	upper colluvium
23	Miocene Kirkwood Formation	upper colluvium
24	Miocene Cohansey Sand	upland colluvium and gravel, undivided
25	Miocene Cohansey Sand	upland colluvium and gravel, undivided
26	Miocene Kirkwood Formation	upland gravel
27	Miocene Kirkwood Formation	outside of mapped area
29	Paleocene Vincentown Formation	upper colluvium
L	Miocene Kirkwood Formation	upper colluvium
Q	Miocene Kirkwood Formation	outside of mapped area

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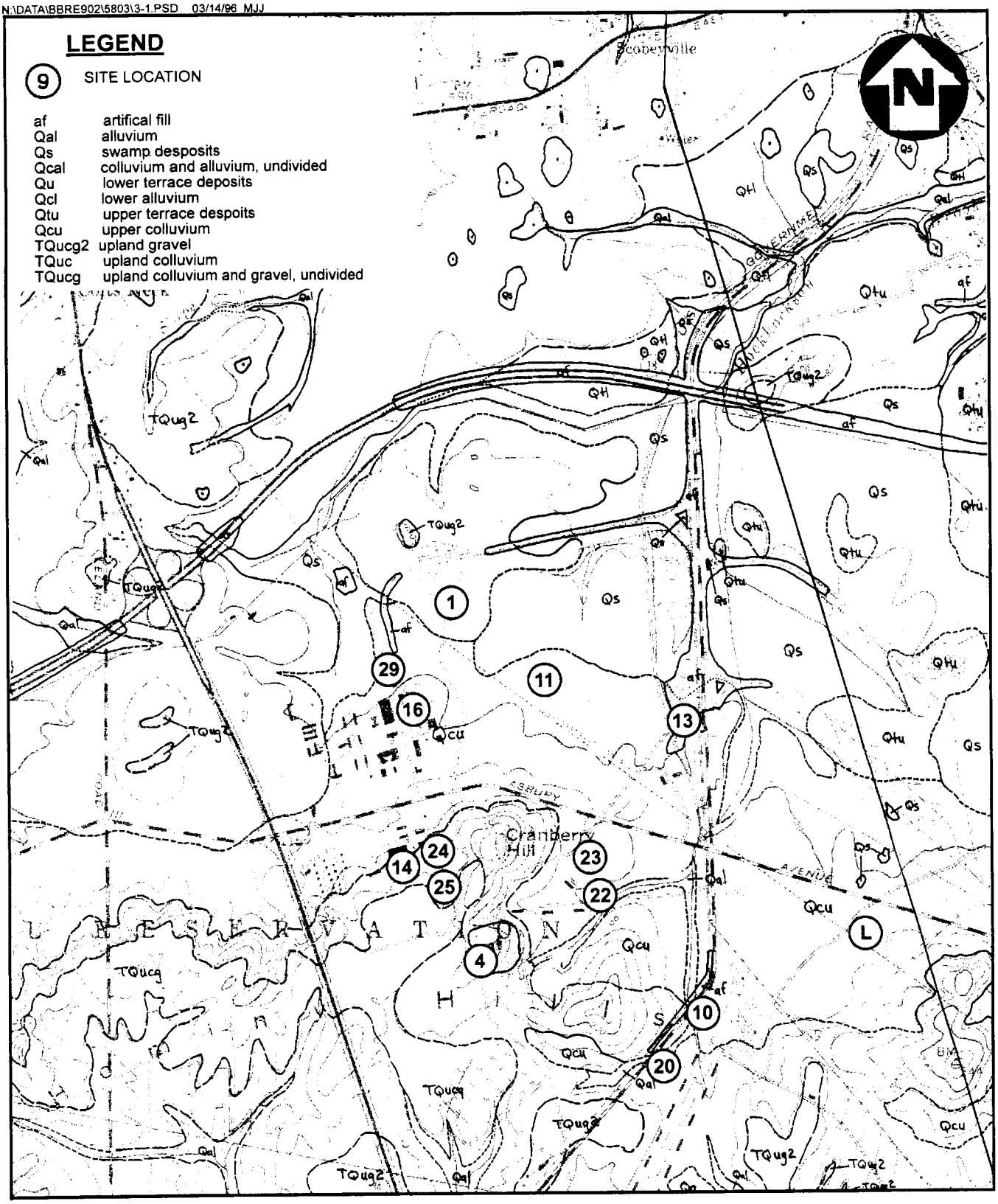

FIGURE 3-1

SURFICIAL DEPOSITS IN MAIN SIDE AREA
NAVAL WEAPONS STATION, EARLE, NJ

0 2000 4000
SCALE IN FEET

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Eolian deposits consist of fine- to medium-grained quartz sand that was derived from underlying formations. The eolian deposits have a maximum thickness of 10 feet and form low dunes.

The colluvium and alluvium unit, undivided, consists of bedded alluvial sand, silt, and minor gravel and massive colluvial sand to silty sand. These deposits have a maximum thickness of 10 feet and were deposited in narrow, steep-walled upland valleys. Modern stream channels may be entrenched as much as 8 feet into the colluvium and alluvium deposits.

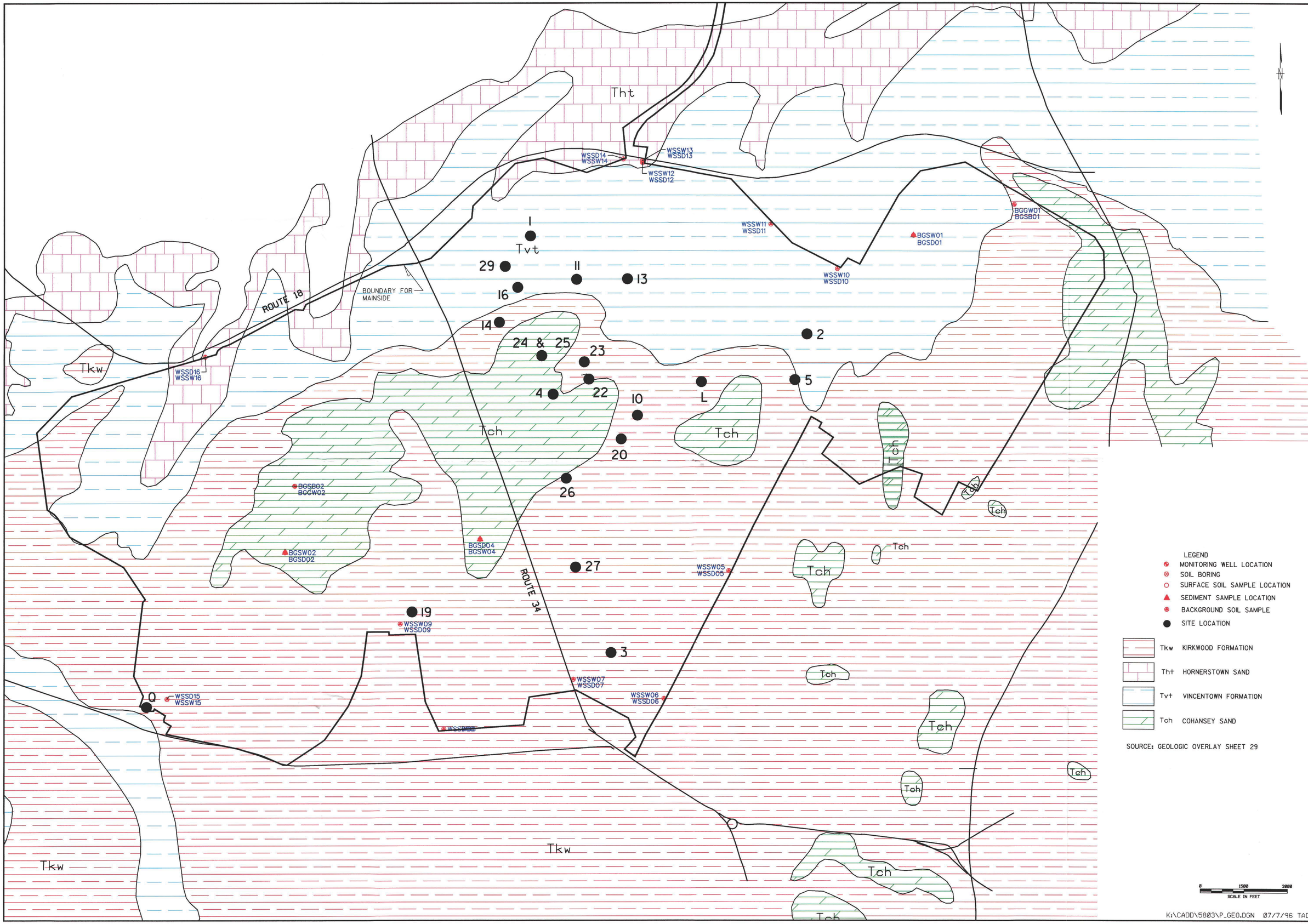
Upland gravel consists of sand and pebble gravel or pebble gravel and sand with minor cobble gravel. The upland gravel has a maximum thickness of 10 feet. The sand and pebble gravel cap hill tops and interfluve 60 to 100 feet above modern valley bottoms. The pebble gravel and sand cap the highest hills in the area. One Mainside site (Site 26) is located in an area mapped as upland gravel.

The upland colluvium and gravel unit, undivided, consists of coarse sand and granule and pebble gravel. These deposits have a maximum thickness of 10 feet and cap flat surfaces and aprons on lower ridgetops and interfluve in the Hominy Hills. The upland colluvium and gravel may have been deposited in lag gravel concentrations from the erosion of the underlying Miocene Cohansey sand. Two of the Mainside sites (Sites 24 and 25) are located in an area mapped as upland colluvium and gravel, undivided.

Artificial fill, consisting of excavated sand, silt, clay, gravel, and man-made materials, is present throughout NWS Earle. The fill has a maximum thickness of 20 feet and is found in railroad and road embankments, dams, and landfills. Two of the Mainside sites (Sites 4 and 13) are located in areas mapped as artificial fill.

3.4.3 Cretaceous to Miocene Coastal Plain Formations

The Upper Cretaceous to Miocene sediments that underlie the surficial deposits were deposited in alternating marine-shelfal and beach environments caused by alternating transgressive and regressive eustatic sea-level cycles. Deposition during the transgressive cycles was characterized by very fine-grained sediments and glauconite. Transgressive units of the New Jersey Coastal Plain include the Manasquan Formation, the Hornerstown Sand, and the Navesink, Marshalltown, and Merchantville Formations. The coarsening-upward sequences that overlie the glauconitic units are characterized by inner-shelf, near-shore, and beach sediments deposited during regressive sea cycles. Regressive units include the Cohansey Sand, the Kirkwood and Vincentown Formations, the Red Bank and Mount Laurel Sands, and the Wenonah and Englishtown Formations. The Upper Cretaceous to Miocene units that crop out in the Mainside and Waterfront/Chapel Hill areas are shown on Figures 3-2 and 3-3, respectively.



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REVISIONS

DESCRIPTION	DATE	APPROVED

EFD
A/E
DESIGN
DRAWN
REVIEW
CHIEF ARCH. / ENGR.
PROJECT MANAGER
FIRE PROTECTION
QUALITY CONTROL
BRANCH MANAGER
DESIGN DIRECTOR
SYM.

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PITTSBURGH, PA 15235

APPROVED DATE
ACTIVITY - SATISFACTORY TO
APPROVED DATE
FOR USE THE COMMANDER NAVFAC

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NORTHERN DIVISION
PHILADELPHIA, PENNSYLVANIA

NWS EARLE

GEOLOGIC MAP FOR THE MAINSIDE FACILITY
COLTS NECK, NEW JERSEY

SOURCE: NEW JERSEY GEOLOGICAL SURVEY MAP - GEOLOGICAL OVERLAY #29

CODE ID. NO. 80091	SIZE D
SCALE:	
EFD NO.	1" = 1500 Feet
STA. PROJ. NO.	
SPEC. NO.	
CONSTR. CONTR. NO.	
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FIGURE 3-2

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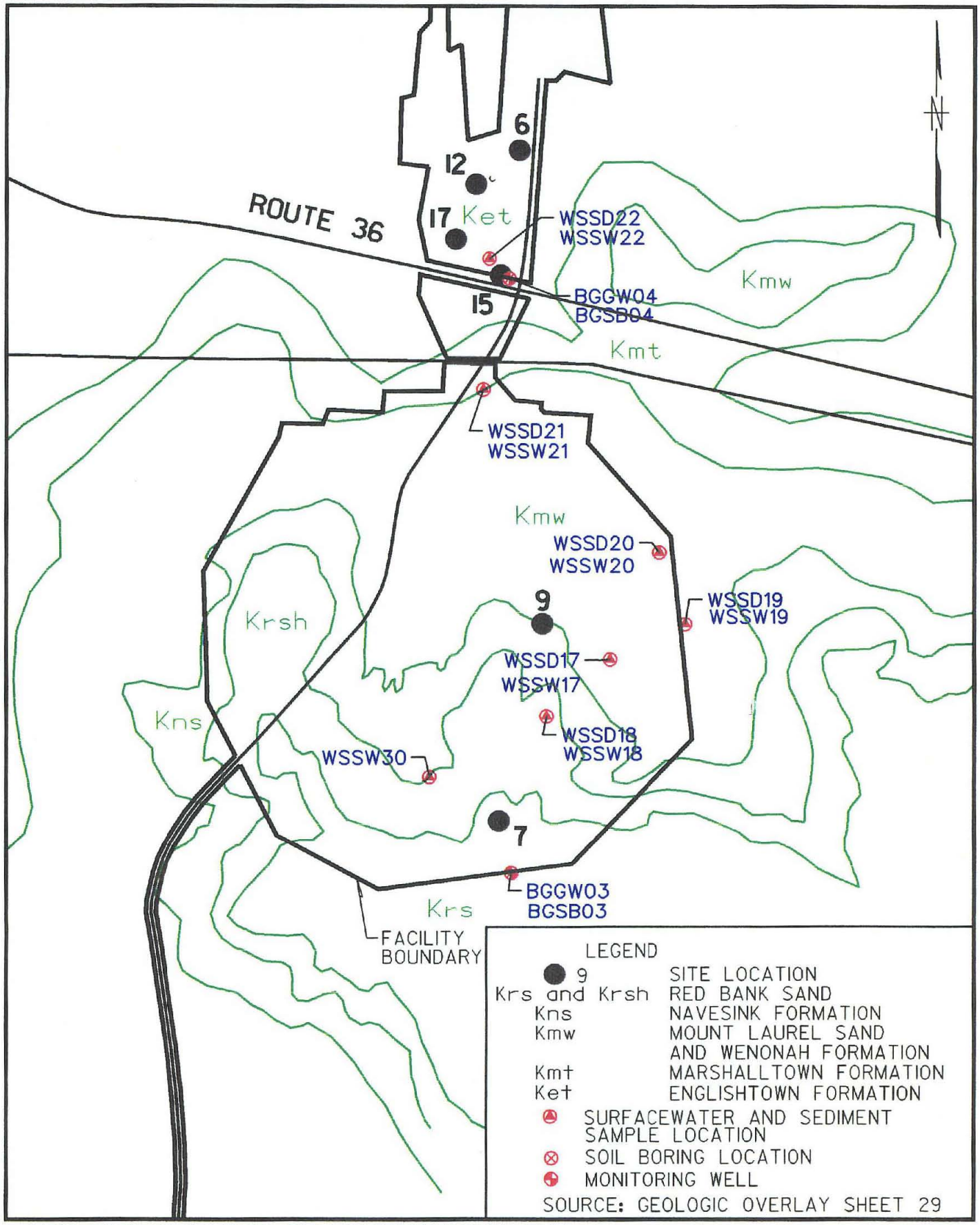

GEOLOGIC MAP FOR THE WATERFRONT AND CHAPEL HILL AREA

FIGURE 3-3

0 1500 3000

SCALE IN FEET

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The Miocene Cohansey Sand consists of light-colored, medium- to coarse-grained, pebbly quartz sand with local clay beds. The Cohansey Sand ranges from 0 to 30 feet in thickness in Monmouth County. Three of the Mainside sites (Sites 4, 24, and 25) are located in the outcrop area of the Cohansey Sand.

The Miocene Kirkwood Formation stratigraphically underlies the Cohansey Sand and consists of gray and tan, very fine- to medium-grained, quartz sand and dark-colored, micaceous diatomaceous clay. The Kirkwood Formation ranges from 60 to 100 feet in thickness in Monmouth County. Twelve of the Mainside sites (Sites 3, 5, 10, 14, 19, 20, 22, 23, 26, 27, L, and Q) are located in the outcrop area of the Kirkwood Formation.

The Eocene Piney Point, Shark River, and Manasquan Formations stratigraphically underlie the Kirkwood Formation and range from a fine- to coarse-grained glauconitic quartz sand to a silty and sandy clay. Based upon outcrop patterns, the Piney Point, Shark River, and Manasquan Formations do not occur beneath NWS Earle. The formations appear to be eroded in this area or are beyond their updip limit.

The Paleocene Vincentown Formation stratigraphically underlies the Manasquan Formation and consists of gray and green, glauconitic, fine- to coarse-grained sand and brown, clayey, very fossiliferous, glauconite and quartzitic calcarenite. The Vincentown Formation ranges from 10 to 130 feet in thickness in Monmouth County. Six Mainside sites (Sites 1, 2, 11, 13, 16/F, and 29) are located in the outcrop area of the Vincentown Formation.

The Paleocene Hornerstown Sand stratigraphically underlies the Vincentown Formation and consists of dark green, clayey, glauconitic, fine- to coarse-grained sand. The Hornerstown Sand ranges from 30 to 100 feet in thickness in Monmouth County and crops out in the Mainside area.

The Upper Cretaceous Tinton Sand stratigraphically underlies the Hornerstown Formation and consists of brown and gray, glauconitic, clayey, micaceous quartz sand. The Tinton Sand does not crop out in the vicinity of NWS Earle. The Upper Cretaceous Red Bank Sand stratigraphically underlies, and is lithologically similar to, the Tinton Sand. The Red Bank and Tinton Sands, combined, range from 30 to 135 feet in thickness in Monmouth County. One Chapel Hill site (Site 7) is located in the outcrop area of the Red Bank Sand.

The Upper Cretaceous Navesink Formation stratigraphically underlies the Red Bank Sand and consists of clayey, silty, glauconitic, green and black, medium- to coarse-grained sand. The Navesink Formation ranges from 10 to 45 feet in thickness in Monmouth County and crops out in the Chapel Hill area.

The Upper Cretaceous Mount Laurel Sand underlies the Navesink Formation and consists of brown and gray, slightly glauconitic, fine- to coarse-grained quartz sand. The Upper Cretaceous Wenonah Formation stratigraphically underlies the Mount Laurel Sand and consists of gray and brown, silty, slightly glauconitic, very fine- to fine-grained sand. These formations are mapped together because of their lithologic similarity. The formations range from 15 to 85 feet in thickness in Monmouth County. One of the two Chapel Hill sites (Site 9) is located in the combined outcrop area of the Wenonah Formation and Mount Laurel Sand.

The Upper Cretaceous Marshalltown Formation stratigraphically underlies the Wenonah Formation and consists of dark greenish-gray clay and glauconitic quartz sand. The Marshalltown Formation ranges from 30 to 50 feet in thickness in Monmouth County and crops out in the Waterfront and Chapel Hill areas.

The Upper Cretaceous Englishtown Formation stratigraphically underlies the Marshalltown Formation and consists of tan and gray, fine- to medium-grained quartz sand with local clay beds. The Englishtown Formation ranges from 35 to 150 feet in thickness in Monmouth County. The four Waterfront area sites (Sites 6, 12, 15, and 17) are located in the outcrop area of the Englishtown Formation.

The Woodbury Clay stratigraphically underlies the Englishtown Formation and consists of gray clay and black, micaceous silt. The Woodbury Clay has an average thickness of 50 feet in Monmouth County. The Woodbury Clay does not crop out in the vicinity of NWS Earle.

The Upper Cretaceous Merchantville Formation stratigraphically underlies Woodbury Clay and consists of gray and black, glauconitic, micaceous clay with locally very fine-grained quartz and glauconite sand. The Merchantville Formation averages between 50 and 60 feet in thickness in Monmouth County. The Merchantville Formation does not crop out in the vicinity of NWS Earle.

The Upper Cretaceous Magothy Formation stratigraphically underlies the Merchantville Formation and consists of sheet deposits of coarse beach sand and other associated near-shore marine deposits. The Magothy Formation ranges from 25 to 175 feet in thickness in Monmouth County. The Magothy Formation does not crop out in the vicinity of NWS Earle.

The Upper Cretaceous Raritan Formation stratigraphically underlies the Magothy Formation and consists of alternating sequences of clay, silt, sand, and gravel that were primarily deposited in a fluvial-continental environment. The Raritan Formation ranges from 150 to more than 400 feet in thickness in Monmouth County. In downdip positions near the coast, the glauconite and shell beds of the Raritan Formation are indicative of a marine depositional environment. The Raritan Formation does not crop out in the vicinity of NWS Earle.

The Lower to Upper Cretaceous Potomac Group stratigraphically underlies the Raritan Formation and consists of alternating sequences of clay, silt, sand, and gravel that were deposited in a continental environment. The oldest sediments deposited on the pre-Cretaceous basement-bedrock complex are of the Lower to Upper Cretaceous Potomac Group. The Potomac Group does not crop out in the vicinity of NWS Earle.

3.5 SOILS

The soils mapped at NWS Earle are described in the Soil Survey of Monmouth County, New Jersey (United States Department of Agriculture, Soil Conservation Service, 1990). The most prevalent soil series mapped in the Mainside, Waterfront, and Chapel Hill areas are summarized in Table 3-3; site-specific soils are summarized in Table 3-4. Mainside soils formed in acid, loamy or sandy, Coastal Plain sediments, Waterfront soils formed in acid, clayey Coastal Plain sediments, and Chapel Hill soils formed in acid, loamy, glauconitic Coastal Plain sediments. Slopes range from zero to 25 percent and the soils are generally extremely acid to strongly acid.

Metals concentrations were determined for 80 samples collected between 1985 and 1987 at select background locations in New Jersey (see NJDEP Site Remedial Program and Division of Science and Research A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey. September 1993). Nine of the 80 samples were collected in soil series considered prevalent at NWS Earle: Manahawkin, Atsion, Freehold, Keyport, Lakewood, Sassafrass, Holmdel, and Adelphia Series. The series sampled, sample numbers counting the samples collected in and land use at each sample location are summarized for the above series is Table 3-5. Metal results are summarized in Table 3-6; the range of positive detects, frequency of positive results, and media value are also provided for each analyte.

3.6 HYDROGEOLOGY

The following section describes the regional hydrogeologic framework in the vicinity of NWS Earle and discusses the regulatory classification of the aquifers. Hydrogeologic parameters such as the depth to the water table and groundwater flow direction are highly variable and are dependent on local conditions such as topography, location relative to discharge points, and proximity to external stresses such as well pumpage. The site-specific hydrogeologic conditions are discussed in Sections 4 through 29.

Table 3-3
Prevalent Soils Series
NWS Earle, Colts Neck, New Jersey

Prevalent Soils in the Mainside Area			
Atsion Series	Evesboro Series	Humaquepts	Keyport Series
Klej Series	Lakehurst Series	Lakewood Series	Manahawkin Series
Marlton Series	Pemberton Series	Pits	Sassafras Series
Shrewsbury Series	Tinton Series	Udorthents	

Prevalent Soils in the Waterfront Area		
Elkton Series	Sulfaquents and Sulfihemists	Udorthents-Urban land complex

Prevalent Soils in the Chapel Hill Area			
Adelphia Series	Collington Series	Colts Neck Series	Freehold Series
Holmdel Series	Phalanx Series	Psamments	Tinton Series
Psamments			

Table 3-4
Site-Specific Soils
NWS Earle, Colts Neck, New Jersey

Site	Soil Name	Description	Permeability (in/in)	Soil Reaction (pH)
1	Udorthents, smoothed	loamy material	N/A	N/A
2	Lakewood sand, 0 to 5 percent slopes	sand, loamy sand, and gravelly sand	0.6-20	3.6-5.0
3	Lakehurst sand, 0 to 2 percent slopes	sand	6.0-20	3.6-5.0
4	Pits, sand and gravel	sandy material with varying amounts of gravel and sandstone fragments	N/A	N/A
5	Lakewood sand, 0 to 5 percent slopes	sand, loamy sand, and gravelly sand	0.6-20	3.6-5.0
6	Sulfaquents and Sulfihemists, frequently flooded	organic material	N/A	N/A
7	Psamments, waste substratum		N/A	N/A
9	Udorthents, smoothed	loamy material	N/A	N/A
10	Udorthents, smoothed	loamy material	N/A	N/A
11	Atsion sand	sand to loamy sand	0.2-20	3.6-5.0
12	Udorthents-Urban land complex, 0 to 3 percent slopes	loamy material	N/A	N/A
13	Udorthents, smoothed	loamy material	N/A	N/A
14	Udorthents, smoothed	loamy material	N/A	N/A
15	Elkton loam	loam and silty clay	<0.2-6.0	3.5-5.5
16/F	Udorthents, smoothed	loamy material	N/A	N/A

Table 3-4
Site-Specific Soils
NWS Earle, Colts Neck, New Jersey
Page 2 of 2

Site	Soil Name	Description	Permeability (in/in)	Soil Reaction (pH)
17	Udorthents-Urban land complex, 0 to 3 percent slopes	loamy material	N/A	N/A
19	Atsion sand	sand to loamy sand	0.2-20	3.6-5.0
20	Udorthents, smoothed	loamy material	N/A	N/A
22	Udorthents, smoothed	loamy material	N/A	N/A
23	Udorthents, smoothed	loamy material	N/A	N/A
24	Evesboro sand, 10 to 15 percent slopes	sand	6.0-20	3.6-5.0
25	Evesboro sand, 10 to 15 percent slopes	sand	6.0-20	3.6-5.0
26	Lakehurst sand, 0 to 2 percent slopes	sand	6.0-20	3.6-5.0
27	Udorthents, smoothed	loamy material	N/A	N/A
29	Udorthents, smoothed	loamy material	N/A	N/A
L	Tinton loamy sand, 5 to 10 percent slopes	loamy sand, sandy clay loam, and loamy sand	0.6-6.0	3.6-5.5
Q	Manahawkin muck	muck, loamy sand and sand	2.0-20	3.6-5.5

N/A - Not Available

TABLE 3-5
SUMMARY INFORMATION ON BACKGROUND SOIL SAMPLES
NAVAL WEAPONS STATION EARLE, NEW JERSEY

Sample No.	County	Soil Series	Land Use
10	Ocean	Manahawkin	Rural
13	Burlington	Atsion	Rural
19	Monmouth	Freehold	Rural
20	Monmouth	Keyport	Rural
26	Hunterdon	Disturbed Soil	Urban
29	Ocean	Disturbed Soil	Urban
30	Camden	Lakewood Series	Rural
32	Atlantic	Disturbed Soil	Urban
34	Cape May	Sassafras	Rural
37	Middlesex	Sassafras	Rural
39	Passaic	Disturbed Soil	Suburban
40	Passaic	Disturbed Soil	Suburban
42	Hudson	Disturbed Soil	Urban
43	Essex	Disturbed Soil	Urban
44	Essex	Disturbed Soil	Urban

TABLE 3-6
TYPICAL STATE-WIDE BACKGROUND METAL CONCENTRATIONS
NAVAL WEAPONS STATION EARLE, NEW JERSEY

Analyte (mg/kg)	Sample No. 10	Sample No. 13	Sample No. 19	Sample No. 20	Sample No. 30	Samples No. 34 & 37		Sample No. 35	Sample No. 36	Range of Values/ No. of Positive Detects	Median Value
	Manahawkin Series [1]	Atsion Series	Freehold Series	Keyport Series	Lakewood Series	Sassafras Series		Holmdel Series	Adelphia Series		
Antimony	ND	ND	NA	NA	0.04	ND	0.02	ND	ND	0.02-0.04 / 2	0.03
Arsenic	4.78	0.23	17.1	2.85	0.14	0.06	8.41	4.56	10.7	0.06-17.1 / 9	4.78
Beryllium	1.63	0.02	0.76	1.07	ND	0.22	0.70	0.09	0.88	0.02-1.63 / 8	0.88
Cadmium	0.146	0.011	0.079	0.03	0.007	0.016	0.164	0.116	0.135	0.011-0.164 / 9	0.079
Chromium	9.7	3.7	20.7	18.9	1.0	4.2	14.3	10.4	14.0	1.0-20.9 / 9	10.4
Copper	10.4	1.31	5.57	5.25	0.78	1.77	41.7	6.05	7.27	0.78-41.7 / 9	5.57
Lead	46.0	7.4	44.3	18.5	5.0	8.0	58.9	25.9	15.1	8.0-58.9 / 9	25.9
Manganese	7	3	28	27	4	17	86	59	120	3-12- / 9	27
Mercury	0.11	ND	0.17	ND	ND	0.1	0.14	ND	ND	0.1-0.17 / 4	0.14
Nickel	6.6	ND	7.6	6.4	ND	2.1	8.5	3.2	8.3	2.1-8.5 / 7	6.6
Selenium	0.80	ND	0.10	0.11	ND	0.05	0.05	0.11	0.17	0.05-0.80 / 7	0.11
Silver	0.03	0.01	0.11	0.10	0.01	0.19	0.42	0.21	0.26	0.01-0.42 / 9	0.19
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	- / 0	-
Vanadium	5.3	0.9	23.5	23.6	1.0	0.7	19.4	1.3	14.0	0.7-23.6 / 9	5.3
Zinc	27.0	5.5	25.5	35.1	3.4	9.5	40.6	44.6	28.1	3.4-44.6 / 9	28.1
Site included in this report underlain law by soil of the same series	Q	11 and 29	(2)	(2)	2 and 5	(2)		(2)	(2)		

1 Sample was collected from a cedar bog in the Pine Barrens.
2 No site included in this report is underlain by a soil in this series.

3.6.1 Aquifer Classification

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

3.6.2 Hydrogeologic Units

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.

Recharge to the groundwater system is through the infiltration of precipitation, seepage from surface water bodies, and leakage through semiconfining beds. Groundwater discharge is induced by movement to overlying surface-water bodies, by evapotranspiration, and by withdrawal from wells. Generally, the regressive depositional units (the Cohansey Sand, the Kirkwood and Vincentown Formations, the Red Bank and Mount Laurel Sands, and the Wenonah and Englishtown Formations) form aquifers and the transgressive depositional units (the Manasquan Formation, the Hornerstown Sand, and the Navesink, Marshalltown, and Merchantville Formations) form confining or semiconfining beds.

The regional hydrogeologic classification system defined in the Hydrogeologic Framework of the New Jersey Coastal Plain, Regional Aquifer-System Analysis (O.S. Zapecza, 1984) has been followed for this report and is summarized in Table 3-1. 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.

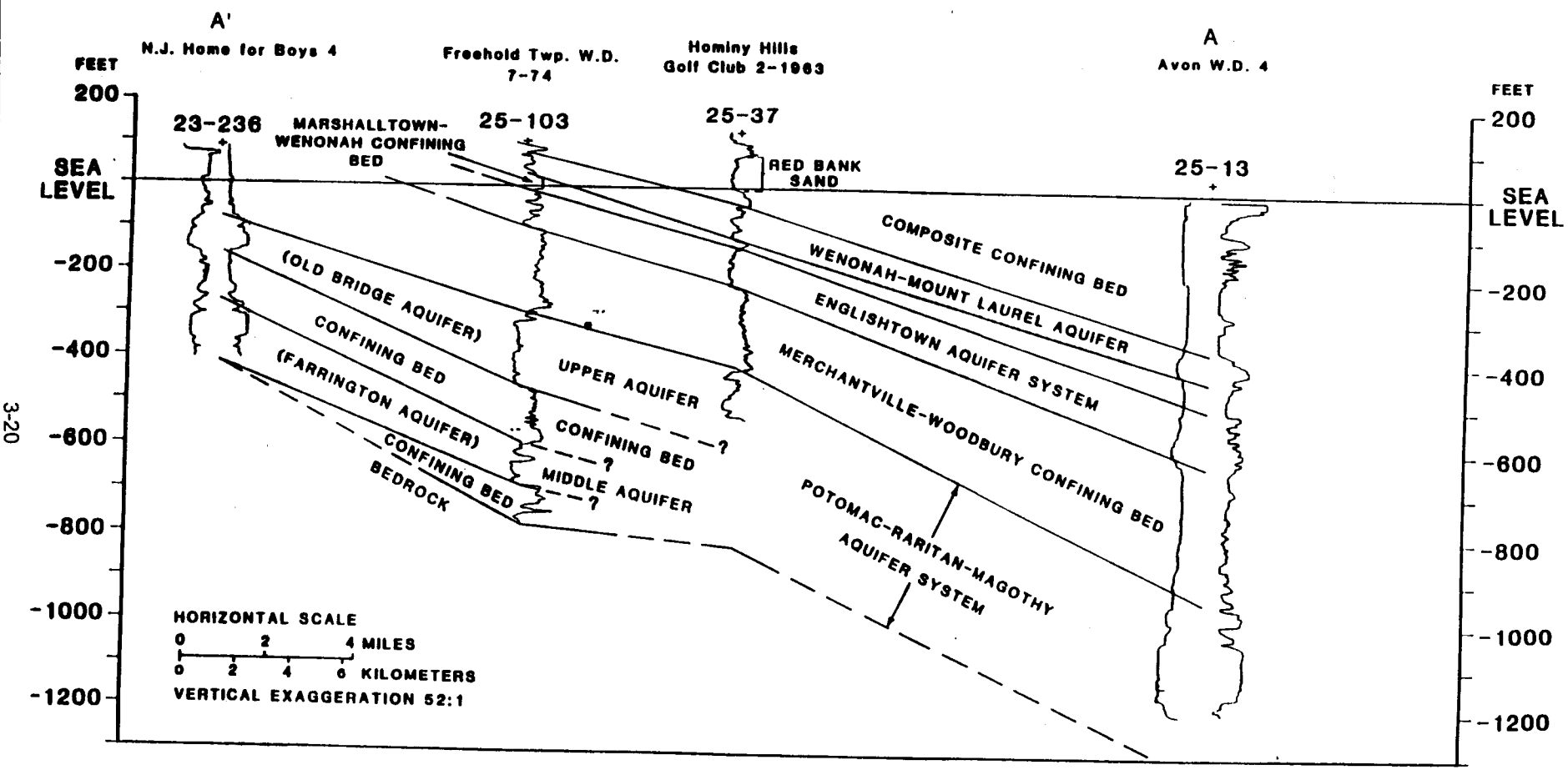
Mainside is situated in the recharge area of the Kirkwood-Cohansey aquifer system and the Vincentown aquifer. Waterfront and Chapel Hill are situated in the recharge areas of the Wenonah-Mount Laurel aquifer system, the Englishtown aquifer, and the Red Bank Sand aquifer. Generalized hydrogeologic cross-sections for the Mainside and Waterfront-Chapel Hill areas are provided in Figures 3-4 and 3-5, respectively.

The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system was reported in previous investigations as being used extensively for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation. Fifteen of the Mainside sites (Sites 3, 4, 5, 10, 14, 19, 20, 22, 23, 24, 25, 26, 27, L, and Q) are located in the recharge area of the Kirkwood-Cohansey aquifer system.

The Atlantic City 800-foot sand (lower Kirkwood Formation) is a significant source of water in the Coastal Plain and is separated from other sands in the Kirkwood Formation by a confining unit. The Atlantic City 800-foot sand is not present in the NWS Earle area.

The Wenonah-Mount Laurel aquifer system is an important source of water in Monmouth County and is developed in the sands of the Wenonah Formation and Mount Laurel Sand. Although these formations are distinct lithological units, they are hydraulically connected. This aquifer system is underlain by semiconfining beds of the Wenonah and Marshalltown Formations. One of the Chapel Hill sites (Site 9) is located in the recharge area of the Wenonah-Mount Laurel aquifer system. This aquifer was reported in previous investigations as not being used as a source of potable water in the Waterfront-Chapel Hill areas.

The Englishtown aquifer is a significant source of water in Monmouth County and is developed in the sands of the Englishtown Formation. This aquifer is underlain by confining beds of the Woodbury Clay and Merchantville Formation. The four Waterfront sites (Sites 6, 12, 15, and 17) are located in the recharge



SOURCE: U.S.G.S. OPEN-FILE REPORT 84-730. HYDROGEOLOGIC FRAMEWORK OF THE NEW JERSEY COSTAL PLAIN.

FIGURE 3-4

GENERALIZED HYDROGEOLOGIC CROSS-SECTION FOR THE MAINSIDE AREA
NWS EARLE, COLTS NECK, NEW JERSEY

Brown & Root Environmental

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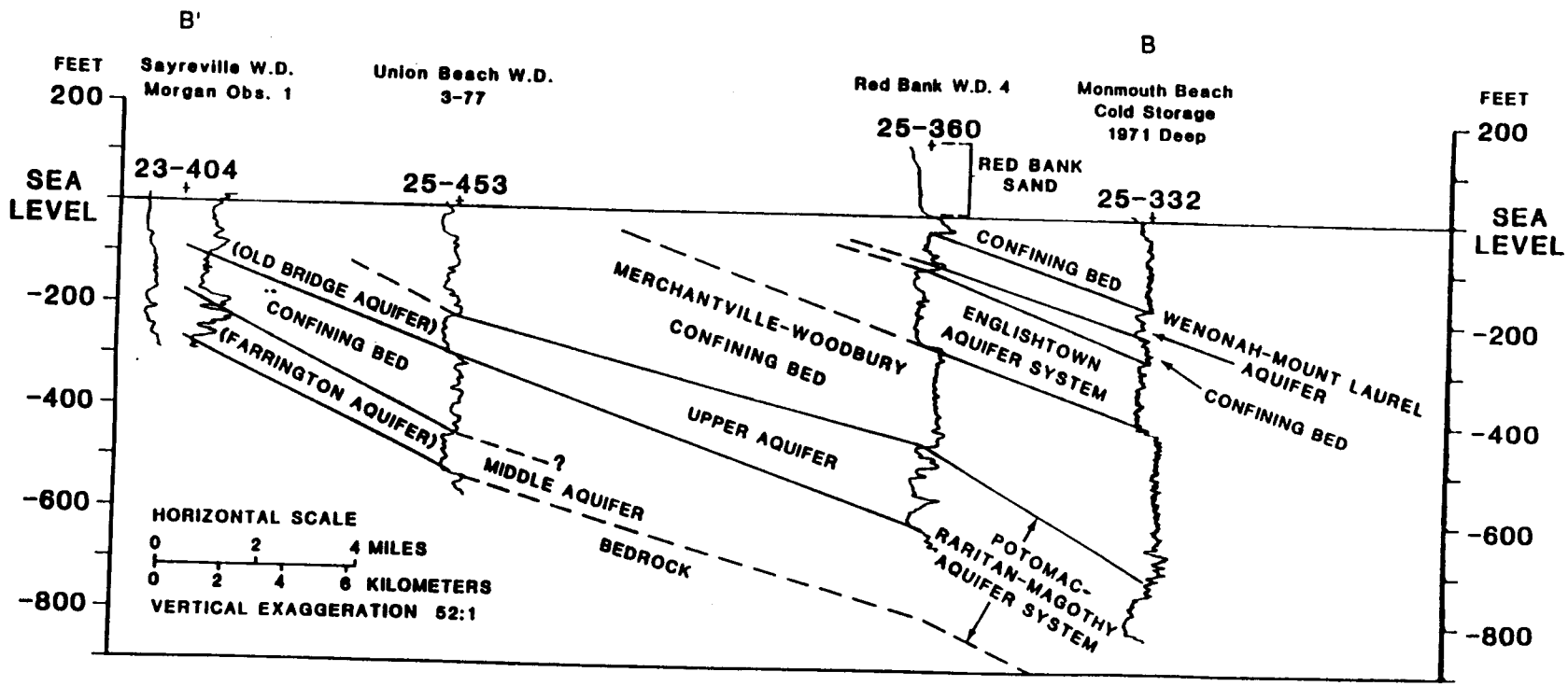

SOURCE: U.S.G.S. OPEN-FILE REPORT 84-730. HYDROGEOLOGIC FRAMEWORK OF THE NEW JERSEY COSTAL PLAIN.

FIGURE 3-5

GENERALIZED HYDROGEOLOGIC CROSS-SECTION FOR THE WATERFRONT AREA
NWS EARLE, COLTS NECK, NEW JERSEY

Brown & Root Environmental

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area of the Englishtown aquifer. This aquifer is probably not used as a source of potable water in the Waterfront-Chapel Hill areas because residences adjacent to these areas are supplied by municipal water systems.

The Potomac-Raritan-Magothy aquifer system underlies the entire New Jersey Coastal Plain and is the most heavily pumped aquifer in the Coastal Plain. This aquifer system is the primary source of groundwater supply in Monmouth County. The Potomac-Raritan-Magothy aquifer system is composed of three aquifers (an upper, a middle, and a lower aquifer) that are separated by confining beds. The upper aquifer is developed in the sands of the Magothy Formation and is underlain by confining beds of the Raritan Formation. The middle aquifer is developed in the sands of the Raritan Formation and is underlain by confining beds of the Potomac Group. The lower aquifer is developed in the sands of the Potomac Group and is underlain by crystalline rocks and metamorphic schists and gneiss of the pre-Cretaceous basement-bedrock complex. The recharge area of the Potomac-Raritan-Magothy aquifer system is located several miles north and west of the Mainside area. Two out-of-service 800-feet-deep water supply wells are located in Mainside; when operational, they produced from the middle and lower aquifers of the Potomac-Raritan-magothy aquifer system.

The Piney Point aquifer is developed in the sands of the Piney Point Formation and is underlain by confining beds of the Shark River and Manasquan Formations. The Piney Point aquifer is not present in the subsurface beneath NWS Earle.

The Vincentown aquifer is developed in the sands and calcarenites of the Vincentown Formation within its outcrop area and extends for approximately 8 to 10 miles downdip. The Vincentown aquifer was reported in previous investigations as being used extensively for residential wells in the Mainside area. This aquifer is underlain by confining beds of the Hornerstown and Tinton Sands. Six of the Mainside sites (Sites 1, 2, 11, 13, 16/F, and 29) are located in the recharge area of the Vincentown aquifer.

The Red Bank Sand aquifer is developed in the Red Bank Sand. This aquifer is underlain by confining beds of the Navesink Formation. One of the Waterfront sites (Site 7) is located in the recharge area of the Red Bank Sand aquifer. This aquifer is probably not used as a source of potable water in the Waterfront-Chapel Hill areas because residences adjacent to these areas are supplied by municipal water systems.

3.6.3 Hydraulic Conductivity

Twenty-eight monitoring wells, including four background wells, were installed as part of this RI. Table 3-7 summarizes the well numbers, formation mapped at the surface location, and the interpreted aquifer for the wells present at each site. Quantitative estimates of hydraulic conductivity have been calculated from rising-head slug tests performed on various monitoring wells located at NWS Earle, including nine of

TABLE 3-7
SUMMARY OF ESTIMATED HYDRAULIC CONDUCTIVITIES BY WELL
NWS EARLE, COLTS NECK, NEW JERSEY

Well Number	Formation Mapped at Surface	Interpreted Aquifer	Hydraulic Conductivity	
			K (cm/sec)	K (ft/day)
MW1-04	Vincentown Formation	Vincentown Formation	6.06×10^{-4}	1.72
MW1-05	Vincentown Formation	Vincentown Formation	1.29×10^{-3}	3.66
MW2-01	Vincentown Formation	Vincentown Formation	4.67×10^{-3}	13.24
MW2-05	Vincentown Formation	Vincentown Formation	4.62×10^{-4}	1.31
MW2-06	Vincentown Formation	Vincentown Formation	4.23×10^{-5}	0.12
MW2-07	Vincentown Formation	Vincentown Formation	1.73×10^{-4}	0.49
MW3-03	Kirkwood Formation	Kirkwood Formation	7.16×10^{-4}	2.03
MW3-06	Kirkwood Formation	Kirkwood Formation	5.50×10^{-4}	1.56
MW4-04	Cohansey Sand	Cohansey Sand	4.48×10^{-4}	1.27
MW5-02	Kirkwood Formation	Kirkwood/Vincentown Formations	3.18×10^{-4}	0.90
MW5-06	Kirkwood Formation	Kirkwood Formation	6.46×10^{-4}	1.83
MW5-07	Kirkwood Formation	Vincentown Formation	2.08×10^{-4}	0.59
MW7-02	Red Bank Sand	Red Bank Sand/Navesink Formation	9.74×10^{-4}	2.76
MW7-03	Red Bank Sand	Red Bank Sand	2.65×10^{-4}	0.75
MW10-04	Kirkwood Formation	Kirkwood/Vincentown Formations	2.54×10^{-4}	0.72
MW10-05	Kirkwood Formation	upper colluvium and Kirkwood/Vincentown Formations	6.99×10^{-4}	1.98
MW10-07	Kirkwood Formation	Kirkwood/Vincentown Formations	1.75×10^{-3}	4.96
MW11-02	Vincentown Formation	Vincentown Formation	3.56×10^{-4}	1.01
MW11-04	Vincentown Formation	upper colluvium and Vincentown Formation	8.64×10^{-4}	2.45
MW13-04	Vincentown Formation	Vincentown Formation	2.64×10^{-5}	0.075

TABLE 3-7
SUMMARY OF ESTIMATED HYDRAULIC CONDUCTIVITIES BY WELL
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

Well Number	Formation Mapped at Surface	Interpreted Aquifer	Hydraulic Conductivity	
			K (cm/sec)	K (ft/day)
MW16-01	Vincentown Formation	Vincentown	3.48×10^{-4}	0.99
MW16-06	Vincentown Formation	upper colluvium and Vincentown	1.39×10^{-3}	3.94
MW19-04	Kirkwood Formation	Kirkwood and Vincentown	6.91×10^{-4}	1.96
MW19-05	Kirkwood Formation	Kirkwood and Vincentown	1.06×10^{-3}	3.00
MW23-01	Kirkwood Formation	Kirkwood and Vincentown	2.79×10^{-3}	7.91
MW23-02	Kirkwood Formation	Kirkwood and Vincentown	2.04×10^{-3}	5.78
MW26-01	Kirkwood Formation	Kirkwood Formation	3.85×10^{-4}	1.09
MW26-03	Kirkwood Formation	Kirkwood Formation	1.92×10^{-3}	5.44
MW26-04	Kirkwood Formation	Kirkwood Formation	7.09×10^{-4}	2.01

the 28 new wells. The hydraulic conductivities from each test, which were calculated using either the Bower and Rice or Hvorslev methods, are listed in Table 3-8. The calculations are included in Appendix H. The interpreted aquifers are based on the geologic map and the site-specific lithologic descriptions. The range and average values of hydraulic conductivity for each aquifer are summarized in Table 3-9. In general, the average hydraulic conductivities calculated for the various aquifers are within one order of magnitude of each other.

3.7 WATER SUPPLY

All facilities located in the Waterfront area and the Mainside Administration area are connected to the 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 well or surface water intake is located on the NWS Earle facility.

A combination of private wells and public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Mainside and Waterfront facilities. A map obtained from Monmouth County Health Department shows the location of public non-community (PNC) wells within 1 mile of the site (Figure 3-6). These wells typically serve commercial or industrial establishments where more than 25 people consume the water. It is estimated all PNC wells are currently in service.

One PNC type well, located west of Highway 34, taps a deep (approximately 200 feet) aquifer source to feed a 300,000-gallon storage tank. Operations buildings draw water from the tank for general industrial use such as fire protection and for potable water uses. This well is located closest to background well BG MW-02, more than 1 mile from any area of concern. Periodic sampling results for a wide suit of drinking water parameters have shown compliances with drinking water standards.

3.7.1 Private Wells

An inventory map of domestic wells within 1 mile of the site was provided by Monmouth County Health Department (Figure 3-7). The domestic well map shows approximate locations (well driller estimates) of domestic wells. It is estimated that 90 percent or more of these wells are currently in use, including some at NWS Earle. However, results of RI activities to date indicate that no measurable concentration of any contaminant of concern exists in groundwater near the facility boundary or is moving off-post.

TABLE 3-8
SUMMARY OF ESTIMATED HYDRAULIC CONDUCTIVITIES BY WELL
NWS EARLE, COLTS NECK, NEW JERSEY

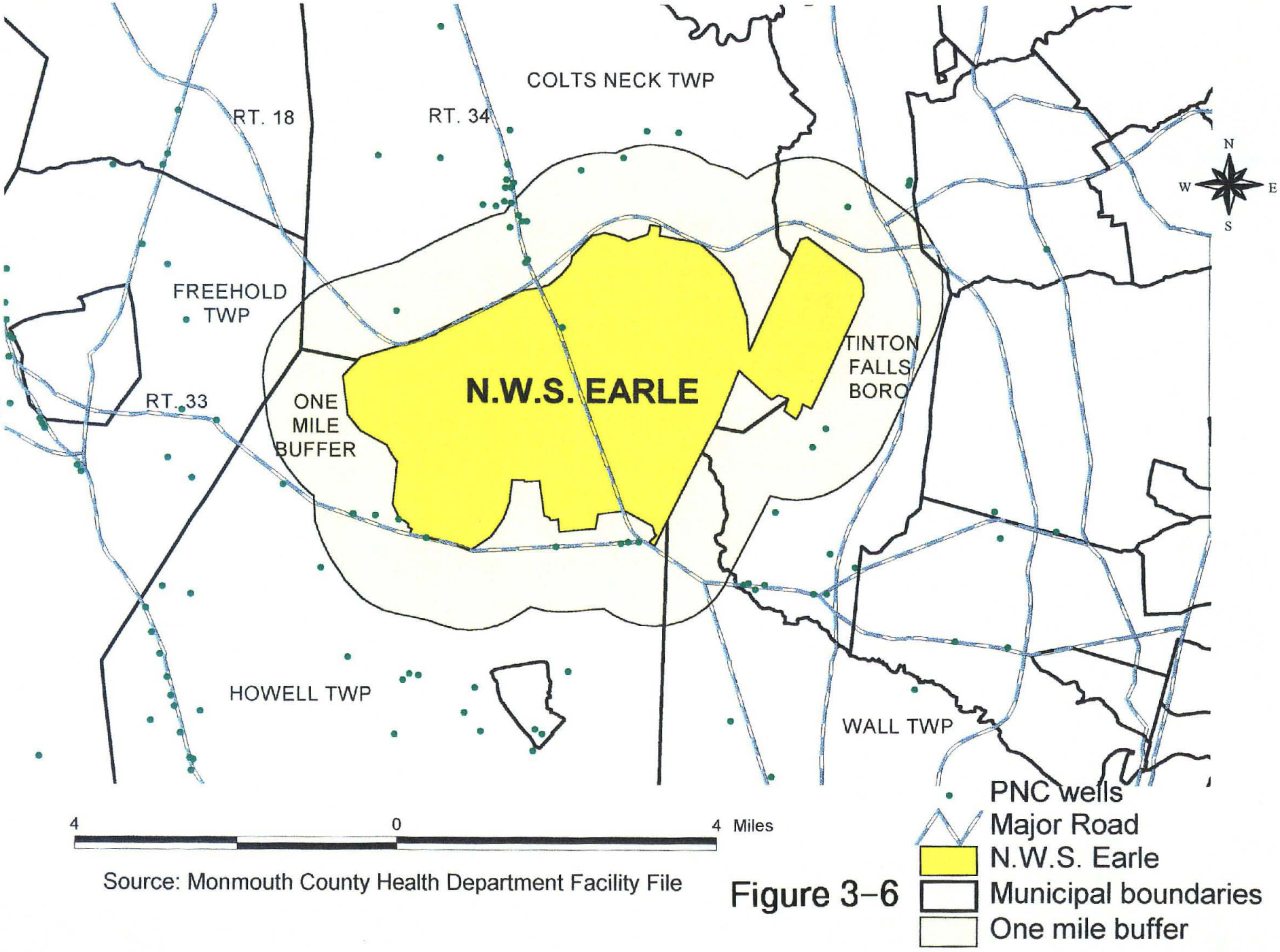
Well Number	Formation Mapped at Surface	Interpreted Aquifer	Hydraulic Conductivity	
			K (cm/sec)	K (ft/day)
MW16-01	Vincentown Formation	Vincentown	3.48×10^{-4}	0.99
MW16-06	Vincentown Formation	upper colluvium and Vincentown	1.39×10^{-3}	3.94
MW19-04	Kirkwood Formation	Kirkwood and Vincentown	6.91×10^{-4}	1.96
MW19-05	Kirkwood Formation	Kirkwood and Vincentown	1.06×10^{-3}	3.00
MW23-01	Kirkwood Formation	Kirkwood and Vincentown	2.79×10^{-3}	7.91
MW23-02	Kirkwood Formation	Kirkwood and Vincentown	2.04×10^{-3}	5.78
MW26-01	Kirkwood Formation	Kirkwood Formation	3.85×10^{-4}	1.09
MW26-03	Kirkwood Formation	Kirkwood Formation	1.92×10^{-3}	5.44
MW26-04	Kirkwood Formation	Kirkwood Formation	7.09×10^{-4}	2.01

TABLE 3-9
SUMMARY OF HYDRAULIC CONDUCTIVITIES BY FORMATION
NWS EARLE, COLTS NECK, NEW JERSEY

Interpreted Aquifer	Frequency (Number of Wells)	Range of Hydraulic Conductivity	Average Hydraulic Conductivity
upper colluvium and Kirkwood and Vincentown Formations	1	6.99×10^{-4} cm/sec	N/A
		2.76 ft/day	N/A
upper colluvium and Vincentown Formation	2	8.64×10^{-4} to 1.39×10^{-3} cm/sec	8.21×10^{-4} cm/sec
		1.09 to 5.44 ft/day	2.33 ft/day
Cohansey Sand	1	4.48×10^{-4} cm/sec	N/A
		1.27 ft.day	N/A
Kirkwood Formation	6	3.85×10^{-4} to 1.92×10^{-3} cm/sec	8.21×10^{-4} cm/sec
		1.09 to 5.44 ft/day	2.33 ft/day
Kirkwood and Vincentown Formations	7	2.54×10^{-4} to 2.79×10^{-3} cm/sec	1.27×10^{-3} cm/sec
		0.72 to 7.91 ft/day	3.64 ft/day
Vincentown Formations	10	2.64×10^{-5} to 4.67×10^{-3} cm/sec	8.19×10^{-4} cm/sec
		0.75 to 13.24 ft/day	2.32 ft/day
Red Bank Sand	1	2.65×10^{-4} cm/sec	N/A
		0.75 ft/day	N/A
Red Bank Sand and Navesink Formation	1	9.74×10^{-4} cm/sec	N/A
		2.76 ft/day	N/A

N/A Not Applicable

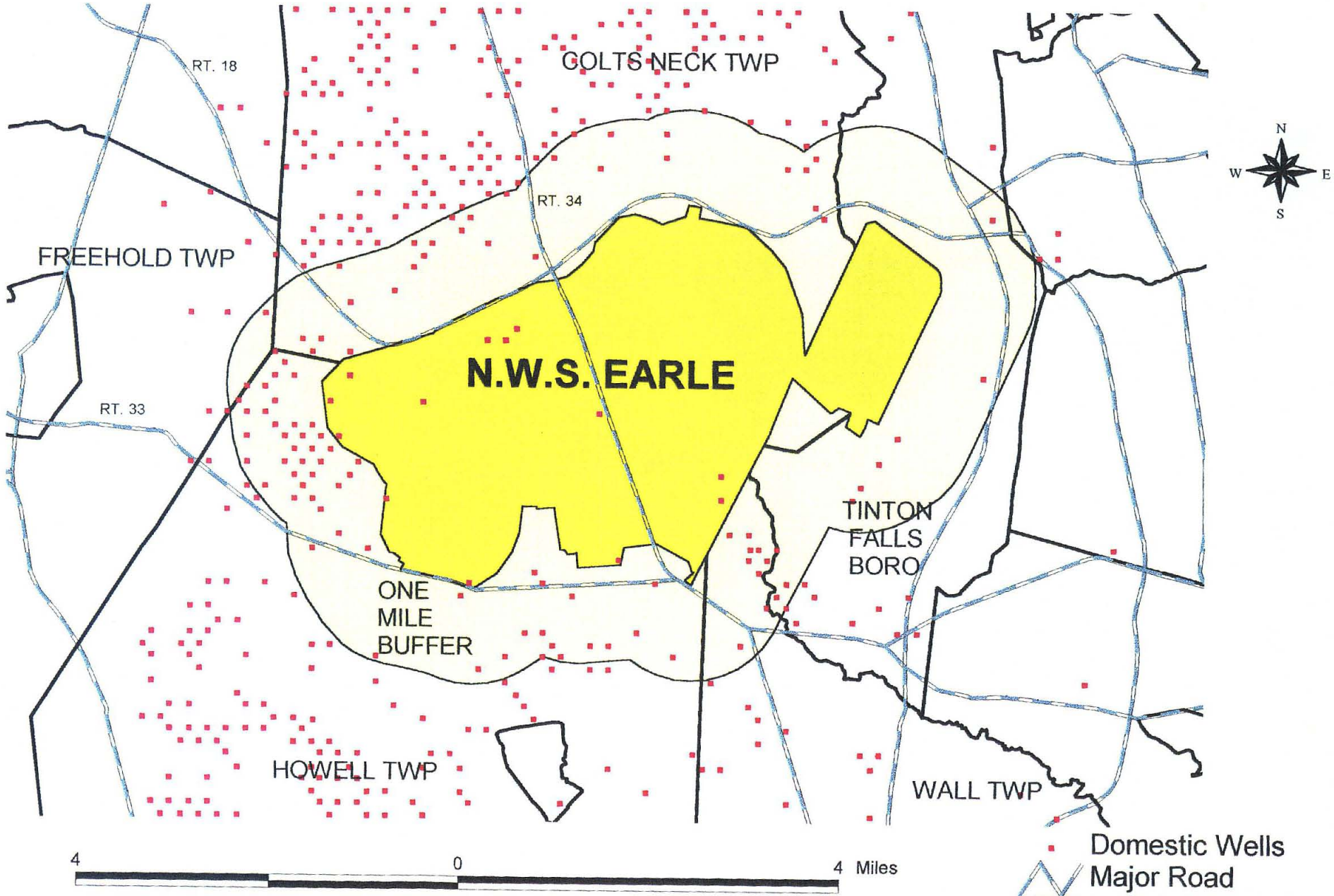
Public Non Community Wells within 1 Mile of N.W.S. EARLE



Source: Monmouth County Health Department Facility File

Figure 3-6

Domestic Wells within 1 Mile of N.W.S. EARLE



Source: State Well Permit File

Monmouth County Health Department

Figure 3–7

Quarters H, located at the western NWS Earle boundary at Tarawa Road, has one domestic well but is not expected to be occupied. The Quarters H well is not near any area of concern. A well located at the ordnance central operations building, located at the intersection of Guadalcanal and Lunga Roads, supplies potable water for drinking and sanitary use. Analytical results for a wide suite of drinking water parameters have shown compliance with drinking water standards. One more domestic well serves the Carpentry Shop, S-35 located on Tarawa Road, west of the intersection with Guadalcanal Road. The well at S-35 has been tested for a wide suite of drinking water parameters showing compliance with drinking water standards.

3.7.2 Municipal Water System

The New Jersey American Water Company (Eastern Division) is the only municipal water supplier operating in the vicinity of NWS Earle. Water resources include various deep wells; surface water intakes on the Jumping Brook, Shark, and Swimming Rivers; a temporary surface water intake on the Manasquan River; and two reservoirs, the Glendola and the Swimming River. Surface water originating at NWS Earle could migrate to any of these surface water intakes.

3.8 POPULATION AND LAND USE

3.8.1 Population

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

3.8.2 Surrounding Land Use

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

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 land and single-family residential land.

3.9 ECOLOGY

There is a rich diversity of ecological systems and habitats at NWS Earle. Much effort has been dedicated to identification of sensitive habitat systems, such as wetlands, and of the fauna/flora potentially affected by individual site-related exposures. Much attention has been given to ecological issues as evidenced by the significant effort given to Watershed surface water and sediment sampling and analysis performed as part of this RI. Section 30.1 presents the results of the Watershed studies.

Knieskern's beaked-rush (Rynchospora knieskernii), a sedge species on the federal endangered list, has been seen on the station, and some species on the New Jersey list such as the swamp pink (Helonias bullata) may be present. An osprey has visited Mainside and may nest in the Chapel Hill area. The Mingamahone Brook supports bog turtles downstream of Mainside and provides an appropriate habitat for them at the Mainside. 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, Incorporated, 1983).

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

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

- 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.

- 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.

Significant agricultural lands under consideration include cranberry bogs located at the headwaters of Yellow Brook and Marsh Bog Brook, potentially affected by Site 19.

Ecological receptors potentially affected by individual site activities are discussed in the site-specific subsections in Sections 4 through 29.

4.0 SITE 1: ORDNANCE DEMILITARIZATION SITE

4.1 SITE BACKGROUND AND PHYSICAL SETTING

The Ordnance Demilitarization Site (Site 1) is a 6-acre open field that was used for burning ordnance material between 1943 and 1975. During site abandonment, the area was plowed, and a layer of diesel-soaked hay was burned on site to remove residual ordnance. This procedure was carried out three times. For several years during the early 1990s, a United States Army communications station and tower were located near the center of the site. The site is currently cleared of all structures. Figure 4-1 is a map of the site.

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

4.2 PREVIOUS INVESTIGATIONS

4.2.1 Summary of Activities and Results

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

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

During the 1993 SI, three monitoring wells were installed and groundwater samples were collected and submitted for TCL VOC, TCL SVOC, and explosive compound analysis. Elevated levels of the following TCL VOCs were found in MW1-01: acetone (up to 7 ppb) and 1,1-dichloroethylene (up to 80 ppb). Elevated levels of the TAL inorganics such as chromium (up to 538 ppb), lead (up to 12.5 ppb), and iron (up to 76,000 ppb) were detected generally in all three monitoring wells. Explosive compounds RDX (up to 8.98 ppb), 2,4-DNT (up to 0.82 ppb), and nitrite - nitrate combined (up to 1.4 ppm) were detected in two wells.

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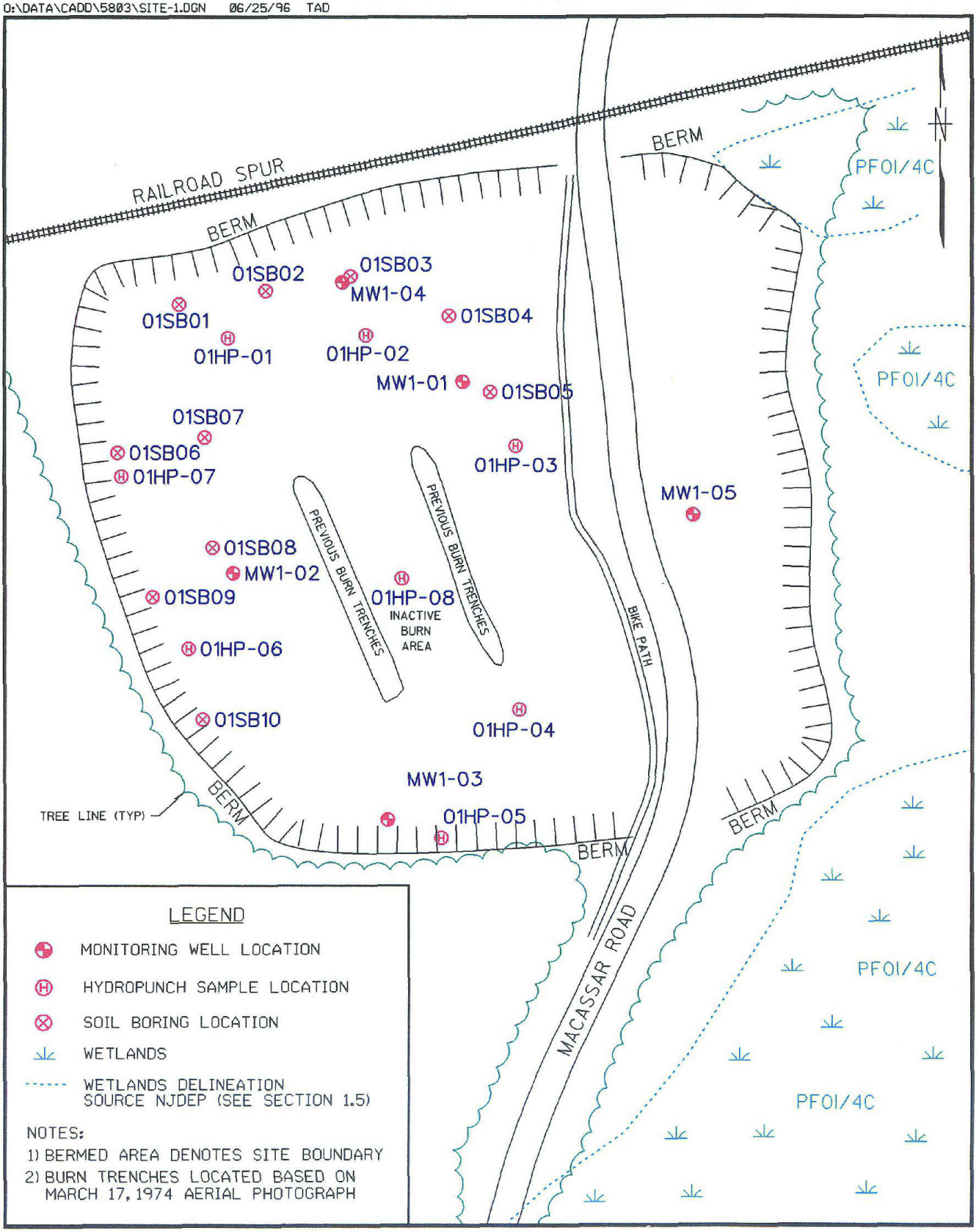

SAMPLE LOCATIONS

SITE 1 - ORDNANCE DEMILITARIZATION SITE

FIGURE 4-1

0 100 200

SCALE IN FEET

Brown & Root Environmental

4.2.2. Summary of Conclusions

Previous investigations indicate widespread metals and TPH in soils at levels below regulatory concern, metals in groundwater above regulatory concern, and limited organics and explosives in groundwater at levels above regulatory concern.

4.2.3. Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Determine vertical extent of compounds in soil.
- Confirm presence and determine horizontal extent of compounds in groundwater.
- Gauge impact of low-flow sampling technique on turbidity and metals results.
- Compare metal levels to background concentrations

4.3 RI FIELD INVESTIGATIONS

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 1:

- Sampling and analysis of groundwater samples from eight hydropunch locations (Section 4.3.1).
- Sampling and analysis of subsurface soil samples from 10 soil borings (Section 4.3.2).
- Drilling and installation of two shallow permanent monitoring wells (Section 4.3.3).
- Sampling and analysis of groundwater from the wells (Section 4.3.3).
- Measurement of static-water levels in the monitoring wells (Section 4.3.3).
- Execution of slug tests in two of the monitoring wells (Section 4.3.4).

The field team surveyed to establish the horizontal locations and vertical elevations of the hydropunch sample locations, soil borings, newly installed monitoring wells, and selected existing wells. Surveying notes are provided in Appendix F.

4.3.1 Hydropunch Groundwater Sampling

Before selecting permanent monitoring well locations, B&R Environmental collected eight hydropunch groundwater samples (01 HP 01 through 01 HP 08) in June 1995 to determine general groundwater quality and the static-water level (Figure 4-1). The eight groundwater samples were submitted to Lancaster Laboratories for TCL VOCs, TCL SVOCs, TCL pesticides, explosives, COD, TOC, nitrate/nitrite, TPH, and BOD analyses on a quick-turnaround basis. Table 4-1 summarizes hydropunch physical/construction data. Table 4-2 summarizes the unvalidated analytical data. Together with data from previous investigations, the hydropunch data were used to place two new wells at Site 1 to confirm the presence and determine the extent of organic compounds in groundwater.

The results of hydropunch sample analysis indicated low levels of explosives or semivolatile organic compounds in 01 HP 01, 01 HP 02, and 01 HP 03 north and east of the former ordnance demilitarization area. In one hydropunch location, 01 HP 08, low levels of explosives and PCE (14 ug/l) were detected.

Based on the hydropunch sampling results, one planned monitoring well (MW1-04) and one additional monitoring well (MW1-05) were installed during RI field activities to gauge the groundwater quality east and northeast of the former ordnance demilitarization area (see Section 4.3.3).

4.3.2 Soil Borings and Subsurface Soil Sampling

B&R Environmental drilled 10 soil borings (01 SB 01 through 01 SB 10) in June 1995 to determine the vertical extent of contamination upgradient of the site (Figure 4-1). The soil borings had a total depth of 4 feet bgs, and saturated conditions were encountered between 3 and 4 feet bgs. Subsurface soil samples were collected continuously from the ground surface to the water table using a 2-inch O.D. by 24-inch-long split-barrel sampler. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors) and for lithologic description. HNu readings were 0 ppm for all soil borings. Boring 01 SB 08 had some dark stains at the 1 to 4-foot interval. No other stains or odors were observed in the borings. A yellowish-brown, silty, fine- to medium-grained sand was encountered in all 10 boreholes. Appendix C contains boring logs.

Table 4-1
Site 1 Hydropunch Groundwater Characteristics Summary
NWS Earle,Colts Neck, New Jersey

Hydropunch Groundwater Location	Total Depth[1] (feet)	Ground Surface Elevation[2]	Approximate Depth to Water[1] (feet)	Screened Interval Depth[1] (feet)
01 HP 01	9	90.30	4	6 - 9
01 HP 02	9	91.40	5	6 - 9
01 HP 03	9	92.00	4	6 - 9
01 HP 04	8	90.80	4.5	5 - 8
01 HP 05	7	90.80	4.9	4 - 7
01 HP 06	7	90.60	4.5	4 - 7
01 HP 07	7.5	90.50	4.5	4 - 7
01 HP 08	7	90.60	4.5	4 - 7

(1) In feet below grade. Reading obtained during hydropunch installation.
(2) In feet above mean sea level.

Table 4-2
Ordnance Demilitarization Site
Hydropunch Groundwater Analysis
Analytical Results (Not Validated)

		01 HP 01 (9 Feet) Sample Results		01 HP 02 (12.5 Feet) Sample Results		01 HP 03 (12.5 Feet) Sample Results		01 HP 04 (8 Feet) Sample Results	
VOLATILE ORGANICS	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
ACETONE	10		U	10	U	10	U	10	U
CHLOROFORM	10			1	J				
SEMIVOLATILE ORGANICS	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
FLUORENE	10	1	U						
PHENANTHRENE	10	9	J			7	J		
ANTHRACENE	10	2	J			1	J		
FLUORANTHENE	10	4	J			2	J		
PYRENE	10	5	J			2	J		
BENZO(A)ANTHRACENE	10	1	J			3	J		
BIS(2-ETHYLHEXYL)PHTHALATE	10	10	U	18	U	10	U	10	U
CHRYSENE	10	2	J			1	J		
BENZO(A)PYRENE	10	1	J						
2,4-DINITROTOLUENE	10			3	J				
EXPLOSIVES	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
RDX	1	0.6	J	1					U
1,3,5-TRINITROBENZENE	0.5	0.9							
2,4,6-TRINITROTOLUENE	0.4	11.2		0.27	J	0.27	J		
4-AMINO-2,6-DINITROTOLUENE	2	0.6	J	1.8	J	3			
2-AMINO-4,6-DINITROTOLUENE	1	1		0.8	J	2			
2,4-DINITROTOLUENE	0.4			3.4					
TPH ANALYSIS		**LOQ**	**MG/L**	**LOQ**		**LOQ**	**MG/L**	**LOQ**	**MG/L**
TOTAL PETROLEUM HYDROCARBONS		0.3	2.4	0.3	0.4	0.3	2.7	0.3	0.2 J
MISCELLANEOUS PARAMETERS		**UNITS**	**RESULT**	**UNITS**	**RESULT**	**UNITS**	**RESULT**	**UNITS**	**RESULT**
BOD		MG/L	5 U	MG/L	2 U	MG/L	1.3 U	MG/L	0.7 U
TOC		MG/L	0.9 J	MG/L	2	MG/L	3	MG/L	3
NITRATE NITROGEN		MG/L	0.5 U	MG/L	1.2	MG/L	0.5 U	MG/L	0.6
NITRITE NITROGEN		MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U
COD		MG/L	29	MG/L	17	MG/L	51	MG/L	32

NOTE: DATA IN THIS TABLE HAS NOT BEEN VALIDATED BECAUSE THE USE OF THE DATA WAS FOR FIELD SCREENING ONLY

U -- NOT DETECTED RESULT (DETECTION/QUANTITATION LIMIT LISTED)

J -- POSITIVE VALUE IS ESTIMATED AND LESS THAN QUANTITATION LIMIT

Table 4-2
Ordnance Demilitarization Site
Hydropunch Groundwater Analysis
Analytical Results (Not Validated)
Page 2 of 2

		01 HP 05 (7 Feet) Sample Results		01 HP 06 (7 Feet) Sample Results		01 HP 07 (7.5 Feet) Sample Results		01 HP 08 (7 Feet) Sample Results	
VOLATILE ORGANICS	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
ACETONE	10	10	U	10	U	10	U	10	U
TETRACHLOROETHENE	10							14	
SEMIVOLATILE ORGANICS	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
BIS(2-ETHYLHEXYL)PHTHALATE	10	11	U	10	U	10	U	10	U
EXPLOSIVES	**CRQL**	**UG/L**		**UG/L**		**UG/L**		**UG/L**	
RDX	1		U		U		U	6	
4-AMINO-2,6-DINITROTOLUENE	2							1.3	J
2-AMINO-4,6-DINITROTOLUENE	1							0.5	J
2,4-DINITROTOLUENE	0.4							1.2	
TPH ANALYSIS		**LOQ**	**MG/L**	**LOQ**		**LOQ**	**MG/L**	**LOQ**	**MG/L**
TOTAL PETROLEUM HYDROCARBONS		0.3	0.2 J	0.3	0.2 J	0.3	0.3 J	3	3 J
MISCELLANEOUS PARAMETERS		**UNITS**	**RESULT**	**UNITS**	**RESULT**	**UNITS**	**RESULT**	**UNITS**	**RESULT**
BOD		MG/L	1.3 U	MG/L	0.4 U	MG/L	0.7 U	MG/L	3 U
TOC		MG/L	3	MG/L	1	MG/L	3	MG/L	5
NITRATE NITROGEN		MG/L	0.5 U	MG/L	0.17 J	MG/L	0.5 U	MG/L	2.3
NITRITE NITROGEN		MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 J	MG/L	0.5 U
COD		MG/L	32	MG/L	16	MG/L	·50	MG/L	86

NOTE: DATA IN THIS TABLE HAS NOT BEEN VALIDATED BECAUSE THE USE OF THE DATA WAS FOR FIELD SCREENING ONLY

U -- NOT DETECTED RESULT (DETECTION/QUANTITATION LIMIT LISTED)

J -- POSITIVE VALUE IS ESTIMATED AND LESS THAN QUANTITATION LIMIT

A total of 21 subsurface soil samples, including one field duplicate, were collected from two depths at each soil boring (0.5 to 2.0 feet and 2.0 to 4.0 feet bgs) and submitted to Lancaster Laboratories for TCL VOC, TAL metals, TPH, nitrites, nitrates, and moisture. GP Environmental Services, Incorporated performed the analyses for the explosive compounds. A field duplicate sample was collected from 01 SB 07-00. The matrix spike/matrix spike duplicate was collected from 01 SB 10-00. The soil sample in each boring with the highest HNu reading and/or the presence of visual staining was selected for laboratory analysis. The second sample obtained from each boring was from the soil/water interface. Soil boring characteristics and sample information are summarized in Table 4-3.

4.3.3 Permanent Monitoring Well Installation, Static-Water-Level Measurements, and Groundwater Sampling

Monitoring Well Installation

The field team installed two shallow permanent monitoring wells (MW1-04 and MW1-05) at the site in July 1995 (Figure 4-1). As stated in Section 4.3.1, the locations of the wells were based upon the analytical results of the groundwater samples collected during the hydropunch activities in June. The borings had total depths of 14 and 15 feet, and water was encountered at 5 feet and 7 feet below grade, respectively, during drilling. The borings were drilled to approximately 8 feet below the water table and completed as 2-inch-diameter cased wells, screened across the water table. Monitoring well characteristics are summarized in Table 4-4.

Subsurface soil samples were collected continuously from the ground surface to the water table by driving 2-inch O.D. by 24-inch-long split-barrel sampler. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors) and for lithologic description. HNu readings were 0 ppm throughout the monitoring well borings with no stains or odors observed. Soil boring log sheets were prepared for each boring to evaluate subsurface lithologies (see Appendix C).

The wells were constructed with 2-inch I.D., flush-jointed and threaded, NSF-certified, Schedule 40 polyvinyl chloride (PVC) well casing and 2-inch I.D., Schedule 40, 0.10-foot slotted PVC well screen fitted with a PVC bottom cap. Ten-foot screens were installed in the wells. The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 1 foot above the top of the screen. Because of the shallow depth to groundwater, only 1 foot of sand was placed above the top of the screen. An approximately 1-foot-thick annular seal, consisting of bentonite pellets, was placed on top of the filter pack (the thin annular seal was also because of the shallow depth to groundwater). The remainder of the well annulus was backfilled with a cement grout to a height approximately 1 foot below the ground surface. The wells were completed with 2-foot-high standpipes surrounded by a 4- by 4-foot concrete pad at ground level keyed approximately 1 foot into the well annulus. Monitoring well construction sheets are in Appendix C.

Table 4-3
Site 1 Soil Boring Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Soil Boring Number	Total Depth[1] (feet)	Ground Surface Elevation[2]	Laboratory Sample Number	Laboratory Sample Depth Interval[1] (feet)	Analytical Parameters[3]
01 SB 01	4	90.20	01 SB 01-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 01-02	2-4	
01 SB 02	4	90.70	01 SB 02-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 02-02	2-4	
01 SB 03	4	92.10	01 SB 03-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 03-02	2-4	
01 SB 04	4	91.80	01 SB 04-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 04-02	2-4	
01 SB 05	4	91.60	01 SB 05-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 05-02	2-4	
01 SB 06	4	90.60	01 SB 06-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 06-02	2-4	
01 SB 07	4	90.20	01 SB 07-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 07-02	2-4	
			DUP-05	0.5-2	
01 SB 08	4	90.40	01 SB 08-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 08-02	2-4	

Table 4-3
Site 1 Soil Boring Characteristics Summary
NWS Earle, Colts Neck, New Jersey
Page 2 of 2

Soil Boring Number	Total Depth[1] (feet)	Ground Surface Elevation[2]	Laboratory Sample Number	Laboratory Sample Depth Interval[1] (feet)	Analytical Parameters[3]
01 SB 09	4	90.40	01 SB 09-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 09-02	2-4	
01 SB 10	4	90.20	01 SB 10-00	0.5-2	TCL VOC, TAL metals, TPH, nitrites, nitrates, explosives, and moisture
			01 SB 10-02	2-4	

(1) In feet below grade.
(2) In feet above mean sea level.
(3) TCL VOC - Target Compound List volatile organic compound; TAL metals - Target Analyte List metals; TPH - Total petroleum hydrocarbons.

Table 4-4
Site 1 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW1-01	16	92.03	93.66	94.09	4	3 to 16	2 to 17[3]	4/29/95
MW1-02	16	91.81	92.44	93.57	4	3 to 16	2 to 17[3]	4/29/95
MW1-03	16	91.94	93.65	94.48	4	3 to 16	2 to 16.5[3]	4/28/95
MW1-04	14	92.04	93.93	94.59	2	4 to 14	3 to 14	7/12/95
MW1-05	15	92.37	94.20	94.77	2	5 to 15	4 to 15	7/12/95

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.

The wells were developed a minimum of 24 hours after installation. Groundwater temperature, pH, conductivity, and turbidity were monitored during development. Both wells were developed until removed water was visibly clear of suspended solids. Approximately 180 gallons of water were removed from MW1-04, and 90 gallons of water were removed from MW1-05.

Static-Water-Level Measurements

In order to define groundwater flow directions and horizontal and vertical groundwater gradients, B&R Environmental collected two rounds of static-water-level measurements. The first round of water-level measurements was collected on August 7, 1995, and the second round was collected on October 17, 1995. Static-water levels were measured from the top of PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 85.52 to 86.28 feet above MSL during the first round of measurements and from approximately 85.69 to 86.56 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 4-5.

Groundwater Sampling

Groundwater samples were obtained from the two newly installed monitoring wells (MW1-04 and MW1-05) and the three existing monitoring wells (MW1-01 through MW1-03). Groundwater from the wells was sampled and analyzed to determine the current level and extent of contamination and to provide data for use in the risk assessment and the evaluation of remedial action alternatives for the feasibility study. The three existing wells were sampled in July 1995, and the two newly installed wells were sampled in August 1995, approximately 4.5 weeks after well development. Field measurements collected during purging were pumping rate (L/min), water level, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity.

Prior to sampling, the wells were purged using the micro-purge protocol to reduce turbidity. The wells were purged until groundwater parameters stabilized within acceptable limits, and care was taken to ensure little or no drawdown in water levels occurred throughout the purging and sampling processes.

A total of six groundwater samples (01 GW 01 through 01 GW 05), including one field duplicate (DUP 15), were collected and submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, COD, TOC, BOD, nitrites, nitrates, and TPH analyses. At the request of NORTHDIV, location 01 GW 05 was also sampled and analyzed for dissolved TAL metals because turbidity could not be brought below approximately 350 NTU by the micro-purge technique. All groundwater samples were also submitted to GP Environmental Services, Incorporated for explosives analysis.

Table 4-5
Site 1 Static Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)	Depth to Water Table[1] (feet)	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)
MW1-01	7.72	93.66	85.94	7.49	93.66	86.17
MW1-02	6.16	92.44	86.28	6.03	92.44	86.41
MW1-03	7.38	93.65	86.27	7.09	93.65	86.56
MW1-04	7.90	93.93	86.03	7.71	93.93	86.22
MW1-05	8.68	94.20	85.52	8.51	94.20	85.69

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

Groundwater sample log sheets are presented in Appendix D. Extra volume was collected for sample 01 GW 03 for the matrix spike/matrix spike duplicate sample.

4.3.4 Slug Testing

Rising-head slug tests were performed in July 1995 in wells MW1-04 and MW1-05 according to the procedure presented in Section 2.1.1.4.

4.4 SITE CHARACTERISTICS

4.4.1 Geology

Regional mapping places Site 1 within the outcrop area of the Vincentown Formation. The Vincentown Formation ranges between 10 and 130 feet in thickness and the soil borings are no more than 16 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Vincentown Formation. In general, the borings encountered alternating beds of yellowish-brown, micaceous, silty, fine- to medium-grained sand and light olive brown, glauconitic, silty sand and sand. Trace amounts of clay and gravel are present in the upper 2 feet of some of the borings and possibly represent the plow zone.

4.4.2 Hydrogeology

Groundwater in the Vincentown aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations are summarized in Table 4-5. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 4-2 and 4-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the east-northeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

The hydraulic conductivities calculated for MW1-04 and MW1-05 are 6.06×10^{-4} cm/sec (1.71 ft/day) and 1.29×10^{-3} cm/sec (3.66 ft/day), respectively. Appendix H contains slug test data and calculations.

4.5 NATURE AND EXTENT OF CONTAMINATION

4.5.1 Subsurface Soils

Twenty site-related subsurface soil samples were collected at Site 1 (Figure 4-1). Table 4-6 presents the occurrence and distribution of inorganic chemicals detected in site-related subsurface soil samples and compares them to background concentrations as presented in Section 31. Tables 4-6a and 4-6b present

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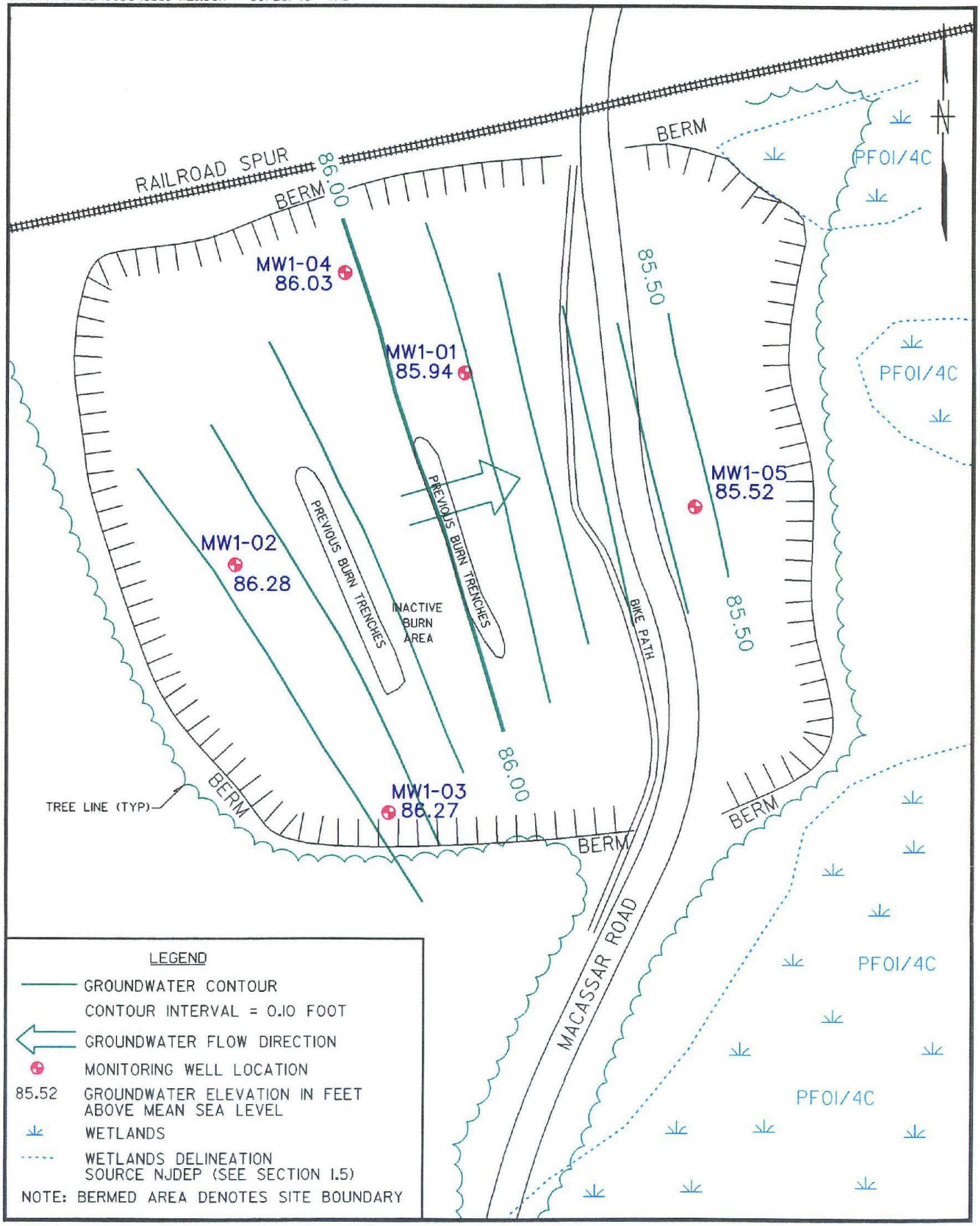


GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 1 - ORDNANCE DEMILITARIZATION SITE

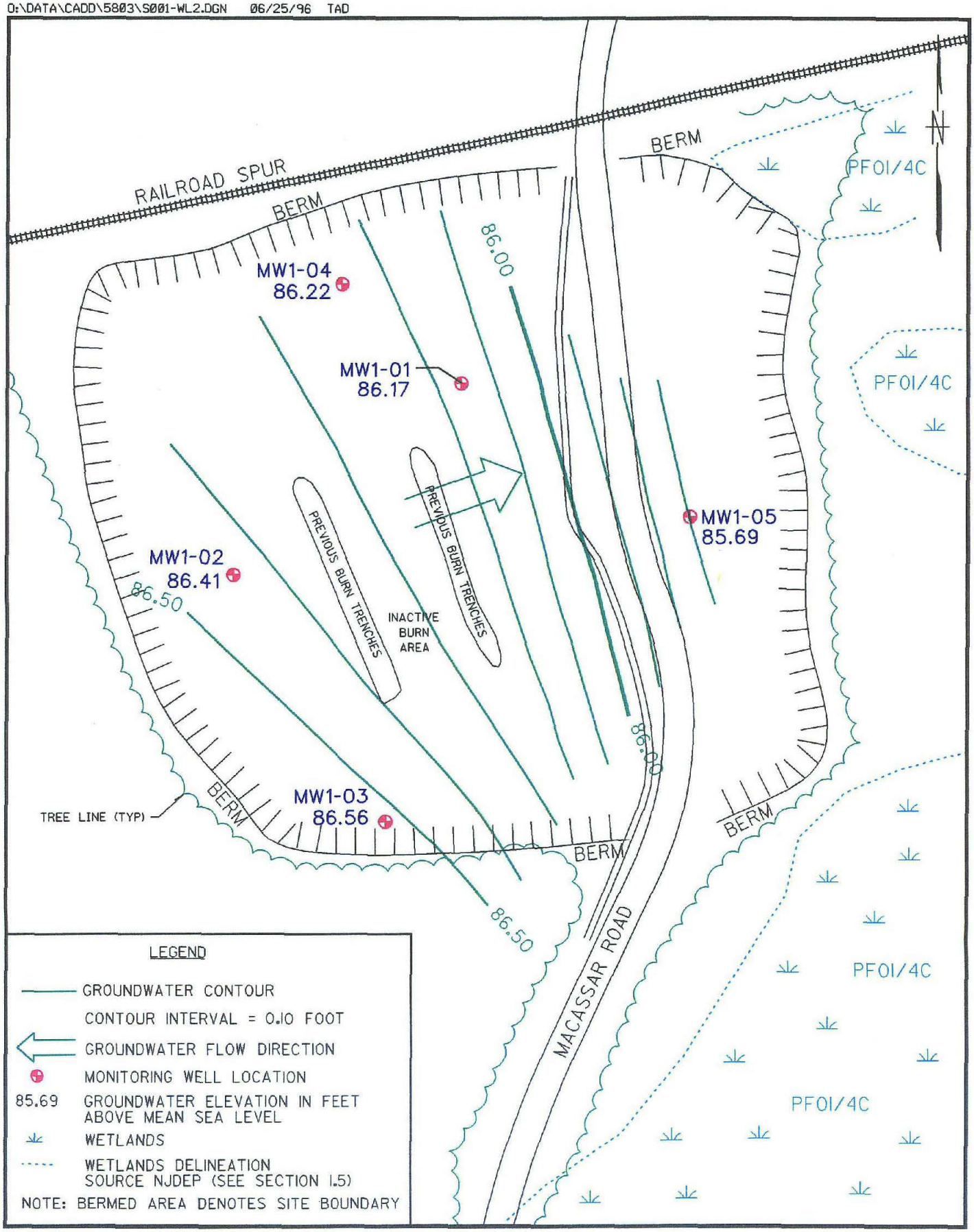
FIGURE 4-2

0 100 200

SCALE IN FEET

Brown & Root Environmental

O:\DATA\CADD\5803\S001-WL2.DGN 06/25/96 TAD



GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 1 - ORDNANCE DEMILITARIZATION SITE

FIGURE 4-3

0 100 200

SCALE IN FEET

Brown & Root Environmental

TABLE 4-6
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SUBSURFACE SOIL AT SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

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

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

TABLE 4-6a

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01SB01-00	01SB01-02	01SB02-00	01SB02-02	01SB03-00	01SB03-02	ARARS & TBCs		
LOCATION:	01SB01	01SB01	01SB02	01SB02	01SB03	01SB03	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	3000	2390	2650	2820	3420	2450	-	-	-
antimony	4.6 U	4.8 U	4.6 U	4.6 U	4.7 U	4.5 U	14.0	340	-
arsenic	10.2 J	6.1 J	10.4 J	9.2 J	27.8 E J	11.0 J	20.0	20.0	-
barium	8.9	9.0	9.4	2.7	25.1	4.3	700	47000	-
beryllium	0.15 U	0.16 U	0.16 U	0.16 U	0.30	0.15 U	1.00	1.00	-
cadmium	0.54 U	0.57 U	0.55 U	0.55 U	0.56 U	0.54 U	1.00	100	-
calcium	47.2	57.4	87.9	35.2	236	81.8	-	-	-
chromium, total	55.1	30.6	69.0	63.2	59.7	63.0	-	500	-
cobalt	1.0 U	1.1 U	1.0 U	1.0 U	1.1 U	1.0 U	-	-	-
copper	1.4	1.1 U	5.4	2.7	8.8	4.5	600	600	-
iron	12800	5820	12000	11100	13000	12500	-	-	-
lead	11.5 J	2.0 J	24.6 J	2.4 J	26.9 J	14.7 J	400	600	-
magnesium	414	160	425	357	562	523	-	-	-
manganese	0.70	1.2	3.1	0.53	4.8	2.1	-	-	-
mercury	0.025	0.027	0.031	0.028	0.050	0.030	14.0	270	-
nickel	1.7 U	1.8 U	1.7 U	1.7 U	1.8 U	1.7 U	250	2400	-
potassium	1180	370	1120	968	1230	1440	-	-	-
selenium	0.54 U	0.57 U	0.55 U	0.55 U	0.57	0.54 U	63.0	3100	-
silver	0.89 U	0.94 U	0.90 U	0.90 U	0.92 U	0.88 U	110	4100	-
sodium	35.0	10.6 U	50.0	10.2 U	60.9	10.0 U	-	-	-
thallium	0.65 U	0.68 U	1.1 J	0.66 U	0.67 U	0.64 U	2.00	2.00	-
vanadium	29.4	23.0	37.9	33.7	28.5	31.2	370	7100	-
zinc	23.4 R	24.1 R	35.1 R	17.8 R	30.1 R	31.8 R	1500	1500	-

TABLE 4-6a

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01SB04-00		01SB04-02		01SB05-00		01SB05-02		01SB06-00		01SB06-02		ARARS & TBCs		
LOCATION:	01SB04		01SB04		01SB05		01SB05		01SB06		01SB06		NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
INORGANICS	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**	**mg/kg**	**mg/kg**
aluminum	2700		1470		1880		1060		2700		5180		-	-	-
antimony	4.4	U	4.5	U	4.5	U	4.4	U	4.5	U	5.1	U	14.0	340	-
arsenic	11.3	J	5.3		8.7	J	6.2	J	9.6	J	14.9	J	20.0	20.0	-
barium	9.8		14.1		2.1		1.8		3.6		4.2		700	47000	-
beryllium	0.24		0.16		0.15	U	0.15	U	0.15	U	0.44		1.00	1.00	-
cadmium	0.52	U	0.53	U	0.53	U	0.52	U	0.53	U	0.60	U	1.00	100	-
calcium	1710	J	347		50.9		33.3		30.1		46.6		-	-	-
chromium, total	42.0		28.4		43.2		30.5		45.1		84.6		-	500	-
cobalt	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.1	U	-	-	-
copper	4.1		2.8		2.2		1.0	U	4.5		1.1	U	600	600	-
iron	9310		4960		8550		5350		9790		18500		-	-	-
lead	10.6	J	5.4	J	2.7	J	1.3		6.9	J	2.7	J	400	600	-
magnesium	571		147		324		121		360		1130		-	-	-
manganese	8.0		0.86		3.3		0.93	J	2.2	J	3.8		-	-	-
mercury	0.035		0.032		0.028		0.026		0.030		0.032		14.0	270	-
nickel	1.7	U	1.7	U	1.7	U	1.7	U	1.7	U	1.9	U	250	2400	-
potassium	1080		325		804		327		908		2930		-	-	-
selenium	0.52	U	0.53	U	0.53	U	0.52	U	0.53	U	0.60	U	63.0	3100	-
silver	0.86	U	0.87	U	0.86	U	0.86	U	0.87	U	1.0	U	110	4100	-
sodium	50.9		9.9	U	9.8	U	9.7	U	9.8	U	11.2	U	-	-	-
thallium	0.63	U	0.64	U	0.70	J	0.63	U	0.64	U	0.73	J	2.00	2.00	-
vanadium	23.2		16.3		21.5		15.9		26.9		50.4		370	7100	-
zinc	12.9	R	6.0	J	6.1	J	4.7	J	11.3	R	10.9	R	1500	1500	-

TABLE 4-6a

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01SB07-00		01SB07-00-DUP		01SB07-02		01SB08-00		01SB08-02		01SB09-00		ARARS & TBCs		
LOCATION:	01SB07		01SB07		01SB07		01SB08		01SB08		01SB09		NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
INORGANICS	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**	**mg/kg**	**mg/kg**
aluminum	2970		4210		3820		897		2200		3870		-	-	-
antimony	4.6	U	4.6	U	5.0	U	1.3		0.56	U	0.54	U	14.0	340	-
arsenic	10.0	J	10.3	J	9.5	J	2.0	J	7.6	J	13.2	J	20.0	20.0	-
barium	86.1		78.7		3.1		121	J	12.0	J	51.9	J	700	47000	-
beryllium	0.28		0.25		0.17	U	0.17		0.25		0.56		1.00	1.00	-
cadmium	0.54	U	0.54	U	0.59	U	0.29		0.10		0.15		1.00	100	-
calcium	58.1		53.0		37.7		153		145		33.4		-	-	-
chromium, total	54.3		74.2		61.4		28.6		42.8		74.6		-	500	-
cobalt	1.0	U	1.0	U	1.1	U	0.14	U	0.19		0.31		-	-	-
copper	38.8		76.4		1.1	U	29.1	J	0.68		19.3	J	600	600	-
iron	10900		15300		12400		2590	J	8060	J	15100	J	-	-	-
lead	32.6	J	93.1	J	2.4	J	6.0	J	1.7	J	45.7	J	400	600	-
magnesium	427		993		608		174		288		653		-	-	-
manganese	10.7	J	35.9	J	1.8		10.3	R	0.027	UJ	5.5	R	-	-	-
mercury	0.067		0.15		0.034		0.20	J	0.0065	U	0.027	J	14.0	270	-
nickel	1.7	U	1.7	U	1.9	U	0.54		0.70		1.6		250	2400	-
potassium	1090		2770		1620		214		542		2010		-	-	-
selenium	0.54	U	0.54	U	0.59	U	0.56	UJ	0.56	UJ	0.56	J	63.0	3100	-
silver	1.3		3.1		1.0	U	0.14	U	0.14		1.3		110	4100	-
sodium	10.1	U	10.1	U	11.0	U	86.6		80.1		100		-	-	-
thallium	0.71	J	0.69	J	0.71	U	0.68	U	0.67	U	1.2	J	2.00	2.00	-
vanadium	32.6		42.8		36.0		5.0		24.6		41.4		370	7100	-
zinc	56.9	R	63.7	R	16.7	R	129	J	6.7	J	19.0	J	1500	1500	-

TABLE 4-6a

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01SB09-02		01SB10-00		01SB10-02		---	---	---	ARARS & TBCs		
LOCATION:	01SB09		01SB10		01SB10		---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI		1995 RI		1995 RI							
INORGANICS	**mg/kg**		**mg/kg**		**mg/kg**					**mg/kg**	**mg/kg**	**mg/kg**
aluminum	3940		3320		3040					-	-	-
antimony	0.60	U	4.7	U	5.1					14.0	340	-
arsenic	10.2	J	10.7	J	11.2	J				20.0	20.0	-
barium	8.1	J	6.6		2.5					700	47000	-
beryllium	0.61		0.16	U	0.17					1.00	1.00	-
cadmium	0.12		0.55	U	0.61					1.00	100	-
calcium	62.3		78.6		59.9					-	-	-
chromium, total	67.1		66.1		62.8					-	500	-
cobalt	0.31		1.0	U	1.1					-	-	-
copper	1.7		1.6		1.3					600	600	-
iron	14000	J	13300		10900					-	-	-
lead	2.9	J	2.2	J	2.3	J				400	600	-
magnesium	459		599		416					-	-	-
manganese	6.7	R	3.1	J	2.0	J				-	-	-
mercury	0.0078	U	0.030		0.032					14.0	270	-
nickel	1.3		1.7	U	1.9					250	2400	-
potassium	1200		1660		988					-	-	-
selenium	0.60	UJ	0.55	U	0.61					63.0	3100	-
silver	0.15	U	0.90	U	1.0					110	4100	-
sodium	115		50.1		11.3					-	-	-
thallium	1.0	J	0.66	U	0.73	J				2.00	2.00	-
vanadium	35.8		33.7		34.8					370	7100	-
zinc	11.6	J	12.7	R	8.3	J				1500	1500	-

TABLE 4-6a
COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCS - SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

. - No standard is available for this chemical in this classification.

TABLE 4-6b

COMPARISON OF SUBSURFACE SOIL EXPLOSIVES AND MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		01SB01-00	01SB01-02	01SB02-00	01SB02-02	01SB03-00	ARARS & TBCs		
LOCATION:		01SB01	01SB01	01SB02	01SB02	01SB03	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
moisture	%	7.9	12.4	8.8	8.6	11.0	-	-	-
nitrate nitrogen	mg/kg	0.54 J	0.50 J	4.0	0.43 J	0.50 J	-	-	-
petroleum hydrocarbons	mg/kg	19.0 J	21.0 J	40.0	19.0 J	60.0	10000 @	10000 @	-
EXPLOSIVES									
nitrocellulose	ug/kg	17600 U	18000 U	18000 U	77000	17800 U	-	-	-

SAMPLE NUMBER:		01SB03-02	01SB04-00	01SB04-02	01SB05-00	01SB05-02	ARARS & TBCs		
LOCATION:		01SB03	01SB04	01SB04	01SB05	01SB05	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
moisture	%	7.6	4.6	5.6	5.2	4.3	-	-	-
nitrate nitrogen	mg/kg	0.46 J	0.44 J	0.53 J	0.53 J	0.32 J	-	-	-
petroleum hydrocarbons	mg/kg	16.0 J	240	18.0 J	13.0 J	17.0 J	10000 @	10000 @	-
EXPLOSIVES									
nitrocellulose	ug/kg	17500 U	17300 U	18000 U	17500 U	17300 U	-	-	-

TABLE 4-6b

COMPARISON OF SUBSURFACE SOIL EXPLOSIVES AND MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		01SB06-00	01SB06-02	01SB07-00	01SB07-00-DUP	01SB07-02	ARARS & TBCs		
LOCATION:		01SB06	01SB06	01SB07	01SB07	01SB07	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
moisture	%	9.2	16.9	10.0	10.0	16.2	-	-	-
nitrate nitrogen	mg/kg	0.35 J	0.40 J	0.70 J	0.70 J	0.60 J	-	-	-
petroleum hydrocarbons	mg/kg	17.0 J	21.0 J	30.0	30.0	23.0 J	10000 @	10000 @	-
EXPLOSIVES									
nitrocellulose	ug/kg	17800 U	17800 U	17800 U	17600 U	17600 U	-	-	-

SAMPLE NUMBER:		01SB08-00	01SB08-02	01SB09-00	01SB09-02	01SB10-00	ARARS & TBCs		
LOCATION:		01SB08	01SB08	01SB09	01SB09	01SB10	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
moisture	%	11.3	10.3	8.1	16.2	9.3	-	-	-
nitrate nitrogen	mg/kg	0.60 J	0.30 J	1.0 U	0.40 J	0.48 J	-	-	-
petroleum hydrocarbons	mg/kg	30.0	20.0	12.0 J	21.0 J	21.0 J	10000 @	10000 @	-
EXPLOSIVES									
nitrocellulose	ug/kg	17300 U	16500 U	17600 U	17300 U	17600 U	-	-	-

TABLE 4-6b

COMPARISON OF SUBSURFACE SOIL EXPLOSIVES AND MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		01SB10-02	---	---	---	---	ARARS & TBCs		
LOCATION:		01SB10	---	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI							
MISCELLANEOUS									
moisture	%	17.5					-	-	-
nitrate nitrogen	mg/kg	0.40 J					-	-	-
petroleum hydrocarbons	mg/kg	20.0					10000 @	10000 @	-
EXPLOSIVES									
nitrocellulose	ug/kg	17600 U					-	-	-

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

. - No standard is available for this chemical in this classification.

@ - Value is New Jersey guideline for maximum total concentration of all organic compounds in soil (including VOCs, SVOCs, and TPH).

a comparison of detected compounds to ARARs and TBCs. Figure 4-4 shows locations and concentrations of compounds that exceed ARARs and TBCs.

4.5.1.1 Inorganics

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

4.5.1.2 Organics

Explosive compounds were analyzed for in 20 subsurface soil samples. Nitrocellulose was detected at a depth of 2 feet in sample location 01 SB 02-02 at a concentration of 77,000 ug/kg. This compound was detected in one background subsurface soil sample.

4.5.1.3 Miscellaneous Parameters

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

4.5.2 Groundwater

Five site-related groundwater samples (01 GW 01 through 01 GW 05) were collected at Site 1 (Figure 4-1). Tables 4-7 and 4-8 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples compared to background. Tables 4-7a and 4-7b present a comparison of detected compounds to applicable or relevant and appropriate requirements (ARARs) and other criteria to be considered (TBCs). Figure 4-4 shows locations and concentrations of compounds that exceed ARARs.

4.5.2.1 Inorganics

Three unfiltered monitoring well samples, 01 GW 02, 01 GW 03, and 01 GW 05, exhibited elevated levels of several metals. Unfiltered monitoring well samples 01 GW 02 and 01 GW 05 exhibited the highest concentrations of aluminum, arsenic, cadmium, chromium, iron, lead, and zinc. Thallium was detected in

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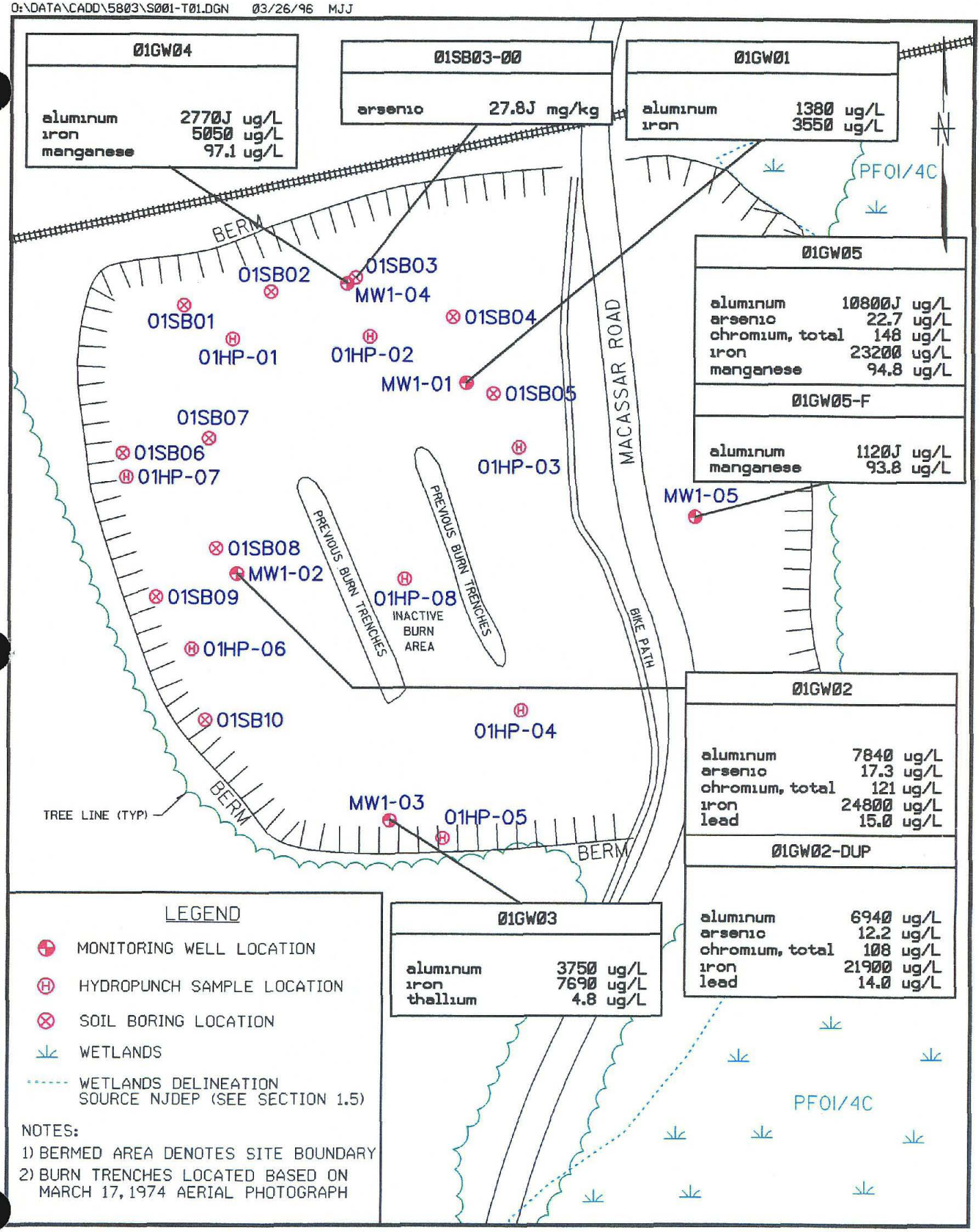

CONCENTRATIONS ABOVE SCREENING LEVELS
SITE 1 - ORDNANCE DEMILITARIZATION SITE

FIGURE 4-4

0 100 200
SCALE IN FEET

Brown & Root Environmental

TABLE 4-7
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM*	11 / 11	287 - 7870	5097.82	5 / 5	1380 - 10800	5218.00	YES	10800
ARSENIC	1 / 11	5.8 - 5.8	4.05	3 / 5	5.8 - 22.7	9.31	YES	22.7
BARIUM	11 / 11	2.6 - 518	229.60	5 / 5	50.1 - 853	489.52	YES	853
BERYLLIUM*	4 / 11	0.21 - 1.6	0.49	4 / 5	0.21 - 0.85	0.375	NO	0.85
CADMIUM	5 / 11	0.6 - 1.9	1.21	5 / 5	1.5 - 3.3	2.53	YES	3.3
CALCIUM	11 / 11	506 - 17200	8306.55	5 / 5	1210 - 5450	3085	NO	5450
CHROMIUM	NOT DETECTED	-	-	5 / 5	19.6 - 148	72	YES	148
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 5	0.7 - 3.4	1.95	NO	3.4
COPPER	9 / 11	0.79 - 13.5	6.53	5 / 5	1.8 - 75.45	25.93	YES	75.45
IRON	11 / 11	153 - 7690	4197.09	5 / 5	3550 - 23350	12568	YES	23350
LEAD	3 / 11	2.1 - 3	2.44	4 / 5	4.7 - 14.5	6.59	YES	14.5
MAGNESIUM	11 / 11	273 - 27400	8449.64	5 / 5	1060 - 2690	1859	NO	2690
MANGANESE	11 / 11	3.3 - 65	46.18	5 / 5	24.2 - 97.1	55.16	YES	90.85
MERCURY	11 / 11	0.005 - 0.12	0.12	5 / 5	0.082 - 0.28	0.1424	YES	0.22
NICKEL*	10 / 11	0.81 - 25.5	11.98	3 / 5	2.3 - 4.6	2.01	NO	4.6
POTASSIUM	11 / 11	350 - 3245	2810.55	5 / 5	2180 - 10700	5056	YES	10700
SILVER	NOT DETECTED	-	-	1 / 5	1.2	0.616	YES	1.09
SODIUM	11 / 11	1850 - 11650	8449.09	5 / 5	1850 - 29500	10335	YES	29500
THALLIUM*	3 / 11	4 - 5.1	5.15	1 / 5	4.8	2.4	NO	4.42
VANADIUM	10 / 11	0.69 - 42.25	16.48	5 / 5	8.2 - 58.4	30.39	YES	58.4
ZINC	9 / 6	3.7 - 348	178.61	5 / 5	131 - 1020	631.4	YES	1020

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

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TABLE 4-8
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 01
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

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

TABLE 4-7a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01GW01	01GW02	01GW02-DUP	01GW03	01GW04	01GW05	ARARS & TBCs		
LOCATION:	01GW01	01GW02	01GW02	01GW03	01GW04	01GW05	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	1380 E	7840 E	6940 E	3750 E	2770 E J	10800 E J	-	-	200
arsenic	3.3 U	17.3 E	12.2 E	5.8	3.3 U	22.7 E	50.0	-	8.00
barium	853	678	731	50.1	371	469	2000	2000 a	2000
beryllium	0.11 U	0.11 U	0.42	0.21	0.34	0.85	4.00	4000 e	20.0
cadmium	2.4	2.9	2.2	1.5	2.9	3.3	5.00	5.00 e	4.00
calcium	2980	1450	1460	1210	5450	4330	-	-	-
chromium, total	19.6	121 E	108 E	43.5	34.4	148 E	100 *	100 a	100
cobalt	1.1	1.6	1.5	0.70	3.0	3.4	-	-	-
copper	20.8	77.9	73.0	1.8	21.0	10.6	1300	-	1000
iron	3550 E	24800 E	21900 E	7690 E	5050 E	23200 E	-	-	300
lead	7.6 J	15.0 E	14.0 E	1.5 UJ	4.7	5.4	15.0	-	10.0
magnesium	1060	2180	1870	1380	2140	2690	-	-	-
manganese	34.1	24.6	23.8	25.6	97.1 E	94.8 E	-	-	50.0
mercury	0.12 J	0.28 J	0.28 J	0.12 J	0.082	0.11	2.00	2.00 b	2.00
nickel	2.4	5.4	3.8	2.3	0.75 U	0.75 U	100	100 a	100
potassium	2180	11000 J	10400 J	2360	5150	4890	-	-	-
silver	1.2	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U	-	100 a	-
sodium	2430	4800	4790	1850	13100	29500	-	-	50000
thallium	3.6 U	3.6 U	3.6 U	4.8 E	3.6 U	3.6 U	2.00	0.400 a	10.0
vanadium	8.2	59.5	53.4	17.2	11.7	58.4	-	-	-
zinc	945 J	672 J	718 J	131 J	1020	366	-	2000 a	5000
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
chloroform	10.0 U	10.0 U	10.0 U	10.0 U	3.0 J	10.0 U	100	100 e	6.00
methylene chloride	10.0 U	10.0 U	10.0 U	1.0 J	10.0 U	10.0 U	5.00	2000 d	2.00
PESTICIDES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
endosulfan I	0.0019 R	0.0024 R	0.0021 R	0.050 U	0.050 U	0.050 U	-	-	0.400
gamma-BHC (Lindane)	0.050 U	0.0011 R	0.0010 JN	0.050 U	0.050 U	0.050 U	0.200	0.200 a	0.200

TABLE 4-7a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01GW05-F	---	---	---	---	---	ARARS & TBCs		
LOCATION:	01GW05	---	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI								
INORGANICS	**ug/L**						**ug/L**	**ug/L**	**ug/L**
aluminum	1120 E J						-	-	200
arsenic	3.3 U						50.0	-	8.00
barium	114						2000	2000 a	2000
beryllium	0.48						4.00	4000 e	20.0
cadmium	3.0						5.00	5.00 e	4.00
calcium	3830						-	-	-
chromium, total	2.0						100 *	100 a	100
cobalt	2.9						-	-	-
copper	2.2						1300	-	1000
iron	20.6						-	-	300
lead	1.5 UJ						15.0	-	10.0
magnesium	1110						-	-	-
manganese	93.8 E						-	-	50.0
mercury	0.0090						2.00	2.00 b	2.00
nickel	5.6						100	100 a	100
potassium	1400						-	-	-
silver	0.94 U						-	100 a	-
sodium	31900						-	-	50000
thallium	3.6 U						2.00	0.400 a	10.0
vanadium	0.61 U						-	-	-
zinc	182						-	2000 a	5000
VOLATILES	**ug/L**						**ug/L**	**ug/L**	**ug/L**
chloroform	n/a						100	100 e	6.00
methylene chloride	n/a						5.00	2000 d	2.00
PESTICIDES	**ug/L**						**ug/L**	**ug/L**	**ug/L**
endosulfan I	n/a						-	-	0.400
gamma-BHC (Lindane)	n/a						0.200	0.200 a	0.200

TABLE 4-7a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 4-7b

COMPARISON OF GROUNDWATER EXPLOSIVES AND MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 1

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	01GW01		01GW02		01GW02-DUP		01GW03		01GW04		01GW05		ARARS & TBCs		
LOCATION:	01GW01		01GW02		01GW02		01GW03		01GW04		01GW05		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
MISCELLANEOUS	**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**		**mg/L**	**mg/L**	**mg/L**
biochemical oxygen demand	0.40	J	3.0		3.0		1.0	J	1.1	J	1.8	J	-	-	-
chemical oxygen demand	2.0	J	5.0	J	5.0	J	3.0	J	5.0	J	5.0	J	-	-	-
nitrate nitrogen	0.80		1.2		1.1		0.28	J	1.5		0.80		10.0	10.0	-
petroleum hydrocarbons	0.30	U	0.20	J	0.20	J	0.20	J	0.30	U	0.30	U	-	-	-
total organic carbon	1.0		1.0		0.90	J	0.70	J	2.0		1.0		-	-	-
EXPLOSIVES	**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**	**ug/L**	**ug/L**
2,4-dinitrotoluene	0.51	U	0.64		0.79		0.42	U	1.0		0.34	U	-	300	e	10.0
2-amino-4,6-dinitrotoluene	1.5		0.45	U	0.40	U	0.42	U	0.46	U	0.34	U	-	-	-
RDX	1.0	U	5.7	E	6.9	E	0.85	U	11.5	E	0.68	U	-	2.00	a	-

TABLE 4-7b
COMPARISON OF GROUNDWATER EXPLOSIVES AND MISCELLANEOUS DATA TO ARARS AND TBCS - SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

01 GW 03 but was not detected in background groundwater samples. Sample 01 GW 05 required filtering in the field, despite the use of micro-flow purge techniques to minimize suspended solids. Filtered sample results from the same location did not exhibit elevated levels of any metals except cadmium (3.0 ug/L) and zinc (182 ug/L).

4.5.2.2 Organics

Chloroform (3 ug/L), gamma-BHC (0.001 ug/L), and methylene chloride (1 ug/L) were each detected in one site-related groundwater sample collected at Site 1. None of these compounds were detected in background groundwater samples.

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

4.5.2.3 Miscellaneous Parameters

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

4.6 CONTAMINANT FATE AND TRANSPORT

Various aspects of fate and transport for chemicals detected at Site 1 are discussed in this section. Chemical and physical properties affecting contaminant migration are discussed in Section 4.6.1. Contaminant persistence is discussed in Section 4.6.2. Trends in detected contaminants and observed contaminant migration routes are identified and discussed in Section 4.6.3.

4.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 1 revealed slightly elevated concentrations of three metals in subsurface soil, low levels of several explosives and trace levels of two VOCs and one pesticide in groundwater, and elevated levels of several metals in unfiltered groundwater. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical

and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

Unfiltered groundwater concentrations of several metals were generally greater than levels in the corresponding filtered sample collected at the same location. With the exception of cadmium and zinc, elevated levels of metals were not present in the filtered sample, which indicates the presence of metals in the suspended solids. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given the geologic formation, which does not include conditions conducive to solution channeling or fracture-based flow. Despite efforts such as installation of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure, at some wells, low-turbidity samples could not be collected. Samples obtained from wells where turbidity could not be reduced displayed metals concentrations higher than representative for the formation and, in the case of 01 GW 05, filtered results are lower.

Slightly elevated levels of antimony, arsenic, and silver were each noted in one subsurface soil sample. The extent to which these metals can be leached from soil and transported in groundwater is largely determined by chemical species present and by environmental factors affecting their solubility and binding to organic materials. Many metals are water insoluble; however, some soluble species of metals exist and are therefore more mobile. Inorganic compounds have a strong tendency to adsorb onto soil/sediment particles, however, which greatly reduces their mobility.

Methylene chloride and chloroform are considered volatile and mobile in the environment (either through soil gas migration or groundwater transport) and were detected at trace levels in one groundwater sample. Gamma-BHC (lindane) was also detected in groundwater at a trace level. Lindane is not considered highly mobile in groundwater; therefore, the significance of a single detection of this compound (at levels below quantitation limits) is not high.

Explosives found in groundwater, 2,4-DNT and RDX, both exhibit moderate solubility and do not bind to soil as readily as many other semivolatile compounds. 2-Amino-4,6-dinitrotoluene is expected to have similar chemical and physical properties. Hence, all three compounds are considered mobile in groundwater. Nitrocellulose is expected to exhibit low solubility (similar to cellulose) and a tendency to bind to soil. Nitrocellulose would not be expected to migrate readily in groundwater.

4.6.2 Contaminant Persistence

For the classes of detected chemicals, environmental persistence varies considerably. Transformation of a chemical to its degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The product chemical(s) may or may not be significantly different from a toxicological or a physical transport

perspective. If the transformational process is known or suspected, product chemicals can be predicted and extent of transformation can be determined from chemical reaction rate data. Other transformational processes may be identified empirically from analytical data.

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

Inorganic compounds have a strong tendency to adsorb onto soil/sediment particles, a factor that greatly reduces their mobility. Many metals are water insoluble; however, some soluble species of metals have increased mobility.

2,4-Dinitrotoluene and 2-amino-4,6-dinitrotoluene are degradation products of 2,4,6-trinitrotoluene (TNT). Microorganisms capable of metabolizing TNT have been reported in soils, composts, muds, and surface waters and their sediments. RDX can be degraded anaerobically but evidence for aerobic biodegradation is not available.

4.6.3 Observed Chemical Contaminant Trends

The presence of suspended solids in samples 01 GW 02, 01 GW 03, and 01 GW 05 is indicated by high turbidity readings and elevated levels of metals, such as aluminum, that are normally relatively insoluble in most common forms. Although unfiltered sample results were used in calculations for the groundwater risk assessment, in line with the recommended conservative approach to this evaluation, an important caveat is that the filtered sample results of two wells at Site 1 appear to be more representative of dissolved-phase contamination, and elevated levels of most metals were not generally found in the filtered aliquot.

Antimony, arsenic, and silver each exhibited elevated concentrations in only one subsurface soil sample. These metals were not detected at elevated levels in filtered groundwater samples.

Methylene chloride and chloroform are considered volatile and mobile in the environment and were detected at trace levels in one groundwater sample. Methylene chloride is considered a common laboratory contaminant; however, the application of data validation protocols did not eliminate this compound from consideration. Gamma-BHC (lindane), detected in one groundwater sample at a trace level, is not considered highly mobile in groundwater. Pesticides were not detected elsewhere in site-related samples and are not related to known previous site activities. Based upon limited detections, it

is appropriate to conclude that there is not a widespread potential for groundwater contamination with methylene chloride, chloroform, or gamma-BHC at this site.

2,4-Dinitrotoluene and 2-amino-4,6-dinitrotoluene were detected in groundwater samples 01 GW 01 and 01 GW 02, but TNT, the parent compound, was not observed. The detected levels of 2,4-dinitrotoluene and RDX in monitoring well MW1-02 are similar to the levels of these compounds observed during a 1993 sampling of this well. All three compounds are considered soluble and may exhibit some degree of mobility in groundwater, although not to the extent of volatile organic compounds, for example. Low levels of degradation products may be associated with contamination from source areas that have since been depleted or from sources not identified during subsurface soil sampling for this investigation. No explosive compounds were found in the sample from MW1-05, which is downgradient from MW1-02.

4.6.4 Conclusions

Elevated levels of certain metals in groundwater may not indicate the potential for groundwater transport because suspended solids in the unfiltered groundwater samples were found. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given the geologic formation, which does not include conditions conducive to solution channeling or fracture-based flow. Only cadmium and zinc were detected at slightly elevated levels in filtered groundwater and these metals were not found at elevated levels in other media sampled at Site 1. Furthermore, historical groundwater data for this site show elevated aluminum levels. This too suggests the presence of suspended solids. Overall, groundwater data do not indicate migration of dissolved inorganic contamination from the site.

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

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

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

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

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

4.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 1. The risk assessment was performed using the approach outlined in Section 2.4. Tables 4-9 and 4-10 provide the selected COPCs and representative concentrations of inorganics in site-related subsurface soil and inorganics and organics in groundwater, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non-cancer risk and greater than 1E-04 for cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 4.7.1.4 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

4.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential and industrial receptors).

4.7.1.1 Future Industrial Receptor

The estimated total cancer risks for the future industrial employee for exposure to COPCs in subsurface soil (assuming subsurface soils become future surface soils) at Site 1 are 6.8E-06 (ingestion), 1.4E-05 (dermal contact), and 3.8E-08 (inhalation of COPCs in fugitive dust). The total subsurface soil cancer risk is within the 1E-04 to 1E-06 target acceptable risk range typically used by EPA to determine the need for

TABLE 4-9
REPESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SUBSURFACE SOIL - SITE 1 (mg/kg)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ANTIMONY	3.64	LOGNORMAL
ARSENIC	12.20	NORMAL
BARIUM	31.13	NORMAL
BERYLLIUM	0.26	NORMAL
CADMIUM	0.31	NORMAL
CHROMIUM	63.02	LOGNORMAL
LEAD	18.26	NORMAL
MERCURY	0.06	NORMAL
SILVER	0.74	NORMAL
ZINC	27.14	NORMAL

TABLE 4-10
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 1 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	10800	NONPARAMETRIC
ARSENIC	22.7	NONPARAMETRIC
BARIUM	853	NONPARAMETRIC
BERYLLIUM	0.85	NONPARAMETRIC
CADMIUM	3.3	NONPARAMETRIC
CHROMIUM	148	NONPARAMETRIC
COPPER	75.45	NONPARAMETRIC
IRON	23350	NONPARAMETRIC
LEAD	14.5	NONPARAMETRIC
MERCURY	0.22	NORMAL
SILVER	1.09	LOGNORMAL
THALLIUM	4.42	LOGNORMAL
VANADIUM	58.4	NONPARAMETRIC
ZINC	1020	NONPARAMETRIC
CHLOROFORM	3	LOGNORMAL
GAMMA-BHC (LINDANE)	0.001	LOGNORMAL
METHYLENE CHLORIDE	1	LOGNORMAL

action at CERCLA/RCRA sites or formulate standards and criteria (ARARs). The principal COPCs contributing to the subsurface soil cancer risk are arsenic (ingestion, 94 percent of the cancer risk for this pathway; and dermal contact, 15 percent of the cancer risk for this pathway) and beryllium (dermal contact, 85 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future industrial employee, assuming exposure to COPCs in subsurface soil (assuming subsurface soil becoming future surface soils), at Site 1 are less than 1.0 for ingestion, dermal contact, and inhalation exposure pathways. Adverse noncarcinogenic effects are not expected when when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial employees exposed to subsurface soil in Tables 4-11 and 4-12, respectively.

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 and an estimated noncarcinogenic HI with a value greater than 1.0 for the future industrial employee assuming exposure to COPCs in groundwater at Site 1. (Ingestion exposures contributed the significant portion of cancer and non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are discussed in Section 4.7.1.4 and presented in Tables 4-13, 4-13a, and 4-14.

4.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 1. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater and subsurface soil (assuming subsurface soils become future surface soils). (Ingestion exposures contributed to the significant portion of groundwater risks and dermal contact contributed to subsurface soil risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. The amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 4.7.1.4 and presented for subsurface soil in Tables 4-15 and 4-16, respectively, and for groundwater in Tables 4-17, 4-17a, 4-18, and 4-18a.

4.7.1.3 Lead Results

Lead was not found above the EPA level of concern (400 mg/kg) in soil samples or above the EPA action level (15 ug/L) in groundwater samples taken during the RI. The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 1 exposures are presented in Appendix I.

TABLE 4-11
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 1
SUBSURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOIL INGESTION	SUBSURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
ANTIMONY	N/A	N/A	N/A
ARSENIC	6.4E-06	2.1E-06	3.6E-09
BARIUM	N/A	N/A	N/A
BERYLLIUM	3.9E-07	1.2E-05	7.3E-11
CADMIUM	N/A	N/A	2.5E-11
CHROMIUM	N/A	N/A	3.4E-08
LEAD	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	6.8E-06	1.4E-05	3.8E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-12
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 1
SUBSURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOIL INGESTION	SUBSURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
ANTIMONY	8.9E-03	5.6E-02	1.6E-06
ARSENIC	4.0E-02	1.3E-02	7.4E-06
BARIUM	4.4E-04	3.4E-03	8.0E-06
BERYLLIUM	5.1E-05	1.6E-03	9.5E-09
CADMIUM	6.0E-04	3.7E-03	3.1E-07
CHROMIUM	1.2E-02	1.9E-01	2.3E-06
LEAD	N/A	N/A	N/A
MERCURY	1.9E-04	1.2E-04	5.9E-08
SILVER	1.4E-04	2.2E-04	2.7E-08
ZINC	8.9E-05	1.1E-04	1.6E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-13
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
CHLOROFORM	6.4E-08	6.3E-10
GAMMA-BHC (LINDANE)	4.5E-09	2.3E-10
METHYLENE CHLORIDE	2.6E-08	1.0E-10
ARSENIC	1.2E-04	5.1E-08
BARIUM	N/A	N/A
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MERCURY	N/A	N/A
SILVER	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	1.2E-04	5.2E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-13a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
CHLOROFORM	7.1E-09	9.9E-11
GAMMA-BHC (LINDANE)	5.0E-10	3.7E-11
METHYLENE CHLORIDE	2.9E-09	1.6E-11
ARSENIC	5.4E-06	3.3E-09
BARIUM	N/A	N/A
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MERCURY	N/A	N/A
SILVER	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	5.4E-06	3.5E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-14
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN								
SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT
CHLOROFORM	2.9E-03			2.9E-03	2.9E-03					2.9E-05
GAMMA-BHC (LINDANE)	3.3E-05			3.3E-05	3.3E-05					1.7E-06
METHYLENE CHLORIDE	1.6E-04				1.6E-04					6.3E-07
ARSENIC	7.4E-01		7.4E-01							3.2E-04
BARIUM	1.2E-01	1.2E-01				1.2E-01		1.2E-01	1.2E-01	1.2E-03
CADMIUM	6.5E-02			6.5E-02						2.6E-04
CHROMIUM	2.9E-01			2.9E-01						5.9E-03
COPPER	1.8E-02	1.8E-02		1.8E-02	1.8E-02					1.3E-05
IRON	7.6E-01				7.6E-01	7.6E-01				6.2E-03
LEAD	N/A	N/A					N/A			N/A
MERCURY	2.1E-02			2.1E-02			2.1E-02		2.1E-02	1.2E-04
SILVER	2.1E-03		2.1E-03							4.4E-06
VANADIUM	8.2E-02									3.3E-03
ZINC	3.3E-02	3.3E-02								5.5E-05
	HI BY TARGET ORGAN	1.7E-01	7.4E-01	4.0E-01	7.8E-01	8.8E-01	2.1E-02	1.2E-01	1.4E-01	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-15
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 1
SUBSURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOIL INGESTION - LIFETIME	SUBSURFACE SOIL DERMAL CONTACT - LIFETIME	INHALATION OF COPCS IN FUGITIVE DUST - LIFETIME
ANTIMONY	N/A	N/A	N/A
ARSENIC	2.9E-05	2.1E-05	2.2E-09
CHROMIUM	N/A	N/A	2.1E-08
TOTAL RISK	2.9E-05	2.1E-05	2.3E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-16
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 1
SUBSURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

	SUBSURFACE SOIL INGESTION BY TARGET ORGAN					
SUBSTANCE	SUBSURFACE SOIL INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	SUBSURFACE SOIL DERMAL CONTACT - CHILD	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
ANTIMONY	1.2E-01	1.2E-01			N/A	1.7E-06
ARSENIC	5.2E-01		5.2E-01		3.2E-01	7.8E-06
CHROMIUM	1.6E-01			1.6E-01	N/A	2.4E-06
	HI BY TARGET ORGAN	1.2E-01	5.2E-01	1.6E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-17
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	2.7E-07	2.0E-08	3.5E-06
GAMMA-BHC (LINDANE)	1.9E-08	7.4E-09	4.9E-08
METHYLENE CHLORIDE	1.1E-07	3.2E-09	2.6E-08
ARSENIC	5.1E-04	1.2E-06	N/A
BARIUM	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
COPPER	N/A	N/A	N/A
IRON	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	5.1E-04	1.2E-06	3.6E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-17a
CETNRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	3.9E-08	3.2E-09	2.0E-07
GAMMA-BHC (LINDANE)	2.8E-09	1.2E-09	2.8E-09
METHYLENE CHLORIDE	1.6E-08	5.1E-10	1.5E-09
ARSENIC	3.0E-05	6.6E-08	N/A
BARIUM	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
COPPER	N/A	N/A	N/A
IRON	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	3.0E-05	7.0E-08	2.0E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-18
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	1.9E-02			1.9E-02	1.9E-02					1.1E-03	N/A
GAMMA-BHC (LINDANE)	2.1E-04			2.1E-04	2.1E-04					6.4E-05	N/A
METHYLENE CHLORIDE	1.1E-03				1.1E-03					2.4E-05	5.5E-05
ARSENIC	4.8E+00		4.8E+00							9.9E-03	N/A
BARIUM	7.8E-01	7.8E-01				7.8E-01		7.8E-01	7.8E-01	3.8E-02	N/A
CADMIUM	4.2E-01			4.2E-01						8.2E-03	N/A
CHROMIUM	1.9E+00			1.9E+00						1.8E-01	N/A
COPPER	1.2E-01	1.2E-01		1.2E-01	1.2E-01					3.9E-04	N/A
IRON	5.0E+00				5.0E+00	5.0E+00				1.9E-01	N/A
LEAD	N/A	N/A					N/A			N/A	N/A
MERCURY	1.4E-01			1.4E-01			1.4E-01		1.4E-01	3.9E-03	N/A
SILVER	1.4E-02		1.4E-02							1.4E-04	N/A
VANADIUM	5.3E-01									1.0E-01	N/A
ZINC	2.2E-01	2.2E-01								1.7E-03	N/A
	HI BY TARGET ORGAN	1.1E+00	4.9E+00	2.6E+00	5.1E+00	5.8E+00	1.4E-01	7.8E-01	9.2E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 4-18a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 1
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	9.0E-03			9.0E-03	9.0E-03					7.3E-04	N/A
GAMMA-BHC (LINDANE)	1.0E-04			1.0E-04	1.0E-04					4.3E-05	N/A
METHYLENE CHLORIDE	5.0E-04				5.0E-04					1.6E-05	1.1E-05
ARSENIC	9.3E-01		9.3E-01							2.7E-03	N/A
BARIUM	2.1E-01	2.1E-01				2.1E-01		2.1E-01	2.1E-01	1.5E-02	N/A
CADMIUM	1.5E-01			1.5E-01						4.2E-03	N/A
CHROMIUM	4.3E-01			4.3E-01						6.0E-02	N/A
COPPER	1.9E-02	1.9E-02		1.9E-02	1.9E-02					9.0E-05	N/A
IRON	1.3E+00				1.3E+00	1.3E+00				7.0E-02	N/A
LEAD	N/A	N/A					N/A			N/A	N/A
MERCURY	6.5E-02			6.5E-02			6.5E-02		6.5E-02	2.6E-03	N/A
SILVER	6.5E-03		6.5E-03							9.1E-05	N/A
VANADIUM	1.3E-01									3.6E-02	N/A
ZINC	6.3E-02	6.3E-02								7.0E-04	N/A
	HI BY TARGET ORGAN	2.9E-01	9.3E-01	6.8E-01	1.3E+00	1.5E+00	6.5E-02	2.1E-01	2.7E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

4.7.1.4 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 1 for future residential receptors assuming exposure to COPCs in subsurface soil and groundwater and recalculated cancer and non-cancer risks for the future industrial employee assuming exposure to COPCs in groundwater.

Comparison to Background: Groundwater

Aluminum, nickel, and thallium were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 4-7 presents the comparison of COPCs to background concentrations. Aluminum was eliminated based on comparison to background upper 95 percent UTLs.

Comparison to Background: Subsurface Soil

Barium, beryllium, cadmium, lead, mercury, silver, and zinc were eliminated from consideration as subsurface soil COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 4-6 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Consideration of Modified Dermal Absorption and Target Organ Grouping: Groundwater

As discussed in Section 2.4.6.2, groundwater cancer and non-cancer risks were recalculated using a modified gastrointestinal absorption factor for one chemical. After these steps, the final RME cancer risks are still above the 1E-04 to 1E-06 target acceptable range for the future residential receptor (5.1E-04, via groundwater ingestion) and the future industrial receptor (1.2E-04, also via groundwater ingestion). Arsenic is the principal COPC contributing to these groundwater RME cancer risks.

The revised HIs are greater than 1.0 for exposure to groundwater by future residential and future industrial receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are less than 1.0 for each affected organ for the future industrial receptor but are greater than 1.0 in some cases for the residential child. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: digestive system (5.8 - iron), liver (5.1 - iron), skin (4.9 - arsenic), and kidney (2.6 - chromium). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial employees exposed to groundwater in Tables 4-13 and 4-14, respectively. Estimated carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to groundwater in Tables 4-17 and 4-18, respectively.

Consideration of Modified Dermal Absorption and Target Organ Grouping: Subsurface Soil

Subsurface soil cancer and non-cancer risks were recalculated using modified soil-to-skin absorption factors for three chemicals and excluding dermal effects for other COPCs. After these steps, the revised risks are within the target range for each exposure route (ingestion, dermal, and inhalation of dust), but the sum of these three HIs exceeded 1.0. Therefore, ingestion risks were grouped by target organ, which then yielded an acceptable worst-case sum (i.e., the ungrouped HIs from dermal and inhalation plus the highest of the HIs from ingestion yielded a total RME HI of less than 1.0 for the future residential child, exposure to subsurface soil).

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to subsurface soil in Tables 4-15 and 4-16, respectively.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate cancer and non-cancer risks for exposure to COPCs in groundwater for future residential receptors and cancer risks for the future industrial employee. 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. Based on this evaluation, the estimated total central tendency cancer risks are within the mid-range of the target acceptable risk range; however, the noncarcinogenic HI was greater than 1.0 for some target organs. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: digestive system (1.5 - iron) and liver (1.3 - iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks are presented for exposure to groundwater for future industrial receptors in Table 4-13a and for future residential receptors in Table 4-17a. Estimated central tendency noncarcinogenic risks are presented for exposure to groundwater for the future residential child in Table 4-18a.

4.7.2 Conclusions

Subsurface soil and groundwater were sampled at Site 1. The potential receptors for this site were future industrial and residential receptors. The RME cancer risks associated with future industrial (subsurface

soil and groundwater) and future residential (subsurface soil and groundwater) exposure scenarios exceeded 1E-04, the upper end of the target risk range. Arsenic (via ingestion of groundwater) was the major COPC that contributed to the cancer risks for these exposure scenarios. However, these RME estimates are probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

RME estimates for noncarcinogenic HIs associated with future industrial (subsurface soil and groundwater) and future residential (subsurface soil and groundwater) exposure scenarios exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Arsenic, chromium, and iron (all via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for these exposure scenarios. The RME estimates of non-cancer risk from exposure to groundwater for the future industrial receptor are probably overconservative because associated central tendency non-cancer HIs are less than 1.0. However, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the target organs liver and digestive system (iron was the principal COPC).

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

Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 1 in Table 4-19 for subsurface soil and groundwater. Table 4-19a presents the relevant central tendency risk estimates associated with potential receptors for groundwater.

The amended risk assessment procedure did not result in the elimination of all cancer and non-cancer risks above guideline limits. Iron by groundwater ingestion remained with a HQ slightly above one.

4.8 ECOLOGICAL RISK

4.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 1 is an open, 6-acre field with scattered grassy vegetation. Some areas on the site are in the early stages of primary succession; some small trees and scattered shrubs are present but provide marginal cover. Site 1 is bordered on the west and south by an earthen berm. A railroad spur and Macassar Road

TABLE 4-19
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 1
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	6.8E-06	2.9E-05^	N/A	N/A	6.3E-02	5.2E-01@	N/A	N/A
	Dermal Contact	N/A	1.4E-05	2.1E-05^	N/A	N/A	2.7E-01	3.2E-01^	N/A	N/A
	Inhalation of Fugitive Dust	N/A	3.8E-08	2.3E-08^	N/A	N/A	2.0E-05	1.2E-05^	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	1.2E-04^	5.1E-04^	N/A	N/A	8.8E-01@	5.8E+00@	N/A	N/A
	Dermal Contact	N/A	5.2E-08^	1.2E-06^	N/A	N/A	1.7E-02^	5.5E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.6E-06^	N/A	N/A	N/A	N/A	5.5E-05^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/S
TOTAL		-	1.4E-04	5.6E-04	-	-	1.2E+00	7.2E+00	5.5E-05	-

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.

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TABLE 4-19a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 1
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/R	N/R	N/A	N/A	N/R	N/R	N/A	N/A
	Dermal Contact	N/A	N/R	N/R	N/A	N/A	N/R	N/R	N/A	N/A
	Inhalation of Fugitive Dust	N/A	N/R	N/R	N/A	N/A	N/R	N/R	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	5.4E-06^	3.0E-05^	N/A	N/A	N/R	1.5E+00@	N/A	N/A
	Dermal Contact	N/A	3.5E-09^	7.0E-08^	N/A	N/A	N/R	1.9E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	2.0E-07^	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/S
	TOTAL	-	5.4E-06	3.0E-05	-	-	-	1.7E+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
** = 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.

border the northern and eastern portions of the site, respectively. No surface water or drainage swales are present on or around the site, which is located in the Hockhockson Brook Watershed. Wooded uplands dominated by white oak and chestnut oak are present south, east, and west of the site. Mountain laurel forms a dense understory in these areas, with soils characterized by excessively drained Evesboro sand.

NJDEP Geographic Information System data originally indicated the presence of wetlands east of the site. However, ground-truthing of the site revealed that no wetlands were present in these areas. No wetland hydrology, hydric soils, or aquatic plants were identified. The surrounding upland areas provide excellent habitat for terrestrial receptors, but the site itself contains marginal habitat for ecological receptors. Shrubs and grasses provide some habitat on the site, but vegetation on the site is thin and scattered, with several bare areas. Small mammals, such as the cottontail rabbit, white-footed mouse, shrews, and voles may make limited use of the site. No sensitive habitats or threatened or endangered species are known to occur on or around the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major release pathway from the site is overland runoff and erosion. Yet runoff from the site is precluded by excessively drained soils and the high berm and roadway that surround most of the site. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations to the east-northeast. Groundwater from the site may eventually discharge to surface water; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms. This migration pathway is limited, however, since surface water is scarce near the site.

Exposure Routes

Terrestrial receptors associated with Site 1 may be exposed to surface soil contaminants via incidental ingestion of soil and ingestion of contaminated food items, although this pathway is limited due to the lack of extensive terrestrial habitat and subsequent receptor use on the site. Terrestrial receptors may also come into contact with contaminants in Site 1 surface water by using it as drinking water, but this is unlikely since surface water near the site is limited.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1993 SI activities for this site. In particular, contaminants detected in Site 1 surface soils were considered preliminary COPCs for quantitative assessment. Subsurface soil and groundwater samples taken as part of 1995 RI activities were assessed qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

4.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential risks to ecological receptors from contaminants in surface soil. Surface soil and terrestrial plant ET values are presented in Tables 2-30 and 2-31, respectively.

4.8.3 Preliminary Exposure Assessment

Representative exposure point contaminant concentrations in surface soil used for this initial screening were obtained from 1993 SI data. The maximum detected contaminant concentrations in surface soil samples taken throughout the site were conservatively used as representative exposure point concentrations for terrestrial animals and plants. Surface soils were not sampled during 1995 RI activities since 1993 SI sampling adequately characterized the nature and extent of surface soil contamination. Data from 1995 RI subsurface soil and groundwater samples were not used quantitatively. However, the results of 1995 RI sampling are discussed in detail in Section 7.8.3, below. Background concentrations were used in this ERA for qualitative comparison to representative exposure point concentrations, and are the maximum values detected in facility-wide background samples. Section 2.4.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

4.8.4 Risk Characterization

For Site 1 surface soils, aluminum (HQ = 5.0), chromium (HQ = 164), copper (HQ = 2.72), mercury (HQ = 9.6), and vanadium (HQ = 2.15) exceeded ET values and were retained as final COPCs (Table 4-20). No organics were detected. For terrestrial plants, aluminum (HQ = 59.6), chromium (HQ = 65.7), copper(1.36), lead (HQ = 3.58), mercury (HQ = 3.2), silver (HQ = 3.4), vanadium (HQ = 21.5), and zinc (HQ = 3.66) exceeded ET values (Table 4-21).

The toxicological properties of all final COPCs in surface soil are summarized in Appendix M.

TABLE 4-20
SURFACE SOIL CONTAMINANTS OF POTENTIAL CONCERN - SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Representative Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	7/12	5310	2980	600	5.0	Retained-HQ > 1
Arsenic	3/12	14.4	4.0	60	0.07	Eliminated-Does not exceed threshold
Barium	3/12	15.8	290	3000	0.10	Eliminated-Does not exceed threshold
Cadmium	3/12	0.37	2.2	20	0.05	Eliminated-Does not exceed threshold
Chromium	7/12	59.5	65.7	0.4	164	Retained-HQ > 1
Copper	4/12	6.6	136	50	2.72	Retained-HQ > 1
Lead	7/12	39.4	179	500	0.36	Eliminated-Does not exceed threshold
Manganese	7/12	93.9	45	100	0.45	Eliminated-Does not exceed threshold
Mercury	3/12	0.1	0.96	0.1	9.6	Retained-HQ > 1
Silver	5/12	0.38	6.8	50	0.14	Eliminated-Does not exceed threshold
Vanadium	7/12	61.6	43.0	20	2.15	Retained-HQ > 1
Zinc	7/12	50.7	183	200	0.9	Eliminated-Does not exceed threshold

TABLE 4-21
TERRESTRIAL PLANT CONTAMINANTS OF POTENTIAL CONCERN - SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Representative Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	7/12	5310	2980	50	59.6	Retained-HQ > 1
Arsenic	3/12	14.4	4.0	10	0.4	Eliminated-Does not exceed threshold
Barium	3/12	15.8	290	500	0.58	Eliminated-Does not exceed threshold
Cadmium	3/12	0.37	2.2	3	0.73	Eliminated-Does not exceed threshold
Chromium	7/12	59.5	65.7	1	65.7	Retained-HQ > 1
Copper	4/12	6.6	136	100	1.36	Retained-HQ > 1
Lead	7/12	39.4	179	50	3.58	Retained-HQ > 1
Manganese	7/12	93.9	45	500	0.09	Eliminated-Does not exceed threshold
Mercury	3/12	0.1	0.96	0.3	3.2	Retained-HQ > 1
Silver	5/12	0.38	6.8	2	3.4	Retained-HQ > 1
Vanadium	7/12	61.6	43.0	2	21.5	Retained-HQ > 1
Zinc	7/12	50.7	183	50	3.66	Retained-HQ > 1

4.8.5 Summary and Conclusions

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

In site surface soils, HQ values for final COPCs were indicative of low potential risk, with the exception of chromium and mercury. Nonetheless, chromium was detected in concentrations comparable to background, and mercury was only detected in three of 12 samples. HQ values for terrestrial plants were indicative of low potential risk, with the exception of aluminum, chromium, and vanadium, but all three of these inorganics were detected below or comparable to background. In addition, these inorganics were not detected in roughly one-half of the samples. Some metals and explosives were detected at slightly elevated levels in groundwater and some metals were present at slightly elevated levels in subsurface soil samples taken as part of the 1995 RI effort. However, no surface water is present near the site, so groundwater discharge to surface water is not expected to be relevant for Site 1. The closest surface water body is a branch of Hockhockson Brook 1/2 mile to the west.

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

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

4.9 EVALUATION AND RECOMMENDATIONS

4.9.1 Evaluation Summary

Compounds found in soil generally confirmed the presence of widespread metals and TPH at levels below regulatory concern concluded from past sampling programs. However, arsenic was found in one subsurface soil sample at a concentration of 27.8 mg/kg, higher than the New Jersey residential direct contact clean-up criterion, 20.0 mg/kg. Arsenic is a common component of soils in this vicinity (Pine Barrens type soils) as discussed in Section 3.5. A single exceedance of this New Jersey guidance criterion, from among 37 surface and subsurface soil samples, indicates that there may be no significant site-related metals contamination related to previous site activities.

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

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

Natural ecological succession should continue to progress and subsequent receptor use should increase. Metals found in near-surface soils, although sometimes at levels of potential concern to future ecological receptors, were generally found in the range of natural background levels and should attenuate with time.

4.9.2 Recommendations

Remediation of site soils by excavation and removal would disrupt succession at the site and may not be desirable.

Remediation of the shallow groundwater beneath the site may not be necessary or practical.

5.0 SITE 2: ACTIVE ORDNANCE DEMILITARIZATION SITE

5.1 SITE BACKGROUND AND PHYSICAL SETTING

The Active Ordnance Demilitarization Site (Site 2) is an 11-acre site that has been used for the demilitarization and disposal of ordnance since 1973. RCRA-regulated activities include the burning of ordnance at an average of approximately 800 pounds per month. From 1973 to 1983, a total of approximately 80,000 pounds of explosives were disposed at the site. The ordnance consisted of explosives and propellants such as ammonium picrate, TNT, cyclonite (RDX), Composition 4 (a plastic explosive compound), black powder, and double-base propellants (a mixture of nitrocellulose and nitroglycerine). Figure 5-1 is a map of the site.

The entire 11-acre site is characterized as a shallow, open, non-vegetated, oval sand pit. Two undeveloped dirt roads access the site, one from the south and one from the west. The perimeter of the site is defined by a berm, which is surrounded by woodlands. The topography of the site slopes downward toward the north from approximately 125 feet above MSL at the bunker to approximately 90 feet above MSL at the open detonation area. In the center of the site is a sand hill that is approximately 200 feet long and 15 feet high. Standing water and wetlands are prevalent in the northeastern portion of the site. The general groundwater flow direction is to the north and east, based on measured groundwater levels.

5.2 PREVIOUS INVESTIGATIONS

5.2.1 Summary of Activities and Results

The 1983 IAS calculated potential nitrate and metals migration based on site use and recommended a confirmation study based on the potential for nitrates to enter the groundwater.

During the SI conducted in 1993, four monitoring wells were installed at the site (MW2-01 through MW2-04). Surface and subsurface soil samples were collected and analyzed for constituents associated with the explosives and potential nitrate residues from detonation activity. None of the parameters analyzed for were detected.

During the RI/FS in 1993, three additional monitoring wells were installed (MW2-05 through MW2-07), one within the detonation area and two outside the site perimeter. These wells were installed to depths of 20 feet. Groundwater from the seven wells was analyzed for TCL organics, TAL inorganics, and explosive compounds. Five subsurface soil samples (from 1 to 2 feet) were collected from a drainage depression on the eastern portion of the site and analyzed for TAL inorganics (including cyanide) and explosive compounds.

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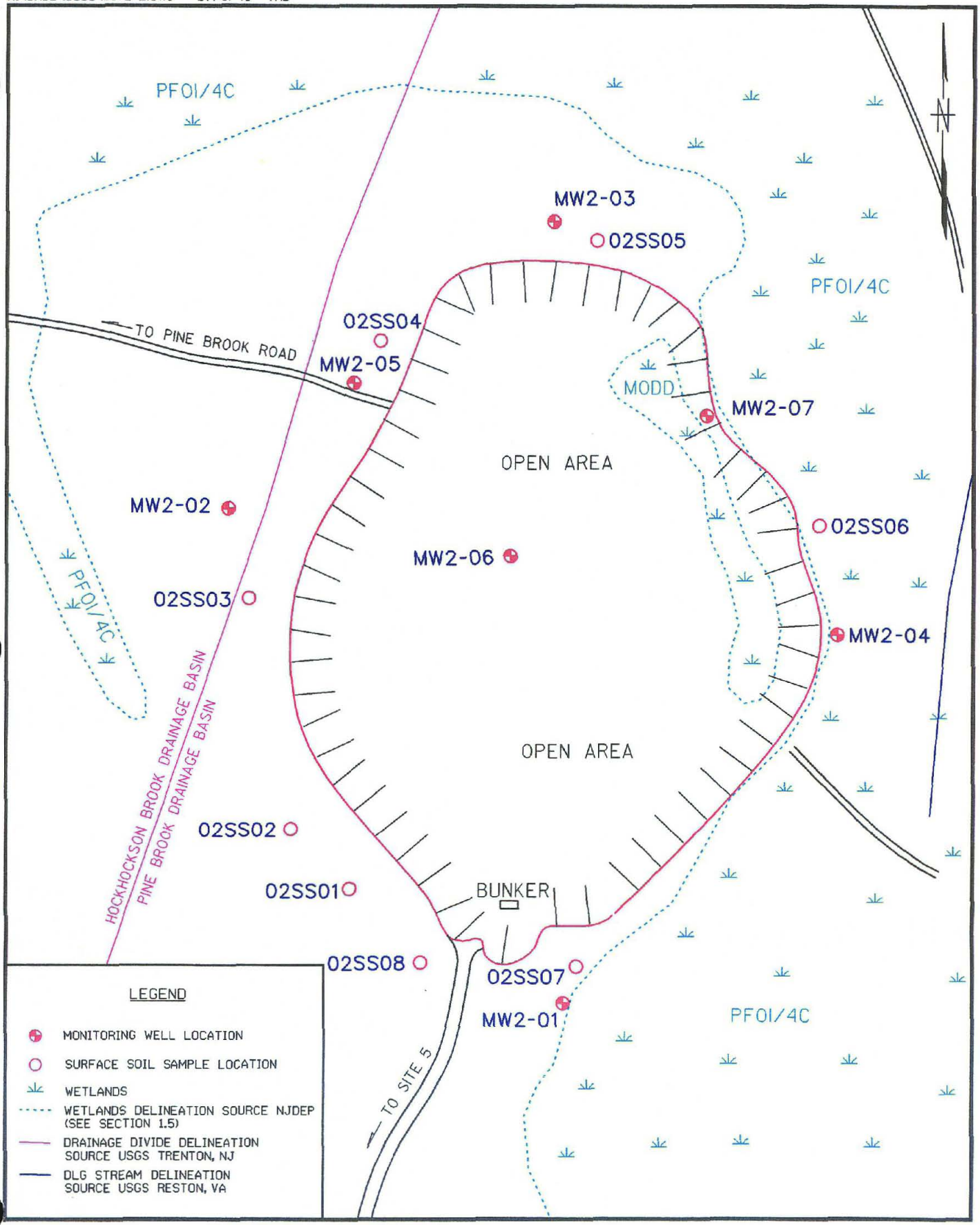

SAMPLE LOCATIONS

SITE 2 - ACTIVE ORDNANCE DEMILITARIZATION SITE

FIGURE 5-1

0 200 400

SCALE IN FEET

Brown & Root Environmental

5.2.2 Summary of Conclusions

Low levels of explosives and metals at levels of potential concern were found in groundwater. No explosives were found in surface soil and metals were found generally in the range of background, although chromium, cadmium, and iron concentrations were at levels of potential concern. No chromium or cadmium concentrations were found above regulatory guidelines.

Analytical results indicate low concentrations of explosive compounds in groundwater samples from two of the wells (MW2-03 and MW2-06). Nitrates were detected in MW2-06. The concentrations of metals in soil and sediment samples were within normal background levels, except for chromium and cadmium. High iron concentrations were attributable to naturally occurring conditions. Elevated metals concentrations were detected in several groundwater samples.

5.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objective:

- Resample all wells to confirm previous results. Determine impact of turbidity on sampling results by using low-flow sampling.
- Obtain surface soil samples beyond the berm to determine if deposition has occurred beyond the site.
- Compare data to background levels and risk-based criteria.

5.3 RI FIELD INVESTIGATIONS

Between July and October 1995, B & R Environmental conducted the following field investigation activities at Site 2:

- Sampling and analysis of groundwater from the existing seven monitoring wells (Section 5.3.1).
- Measurement of static-water levels in the existing wells (Section 5.3.1).
- Sampling and analysis of eight surface soil samples (Section 5.3.2).

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the surface soil samples. Surveying notes are provided in Appendix F.

5.3.1 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of measurements was collected on August 7, 1995, and the second round was collected on October 17, 1995. Static-water levels were measured from the top of each well's PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 82.48 to 87.88 feet above MSL during the first round of measurements and from approximately 82.13 to 85.93 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 5-1. Monitoring well characteristics are presented in Table 5-1a.

Groundwater Sampling

Groundwater samples were obtained from the seven existing monitoring wells (MW2-01 through MW2-07) during July and August 1995. Figure 5-1 shows the well locations. Groundwater was sampled and analyzed to determine the current level and extent of contamination, if any, and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. Prior to sampling, the wells were purged, using the micro-purge protocol to reduce turbidity, until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purge and sample process. Field measurements collected during purging were pumping rate (L/min), water level, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity.

A total of seven groundwater samples (02 GW 01 through 02 GW 07) were collected and submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TAL metals, and hexavalent chromium. At the request of NORTHDIV, groundwater sample 02 GW 07 was also analyzed for TAL dissolved metals. Samples from all wells were also submitted to GP Environmental Services for the explosives analysis.

Sample log sheets are presented in Appendix D.

5.3.2 Surface Soil Sampling

Eight surface soil samples (02 SS 01 through 02 SS 08) were collected in August 1995 and submitted to Lancaster Laboratories for TCL SVOC, TAL metals, hexavalent chromium, and moisture analyses and

Table 5-1
Site 2 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1]	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)
MW2-01	14.73	101.43	86.70	15.50	101.43	85.93
MW2-02	9.99	94.85	84.86	10.41	94.85	84.44
MW2-03	5.60	88.75	83.14	5.88	88.74	82.86
MW2-04	4.33	88.93	84.60	4.86	88.93	84.07
MW2-05	9.44	91.92	82.48	9.79	91.92	82.13
MW2-06	6.04	93.92	87.88	9.46	93.92	84.46
MW2-07	7.60	94.05	86.45	9.47	94.05	84.58

1 Below top of riser
2 Above MSL

Table 5-1a
Site 2 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW2-01	30.0	NS	101.43	NS	4	13 to 30	3 to 30	2/27/86
MW2-02	20.0	NS	94.85	NS	4	3 to 20	2 to 19	2/28/86
MW2-03	24.0	NS	88.75	NS	4	4 to 24	2.5 to 24	2/21/86
MW2-04	19.0	NS	88.93	NS	4	4 to 19	2.5 to 19	2/28/86
MW2-05	19.28	99.94	91.92	NS	4	4.25 to 19.28	3 to 19.75	1/25/91
MW2-06	19.8	91.84	93.92	94.09	4	4.8 to 19.8	3.8 to 16.5[3]	1/24/91
MW2-07	20.0	92.05	94.05	NS	4	5.0 to 20.0	4 to 20.5[3]	1/25/91

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.
(NS) Not surveyed.

to GP Environmental Services for explosive compound analyses to determine if ordnance disposal activities had affected soils outside the berm. Extra volume was collected at sample location 02 SS 02 for the matrix spike/matrix spike duplicate sample. Surface soils consisted of gray to black, fine-grained sand with some silt. Sample log sheets are presented in Appendix D.

The samples were collected from 0 to 6 inches bgs using stainless-steel trowels and placed directly into the appropriate bottleware.

5.4 SITE CHARACTERISTICS

5.4.1 Geology

Regional mapping places Site 2 within the outcrop area of the Vincentown Formation. The Vincentown Formation ranges between 10 and 130 feet in thickness and the soil borings are no more than 30 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Vincentown Formation. In general, the borings encountered alternating beds of yellowish-brown, micaceous, silty, fine- to medium-grained sand and light olive-brown, glauconitic, silty sand and sand. Five feet of olive to blue-green clayey sand was encountered in one of the borings.

5.4.2 Hydrogeology

Groundwater in the Vincentown aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations are summarized in Table 5-1. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 5-2 and 5-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is north and east. There does not appear to be a significant seasonal variation in groundwater flow direction.

The hydraulic conductivities calculated for MW2-05, MW2-06, and MW2-07 are 4.62×10^{-4} cm/sec (1.31 ft/day), 4.23×10^{-5} cm/sec (0.12 ft/day), and 1.73×10^{-4} cm/sec (0.46 ft/day), respectively.

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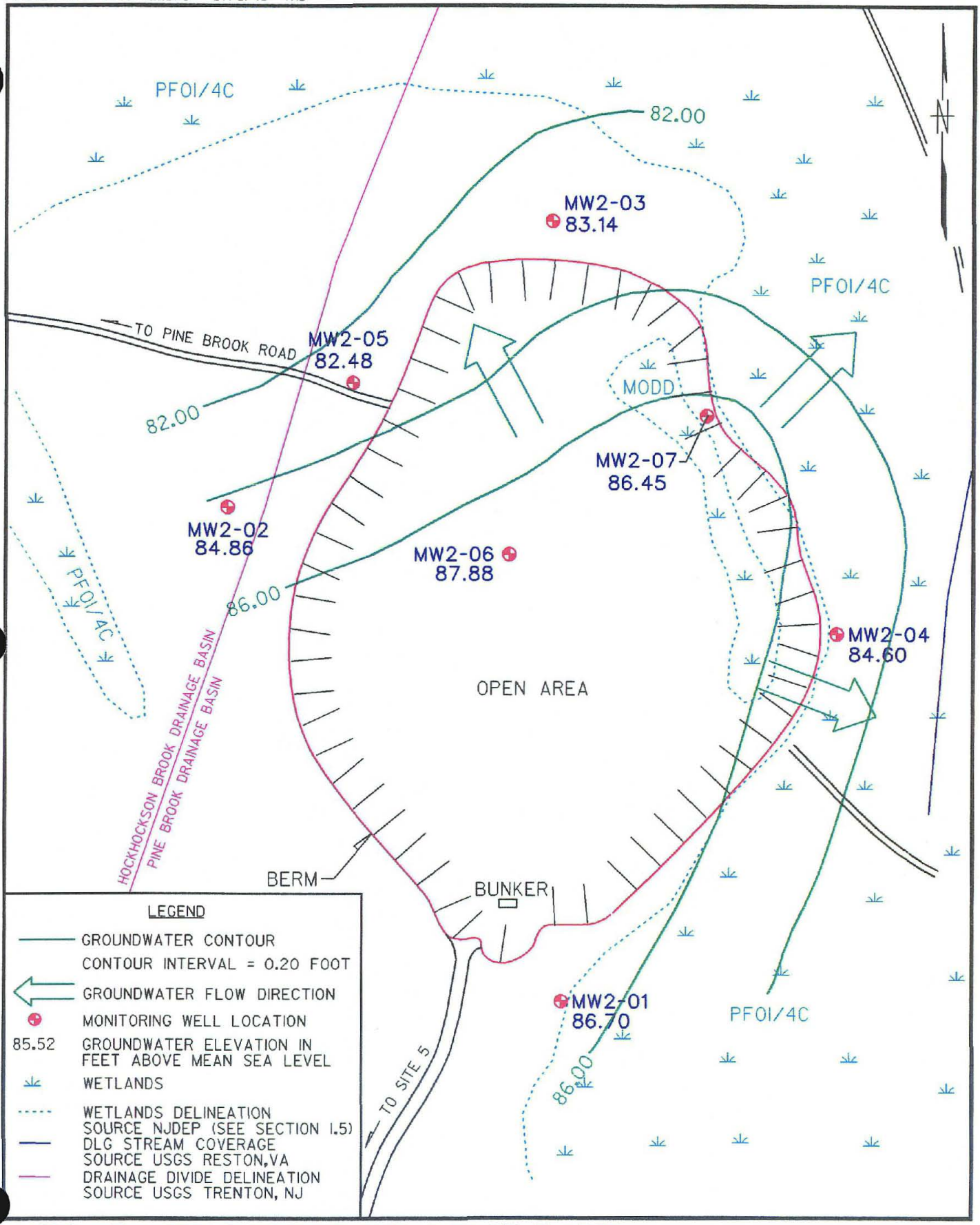

GROUNDWATER CONTOURS MAP AUGUST 7, 1995

SITE 2 - ACTIVE ORDNANCE DEMILITARIZATION SITE

FIGURE 5-2

0 200 400

SCALE IN FEET

Brown & Root Environmental

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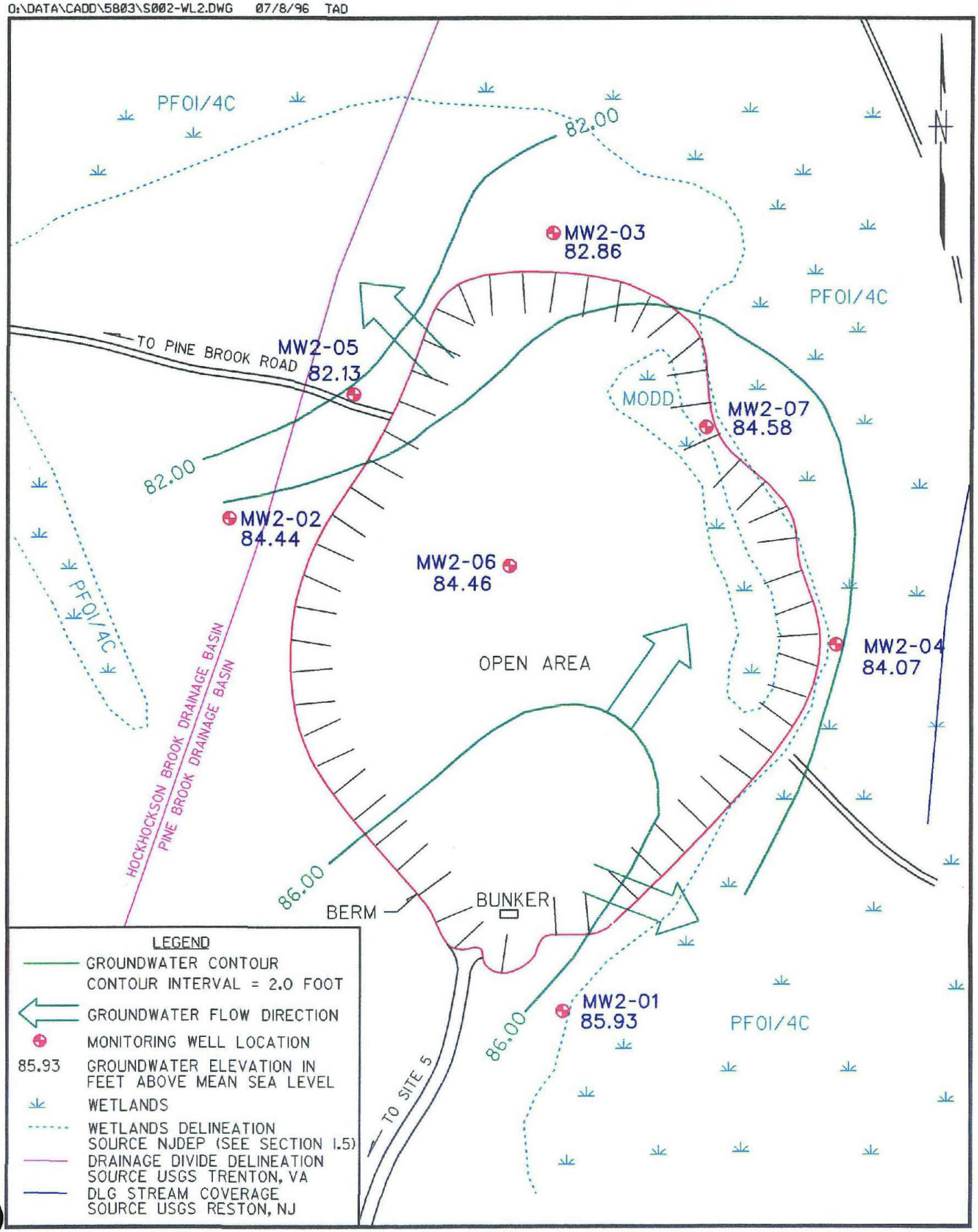

GROUNDWATER CONTOURS MAP OCTOBER 17, 1995

SITE 2 - ACTIVE ORDNANCE DEMILITARIZATION SITE

FIGURE 5-3

0 200 400
SCALE IN FEET

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5.5 NATURE AND EXTENT OF CONTAMINATION

5.5.1 Surface Soils

Eight surface soil samples (02 SS 01 through 02 SS 08) were collected at Site 2 (Figure 5-1). Tables 5-2 and 5-3 present the occurrence and distribution of inorganic and organic chemicals detected in site-related surface soil samples and compare them to background as presented in Section 31. Tables 5-2a and 5-2b present a comparison of detected compounds to ARARS and TBCs. Figure 5-4 shows sample locations and concentrations of compounds that exceed ARARS and TBCs.

5.5.1.1 Inorganics

Concentrations of metals found in site-related samples were generally similar to the ranges associated with background surface soil samples.

5.5.1.2 Organics

Bis(2-ethylhexyl) phthalate (60 ug/kg to 320 ug/kg) was detected in eight surface soil samples at Site 2. This compound was not detected in background surface soil samples. No explosives were found in surface soils.

5.5.1.3 Miscellaneous Parameters

Hexavalent chromium was detected in one Site 2 surface soil sample (02 SS 07) at a concentration of 4.0 mg/kg.

5.5.2 Groundwater

A groundwater sample (02 GW 01 through 02 GW 07) was collected from each of the seven on-site wells (Figure 5-1). Tables 5-4 and 5-5 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples and compare them to background. Tables 5-4a and 5-4b present a comparison of detected compounds to ARARS and TBCs. Figure 5-4 shows sample locations and concentrations of compounds which exceed ARARS and TBCs.

5.5.2.1 Inorganics

Two unfiltered monitoring well samples, 02 GW 05 and 02 GW 07, exhibited elevated levels of several metals. Unfiltered monitoring well sample 02 GW 07 exhibited the highest concentrations of aluminum,

TABLE 5-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL AT SITE 2
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	8 / 8	120 - 1690	551.88	NO	912.53
ANTIMONY	NOT DETECTED	-	-	3 / 8	0.68 - 0.89	0.48	YES	0.66
ARSENIC	4 / 4	1.35 - 14.4	13.43	6 / 8	0.75 - 3.4	1.70	NO	3.4
BARIUM	4 / 4	1.85 - 31	22.53	8 / 8	1.4 - 9.8	3.36	NO	5.18
CADMIUM	1 / 4	0.57	0.67	4 / 8	0.13 - 0.49	0.14	NO	0.25
CALCIUM	4 / 4	40.1 - 519	551.80	8 / 8	22.6 - 137	76.43	NO	137
CHROMIUM	4 / 4	7.8 - 59.5	69.05	8 / 8	2.2 - 40.5	16.00	NO	26.96
COBALT	2 / 4	0.75 - 5	3.15	1 / 8	0.24	0.08	NO	0.13
COPPER	4 / 4	0.97 - 8.4	10.06	8 / 8	2.2 - 6.4	3.54	NO	4.58
IRON	4 / 4	3745 - 62500	52402.50	8 / 8	352 - 10300	2930.50	NO	5225.71
LEAD	4 / 4	1.8 - 39.4	37.30	8 / 8	5 - 22.1	13.65	NO	21.03
MAGNESIUM	4 / 4	71.7 - 619	578.85	8 / 8	19.1 - 220	77.73	NO	206.20
MANGANESE	4 / 4	3.45 - 214	128.33	8 / 8	1.3 - 7.1	3.34	NO	6.44
MERCURY	4 / 4	0.035 - 0.17	0.18	8 / 8	0.016 - 0.052	0.03	NO	0.05
NICKEL	2 / 4	1.8 - 7.2	5.18	8 / 8	0.18 - 1.7	0.59	NO	0.91
POTASSIUM	4 / 4	95 - 792	912.50	8 / 8	56.7 - 392	171.74	NO	388.04
SILVER	2 / 4	0.37 - 0.67	0.69	1 / 8	0.24	0.12	NO	0.15
SODIUM	4 / 4	17.5 - 86.2	78.30	8 / 8	20.9 - 610	105.59	YES	242.23
VANADIUM	4 / 4	11.05 - 64	70.13	8 / 8	4.8 - 49.3	21.41	NO	33.88
ZINC	3 / 4	1.1 - 27.6	22.80	2 / 8	1.5 - 3.8	5.16	NO	3.8

Note: Selected COPCs are indicated in boldface type.

TABLE 5-3
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOIL AT SITE 02
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	-	-	8 / 8	60 - 320	213.25

TABLE 5-2a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02SS01	02SS02	02SS03	02SS04	02SS05	02SS06	ARARS & TBCs		
LOCATION:	02SS01	02SS02	02SS03	02SS04	02SS05	02SS06	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	120	140	463	778	162	1690	-	-	-
antimony	0.84	0.89	0.55 U	0.57 U	0.56 U	0.65 U	14.0	340	-
arsenic	0.69 U	1.0	1.9	2.5	0.68 U	3.4	20.0	20.0	-
barium	2.3	2.2	3.6	3.6	2.1	9.8	700	47000	-
cadmium	0.079 U	0.080 U	0.14	0.13	0.078 U	0.49	1.00	100	-
calcium	44.5	115	75.6	137	64.9	117	-	-	-
chromium, hexavalent	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	-	10.0	-
chromium, total	2.2 J	2.6 J	15.8 J	21.5 J	2.3 J	40.5 J	-	500	-
cobalt	0.13 U	0.13 U	0.12 U	0.13 U	0.12 U	0.24	-	-	-
copper	2.6	2.7	4.2	5.2	2.5	6.4	600	600	-
iron	420	592	2490	2780	352	10300	-	-	-
lead	12.6	11.7	14.8	20.0	14.0	22.1	400	600	-
magnesium	25.0	33.8	66.9	101	19.1	220	-	-	-
manganese	1.8	7.1	6.4	3.6	1.3	2.5	-	-	-
mercury	0.030	0.023	0.049	0.039	0.028	0.052	14.0	270	-
nickel	0.18	0.28	0.38	0.74	0.34	1.7	250	2400	-
potassium	67.5	64.7	159	241	56.7	392	-	-	-
selenium	1.3 R	0.93 U	0.90 U	0.94 U	0.91 U	1.1 U	63.0	3100	-
silver	0.24	0.20 U	0.19 U	0.20 U	0.19 U	0.23 U	110	4100	-
sodium	44.0	24.6	44.1	38.4	610	20.9	-	-	-
vanadium	6.0	7.5	18.4	26.1	4.8	49.3	370	7100	-
zinc	1.5 J	4.4 R	8.7 R	10.4 R	14.6 R	9.4 R	1500	1500	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
bis(2-ethylhexyl)phthalate	320 J	84.0 J	74.0 J	140 J	73.0 J	84.0 J	49000	210000	100000

TABLE 5-2a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02SS07	02SS08	---	---	---	---	ARARS & TBCs		
LOCATION:	02SS07	02SS08	---	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**mg/kg**	**mg/kg**					**mg/kg**	**mg/kg**	**mg/kg**
aluminum	819	243					-	-	-
antimony	0.56 U	0.68					14.0	340	-
arsenic	3.4	0.75					20.0	20.0	-
barium	1.9	1.4					700	47000	-
cadmium	0.24	0.078 U					1.00	100	-
calcium	34.8	22.6					-	-	-
chromium, hexavalent	4.0	2.0 U					-	10.0	-
chromium, total	39.2 J	3.9 J					-	500	-
cobalt	0.12 U	0.12 U					-	-	-
copper	2.5	2.2					600	600	-
iron	5380	1130					-	-	-
lead	9.0	5.0					400	600	-
magnesium	106	50.0					-	-	-
manganese	2.6	1.4					-	-	-
mercury	0.023	0.016					14.0	270	-
nickel	0.48	0.59					250	2400	-
potassium	266	127					-	-	-
selenium	0.91 U	0.91 U					63.0	3100	-
silver	0.20 U	0.19 U					110	4100	-
sodium	33.5	29.2					-	-	-
vanadium	49.3	9.9					370	7100	-
zinc	3.8 J	24.5 R					1500	1500	-
SEMIVOLATILES	**ug/kg**	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**
bis(2-ethylhexyl)phthalate	300 J	60.0 J					49000	210000	100000

TABLE 5-2a
COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCS - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

- No standard is available for this chemical in this classification.

TABLE 5-2b

COMPARISON OF SURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02SS01	02SS02	02SS03	02SS04	02SS05	02SS06	ARARS & TBCs		
LOCATION:	02SS01	02SS02	02SS03	02SS04	02SS05	02SS06	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS	%	%	%	%	%	%	%	%	%
moisture	4.2	5.0	4.3	6.0	7.6	18.2	-	-	-

SAMPLE NUMBER:	02SS07	02SS08	---	---	---	---	ARARS & TBCs		
LOCATION:	02SS07	02SS08	---	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI							
MISCELLANEOUS	%	%					%	%	%
moisture	3.8	5.0					-	-	-

TABLE 5-2b
COMPARISON OF SURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

. - No standard is available for this chemical in this classification.

@ - Value is New Jersey guideline for maximum total concentration of all organic compounds in soil (including VOCs, SVOCs, and TPH).

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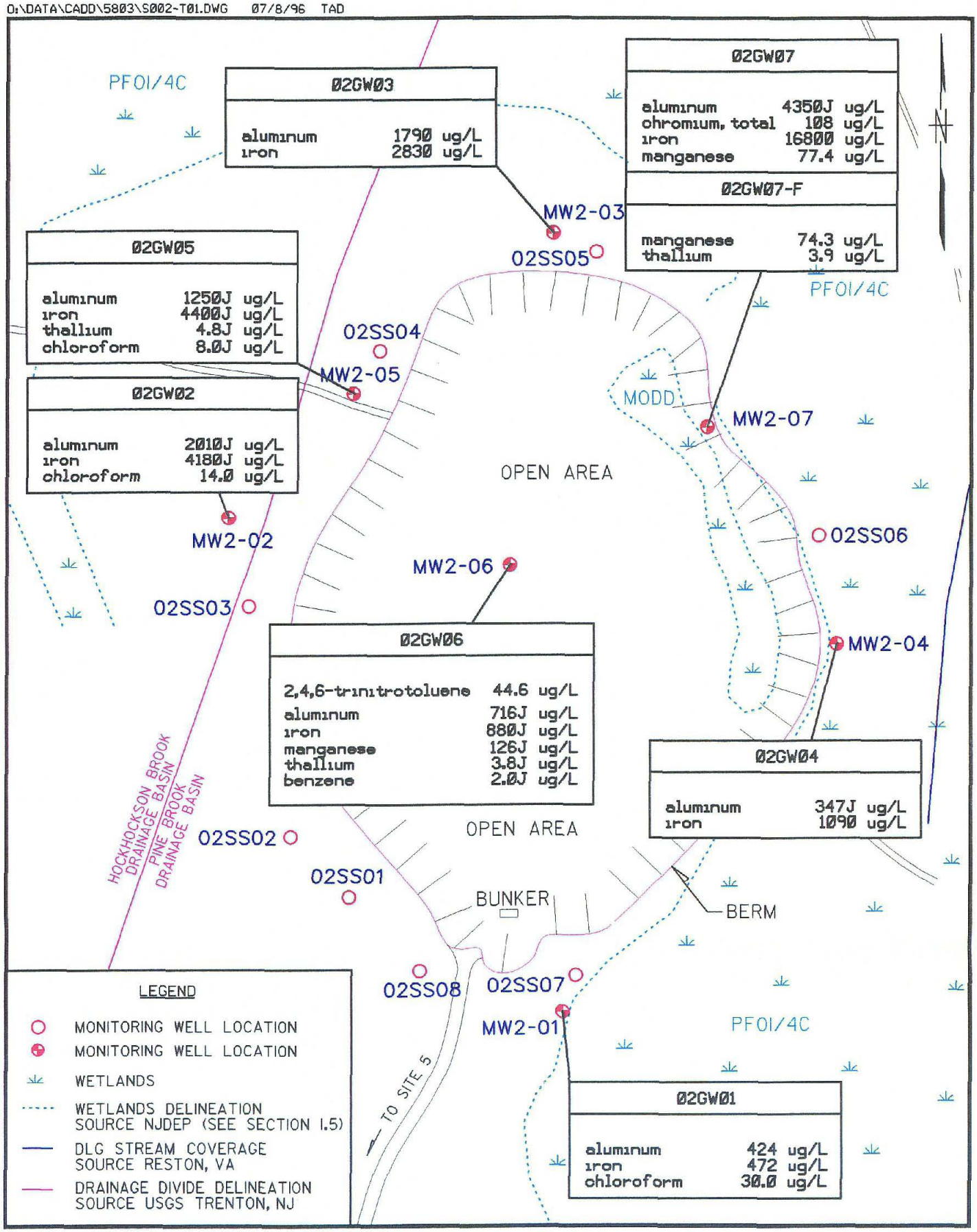

CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 2 - ACTIVE ORDNANCE DEMILITARIZATION SITE

FIGURE 5-4

0 200 400

SCALE IN FEET

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TABLE 5-4
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	REPRESENTATIVE CONCENTRATION
ALUMINUM*	11 / 11	287 - 7870	5097.82	7 / 7	347 - 4350	1555.29	NO	4350
ANTIMONY	NOT DETECTED	-	-	2 / 7	2.7 - 2.8	1.75	YES	2.40
BARIUM*	11 / 11	2.6 - 518	229.60	7 / 7	16.7 - 483	200.46	NO	365.34
BERYLLIUM*	4 / 11	0.21 - 1.6	0.49	3 / 7	0.25 - 0.42	0.17	NO	0.42
CADMIUM*	5 / 11	0.6 - 1.9	1.21	5 / 7	0.41 - 0.68	0.45	NO	0.68
CALCIUM	11 / 11	506 - 17200	8306.55	7 / 7	518 - 3700	1746.00	NO	3700
CHROMIUM	NOT DETECTED	-	-	7 / 7	6.6 - 108	30.60	YES	56.94
COBALT	6 / 11	0.7 - 10.1	4.06	4 / 7	0.66 - 2.2	0.77	NO	1.27
COPPER*	9 / 11	0.79 - 13.5	6.53	4 / 7	1.6 - 13.6	5.67	NO	10.26
IRON	11 / 11	153 - 7690	4197.09	7 / 7	472 - 16800	4378.86	YES	8566.38
LEAD*	3 / 11	2.1 - 3	2.44	3 / 7	2.1 - 4.4	1.84	NO	4.4
MAGNESIUM	11 / 11	273 - 27400	8449.64	7 / 7	835 - 1950	1502.43	NO	1950
MANGANESE	11 / 11	3.3 - 65	46.18	7 / 7	2.1 - 126	39.07	NO	72.74
MERCURY*	11 / 11	0.005 - 0.12	0.12	5 / 7	0.008 - 0.31	0.07	NO	0.153131
NICKEL	10 / 11	0.81 - 25.5	11.98	5 / 7	1.2 - 4.4	1.84	NO	4.4
POTASSIUM	11 / 11	350 - 3245	2810.55	7 / 7	1190 - 5510	2314.29	NO	3372.94
SODIUM	11 / 11	1850 - 11650	8449	7 / 7	2810 - 5200	3825.71	NO	4619.00
THALLIUM*	3 / 11	4 - 5.1	5.15	2 / 7	3.8 - 4.8	2.51	NO	3.79
VANADIUM	10 / 11	0.69 - 42.25	16.48	7 / 7	2.4 - 85.3	21.21	YES	42.91
ZINC*	6 / 9	3.7 - 348	178.61	6 / 7	2.3 - 328	162.58	NO	285.49

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

TABLE 5-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 02
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
1,2,4-TRICHLOROBENZENE	NOT DETECTED	-	-	2 / 7	2 - 6	6
1,2-DICHLOROBENZENE	NOT DETECTED	-	-	2 / 7	3 - 12	8.42
2,4-DINITROTOLUENE	NOT DETECTED	-	-	1 / 7	4	4
BENZENE	NOT DETECTED	-	-	1 / 7	2	2
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	1 / 7	12	8.02
CHLOROFORM	NOT DETECTED	-	-	4 / 7	4 - 30	24.56
2,4,6-TRINITROTOLUENE	NOT DETECTED	-	-	1 / 7	44.6	44.60
NAPHTHALENE	NOT DETECTED	-	-	2 / 7	2 - 4	4

TABLE 5-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02GW01	02GW02	02GW03	02GW04	02GW05	02GW06	ARARS & TBCs		
LOCATION:	02GW01	02GW02	02GW03	02GW04	02GW05	02GW06	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	424 E	2010 E J	1790 E	347 E J	1250 E J	716 E J	-	-	200
antimony	2.7	2.7 U	2.8	2.7 U	2.7 U	2.7 U	6.00	3.00 a	20.0
barium	19.4	462	21.2	16.7	483	33.9	2000	2000 a	2000
beryllium	0.25	0.11 U	0.42	0.11 U	0.11 U	0.11 U	4.00	4000 e	20.0
cadmium	0.38 U	0.68	0.45	0.38 U	0.68	0.41	5.00	5.00 e	4.00
calcium	518	1460	1020	564	1910	3050	-	-	-
chromium, hexavalent	3.0 J	20.0 U	20.0 U	20.0 U	2.0 J	20.0 U	100 *	100 a	-
chromium, total	9.9	30.7	17.3	6.6	34.2	7.5	100 *	100 a	100
cobalt	0.60 U	0.66	0.60 U	0.93	0.60 U	0.70	-	-	-
copper	0.77 U	11.6	0.77 U	0.77 U	13.6	1.6	1300	-	1000
iron	472 E	4180 E J	2830 E	1090 E	4400 E J	880 E J	-	-	300
lead	1.5 UJ	3.4	1.5 UJ	1.5 U	2.1	1.5 U	15.0	-	10.0
magnesium	1760	1790	972	1380	835	1830	-	-	-
manganese	3.9	26.4 J	19.4	2.1	18.3 J	126 E J	-	-	50.0
mercury	0.0040 UJ	0.0090	0.0040 UJ	0.083	0.0080	0.31	2.00	2.00 b	2.00
nickel	1.7	3.0	1.8	0.75 U	1.2	4.4	100	100 a	100
potassium	1190	2060	2110	1720	1880	1730	-	-	-
sodium	3230	4870	2810	3690	3240	3740	-	-	50000
thallium	3.6 U	3.6 U	3.6 U	3.6 U	4.8 E J	3.8 E J	2.00	0.400 a	10.0
vanadium	2.9	22.6	11.0	3.0	21.3	2.4	-	-	-
zinc	3.2	314	18.0	2.3	328	25.2 R	-	2000 a	5000
SEMIVOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,2,4-trichlorobenzene	10.0 U	10.0 U	10.0 U	10.0 U	6.0 J	2.0 J	70.0	40.0 a	8.00
1,2-dichlorobenzene	10.0 U	10.0 U	10.0 U	10.0 U	12.0	3.0 J	600	3000 a	600
2,4-dinitrotoluene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	4.0 J	-	300 e	10.0
bis(2-ethylhexyl)phthalate	10.0 U	10.0 U	10.0 U	10.0 U	12.0	10.0 U	-	-	30.0
naphthalene	10.0 U	10.0 U	10.0 U	10.0 U	4.0 J	2.0 J	-	20.0 a	-

TABLE 5-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02GW01	02GW02	02GW03	02GW04	02GW05	02GW06	ARARS & TBCs		
LOCATION:	02GW01	02GW02	02GW03	02GW04	02GW05	02GW06	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
VOLATILES	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
benzene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	2.0 E J	5.00	200 d	1.00
chloroform	30.0 E	14.0 E	10.0 U	4.0 J	8.0 E J	10.0 U	100	100 e	6.00

TABLE 5-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02GW07	02GW07-F	---	---	---	---	ARARS & TBCs		
LOCATION:	02GW07	02GW07	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
aluminum	4350 E J	141					-	-	200
antimony	2.7 U	2.7 U					6.00	3.00 a	20.0
barium	367	14.0					2000	2000 a	2000
beryllium	0.31	0.11 U					4.00	4000 e	20.0
cadmium	0.52	1.0					5.00	5.00 e	4.00
calcium	3700	3090					-	-	-
chromium, hexavalent	2.0 J	n/a					100 *	100 a	-
chromium, total	108 E	8.6					100 *	100 a	100
cobalt	2.2	1.8					-	-	-
copper	11.7	2.2					1300	-	1000
iron	16800 E	79.5					-	-	300
lead	4.4	1.5 UJ					15.0	-	10.0
magnesium	1950	814					-	-	-
manganese	77.4 E	74.3 E					-	-	50.0
mercury	0.084	0.017					2.00	2.00 b	2.00
nickel	0.75 U	2.4					100	100 a	100
potassium	5510	1990					-	-	-
sodium	5200	5380					-	-	50000
thallium	3.6 U	3.9 E					2.00	0.400 a	10.0
vanadium	85.3	1.6					-	-	-
zinc	310	54.5					-	2000 a	5000
SEMIVOLATILES	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
1,2,4-trichlorobenzene	10.0 U	n/a					70.0	40.0 a	8.00
1,2-dichlorobenzene	10.0 U	n/a					600	3000 a	600
2,4-dinitrotoluene	10.0 U	n/a					-	300 e	10.0
bis(2-ethylhexyl)phthalate	10.0 U	n/a					-	-	30.0
naphthalene	10.0 U	n/a					-	20.0 a	-

TABLE 5-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02GW07		02GW07-F	---	---	---	---	ARARS & TBCs			
LOCATION:	02GW07		02GW07	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)		NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI								
VOLATILES	**ug/L**		**ug/L**					**ug/L**	**ug/L**		**ug/L**
benzene	10.0	U	n/a					5.00	200	d	1.00
chloroform	10.0	U	n/a					100	100	e	6.00

TABLE 5-4a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

• - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 5-4b

COMPARISON OF GROUNDWATER EXPLOSIVES DATA TO ARARS AND TBCs - SITE 2

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	02GW01		02GW02		02GW03		02GW04		02GW05		02GW06		ARARS & TBCs		
LOCATION:	02GW01		02GW02		02GW03		02GW04		02GW05		02GW06		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
EXPLOSIVES	**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**	**ug/L**	**ug/L**
2,4,6-trinitrotoluene	0.48	U	0.40	U	0.42	U	0.42	U	0.40	U	44.6	E	-	2.00 a	-
2,4-dinitrotoluene	0.48	U	0.40	U	0.42	U	0.42	U	0.40	U	5.6		-	300 e	10.0
4-amino-2,6-dinitrotoluene	0.48	U	0.40	U	0.42	U	0.42	U	0.40	U	15.3		-	-	-
HMX	1.0	U	0.79	U	0.85	U	0.85	U	0.79	U	1.1		-	400 a	-
RDX	1.0	UJ	0.79	U	0.85	U	0.85	U	0.79	U	10.0	E	-	2.00 a	-

SAMPLE NUMBER:	02GW07		---	---	---	---	---	ARARS & TBCs		
LOCATION:	02GW07		---	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI									
EXPLOSIVES	**ug/L**							**ug/L**	**ug/L**	**ug/L**
2,4,6-trinitrotoluene	0.51	U						-	2.00 a	-
2,4-dinitrotoluene	0.51	U						-	300 e	10.0
4-amino-2,6-dinitrotoluene	0.51	U						-	-	-
HMX	1.0	U						-	400 a	-
RDX	1.0	U						-	2.00 a	-

TABLE 5-4b
COMPARISON OF GROUNDWATER EXPLOSIVES DATA TO ARARS AND TBCS - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

chromium, and iron and unfiltered sample 02 GW 05 revealed the highest concentrations of barium and zinc. Thallium was detected in 02 GW 05 and 02 GW 06 but was not detected in background groundwater samples.

Sample 02 GW 07 required filtering in the field, despite the use of low-flow purge techniques to minimize suspended solids. Filtered sample results from the same location did not exhibit elevated levels of any metals except thallium (3.9 ug/L).

Hexavalent chromium results were available for three groundwater samples and suggest that groundwater levels of hexavalent chromium represent only a small fraction of the total chromium concentration (in the 2 ug/L to 3 ug/L range).

5.5.2.2 Organics

Several explosives or their degradation products were detected in one groundwater sample (02 GW 06). These include 2,4,6-trinitrotoluene (44.6 ug/L), 2,4-dinitrotoluene (5.6 ug/L), 4-amino-2,6-dinitrotoluene (15.3 ug/L), HMX (1.1 ug/L), and RDX (10 ug/L). Chloroform (4 ug/L to 30 ug/L) was detected in four groundwater samples collected at Site 2. 1,2,4-Trichlorobenzene (2 ug/L to 6 ug/L), 1,2-dichlorobenzene (3 ug/L to 12 ug/L), and naphthalene (2 ug/L to 4 ug/L) were each detected in two groundwater samples (02 GW 06 and 02 GW 05). Benzene (2 ug/L) and bis(2-ethylhexyl) phthalate (12 ug/L) were each detected in one groundwater sample (02 GW 06). None of these compounds were detected in background groundwater samples.

5.5.2.3 Miscellaneous Parameters

Hexavalent chromium was detected in three groundwater samples at levels below ARARs. Analytical results are presented in Appendix A.

5.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 2 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 5.6.1. Persistence of detected chemicals in the environment is discussed in Section 5.6.2. Section 5.6.3 presents a brief discussion of contaminant trends.

5.6.1 Detected Chemicals and Transport Potential

VOCs, chlorinated benzenes, and nitroaromatics were detected in Site 2 groundwater samples. Elevated levels of metals were detected in unfiltered groundwater samples. One SVOC [bis(2-ethylhexyl) phthalate] was present in surface soil samples. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

For soil contaminants, surface dispersion transport modes, such as erosion and dust migration, typically do not provide the greatest contribution to the overall transport of chemicals in the environment. Sampling of surface soils upwind and downwind of the explosive demilitarization and disposal area did not reveal elevated levels of hazardous substances outside the bermed area.

Benzene and chloroform are considered volatile and mobile in the environment (either through soil gas migration or groundwater transport). Both compounds exhibit relatively high water solubilities and are not strongly bound to soils.

Relative to the properties of other semivolatile compounds, 2,4,6-TNT, 2,4-DNT, HMX, and RDX all exhibit a moderate degree of water solubility and do not bind to soil as readily as other compounds. 2-Amino-4,6-dinitrotoluene is also expected to have similar chemical and physical properties. These substances are all considered mobile in groundwater but are not expected to migrate as quickly as many of the VOCs.

5.6.2 Contaminant Persistence

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

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

2,4-Dinitrotoluene and 2-amino-4,6-dinitrotoluene are degradation products of 2,4,6-TNT. Microorganisms capable of metabolizing TNT have been reported in soils, composts, muds, and surface waters and their sediments. RDX (and to a lesser extent, HMX) can be degraded anaerobically but evidence for aerobic biodegradation is not available.

1,2,4-Trichlorobenzene exhibits a slight tendency to volatilize. Studies have shown it to be biodegradable (Clement Associates, 1985). Benzene and naphthalene are both considered biodegradable in the subsurface environment.

5.6.3 Observed Chemical Contaminant Trends

Benzene was detected in one well (MW2-06) located in the center of the site, and chloroform was detected at the highest levels in wells located south (MW2-01) (30 ug/L) and east (MW2-04) (14 ug/L) of the site. Only trace levels of chloroform were detected in two wells west (MW2-02) and northwest (MW2-05) of the center of the site.

The explosives and by-products detected in groundwater are consistent with the site history. The 1993 sampling of MW2-06 revealed concentrations of organic chemicals (volatiles and explosives) similar to those detected in the current investigation. In this investigation, only the well near the center of the site (MW2-06) revealed contamination with nitroaromatics. Other semivolatile compounds (1,2,4-trichlorobenzene, 1,2-dichlorobenzene, and naphthalene) were detected in this well and also in MW2-05, to the northwest. The chlorinated benzenes and chloroform are apparently unrelated to the use of explosives; however, it is not known whether spent solvents could have been disposed in these areas. Benzene and naphthalene are associated with fuels; it is not known whether fuels were burned in this area to remove unexploded ordnance residues.

None of the organic compounds that were detected in groundwater were detected in surface soils from outside the bermed area. Sampling of surface soils upwind and downwind of the site did not reveal any hazardous substance other than low levels of bis(2-ethylhexyl) phthalate, which is a common plasticizer. Plasticizers are used in several explosive formulations and could be present for this reason or associated with small plastic fragments of explosive casings or other discarded plastics. Previous investigations have indicated that explosives are present at soil locations within the bermed area. Leaching from unknown source locations within the site into groundwater is considered the primary transport pathway for organics at this site, based on the expected mobility of the chemicals detected in groundwater.

The presence of suspended solids in sample 02 GW 02, 02 GW 05, and 02 GW 07 is indicated by elevated turbidity readings and elevated levels of metals such as aluminum, whose common species are relatively insoluble. Unfiltered sample results were used in calculations for the groundwater risk

assessment, in line with the recommended conservative approach to this evaluation. Filtered sample results of two wells at Site 2 may be more representative of dissolved-phase contamination, and elevated levels of most metals were not generally found in the filtered aliquots.

5.6.4 Conclusions

Surface soil sampling indicates that ordnance disposal activities have not affected soils outside the berm. The identified locations where explosives were detected in groundwater are consistent with site history and with results of previous sampling investigations. The volatile and explosive compounds detected in groundwater exhibit chemical and physical properties that indicate a potential for continued leaching of any residual substances possibly present in subsurface soil. The detected VOCs are expected to migrate more rapidly than explosives. Sampling data revealed that only the well in the center of the site contained detectable levels of nitroaromatic compounds, whereas several volatiles and chlorinated benzenes were detected in the well (MW2-02) located west/northwest of the center of the site. The detected phthalate in groundwater could be related to leaching from surface soil; however, this is difficult to ascertain due to the ubiquitous use of plastics (for example in laboratory gloves and packaging).

Elevated levels of certain metals in groundwater may not indicate their potential for transport in groundwater because they are in suspended form. Metals in suspension are expected to have greatly diminished potential for in-situ transport compared to metals in solution, given geologic conditions not conducive to solution channeling or fracture-based flow. Only thallium was detected at a slightly elevated level in filtered groundwater. Thallium was not detected in the corresponding unfiltered sample and was not found at elevated levels in other media sampled at Site 2. Overall, groundwater data do not suggest migration of dissolved inorganic contamination from the site.

5.7 BASELINE RISK ASSESSMENT

This section of the RI report presents the results of the baseline risk assessment for Site 2. The risk assessment was performed using the approach outlined in Section 2.4. Tables 5-6 and 5-7 provide the selected COPCs and representative concentrations of inorganics and organics in site-related surface soil and groundwater, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 5.7.1.5 discusses the modifications made to the conservative preliminary baseline risk assessment.

TABLE 5-6
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCs
SURFACE SOIL - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ANTIMONY	0.66	NORMAL
ARSENIC	3.4	NONPARAMETRIC
CADMIUM	0.25	NORMAL
CHROMIUM VI	2.75	NORMAL
CHROMIUM III	24.21	NORMAL
LEAD	21.03	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	213.25	NORMAL

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

TABLE 5-7
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCs
GROUNDWATER - SITE 2 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	4350	NONPARAMETRIC
ANTIMONY	2.40	LOGNORMAL
BARIUM	365.34	NORMAL
BERYLLIUM	0.42	LOGNORMAL
CADMIUM	0.68	NONPARAMETRIC
CHROMIUM VI	7.40	NORMAL
CHROMIUM III	49.54	NORMAL
COPPER	10.26	NORMAL
IRON	8566.38	NORMAL
LEAD	4.4	LOGNORMAL
MERCURY	0.15	NORMAL
THALLIUM	3.79	LOGNORMAL
VANADIUM	42.91	NORMAL
ZINC	285.49	NORMAL
1,2,4-TRICHLOROBENZENE	6	LOGNORMAL
1,2-DICHLOROBENZENE	8.42	NORMAL
2,4-DINITROTOLUENE	4	LOGNORMAL
BENZENE	2	LOGNORMAL
BIS(2-ETHYLHEXYL)PHTHALATE	8.02	LOGNORMAL
CHLOROFORM	24.56	NORMAL
2,4,6-TRINITROTOLUENE	44.60	NONPARAMETRIC
NAPHTHALENE	4	LOGNORMAL

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The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used in the risk management process, where clean-up goals and remediation alternatives are identified for a site.

5.7.1 Risk Characterization

The results of the risk assessment are presented below on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of current land use (industrial employee) and hypothetical future land use (residential and industrial receptors).

5.7.1.1 Current Industrial Employee

The estimated total cancer risks for the current industrial employee for exposure to COPCs in surface soil at Site 2 are 1.8E-06 (ingestion), 5.9E-07 (dermal contact), and 2.5E-09 (inhalation of COPCs in fugitive dust). The total surface soil cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or to formulate ARARs. The principal COPC contributing to the surface soil cancer risk is arsenic (ingestion, 99 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HIs for the current industrial employee assuming exposure to COPCs in surface soil at Site 2 are less than 1.0 for the ingestion, dermal contact, and inhalation exposure pathways. Adverse noncarcinogenic health effects are not expected when the HQs are below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for current industrial receptors exposed to surface soils at Site 2 in Tables 5-8 and 5-9, respectively.

5.7.1.2 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 2 are within the mid-range of the 1E-04 to 1E-06 target acceptable risk range. (Ingestion exposures contributed the significant portion of risk.)

The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future industrial employee assuming exposure to COPCs in groundwater at Site 2. (Ingestion exposures contributed the significant portion of risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are discussed in Section 5.7.1.4 and presented in Tables 5-10, 5-11, and 5-11a.

TABLE 5-8
RME CARCINOGENIC RISK TO CURRENT INDUSTRIAL RECEPTORS - SITE 2
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
BIS(2-ETHYLHEXYL)PHTHALATE	1.5E-09	4.7E-09	2.8E-13
ANTIMONY	N/A	N/A	N/A
ARSENIC	1.8E-06	5.9E-07	9.9E-10
CADMIUM	N/A	N/A	N/A
CHROMIUM VI	N/A	N/A	1.5E-09
CHROMIIUM III	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
TOTAL RISK	1.8E-06	5.9E-07	2.5E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-9
RME NONCARCINOGENIC HQS, CURRENT INDUSTRIAL RECEPTORS - SITE 2
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
BIS(2-ETHYLHEXYL)PHTHALATE	1.5E-05	4.7E-05	2.8E-09
ANTIMONY	1.6E-03	1.0E-02	3.0E-07
ARSENIC	1.1E-02	3.6E-03	2.1E-06
CADMIUM	4.9E-04	3.1E-03	2.5E-07
CHROMIUM VI	5.4E-04	8.4E-03	1.0E-07
CHROMIIUM III	2.4E-05	3.7E-04	1.5E-03
LEAD	N/A	N/A	N/A

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-10
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,2,4-TRICHLOROBENZENE	N/A	N/A
1,2-DICHLOROBENZENE	N/A	N/A
2,4-DINITROTOLUENE	N/A	N/A
BENZENE	2.0E-07	3.5E-09
BIS(2-ETHYLHEXYL)PHTHALATE	3.9E-07	1.9E-07
CHLOROFORM	5.2E-07	5.1E-09
2,4,6-TRINITROTOLUENE	4.7E-06	6.0E-08
NAPHTHALENE	N/A	N/A
ANTIMONY	N/A	N/A
CHROMIUM VI	N/A	N/A
CHROMIUM III	N/A	N/A
IRON	N/A	N/A
VANADIUM	N/A	N/A
TOTAL RISK	5.8E-06	2.6E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-11
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN						
SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT
1,2,4-TRICHLOROBENZENE	5.9E-03							9.9E-04
1,2-DICHLOROBENZENE	9.2E-04							7.4E-05
2,4-DINITROTOLUENE	2.0E-02	2.0E-02		2.0E-02		2.0E-02		1.2E-04
BENZENE	N/A	N/A				N/A		N/A
BIS(2-ETHYLHEXYL)PHTHALATE	3.9E-03			3.9E-03			3.9E-03	1.9E-03
CHLOROFORM	2.4E-02		2.4E-02	2.4E-02				2.4E-04
2,4,6-TRINITROTOLUENE	8.7E-01			8.7E-01				1.1E-02
NAPHTHALENE	9.8E-04	9.8E-04	9.8E-04					N/A
ANTIMONY	5.9E-02	5.9E-02						4.8E-04
CHROMIUM VI	1.4E-02		1.4E-02					3.0E-04
CHROMIUM III	4.8E-04							9.9E-06
IRON	2.8E-01			2.8E-01	2.8E-01			2.3E-03
VANADIUM	6.0E-02							2.5E-03
	HI FOR TARGET ORGAN	7.9E-02	3.9E-02	1.2E+00	2.8E-01	2.0E-02	3.9E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-11a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT
1,2,4-TRICHLOROBENZENE	2.8E-03							6.8E-04
1,2-DICHLOROBENZENE	5.6E-04							6.5E-05
2,4-DINITROTOLUENE	1.2E-02	1.2E-02		1.2E-02		1.2E-02		1.1E-04
BENZENE	N/A	N/A				N/A		N/A
BIS(2-ETHYLHEXYL)PHTHALATE	2.4E-03			2.4E-03			2.4E-03	1.7E-03
CHLOROFORM	1.5E-02		1.5E-02	1.5E-02				2.1E-04
2,4,6-TRINITROTOLUENE	5.4E-01			5.4E-01				9.8E-03
NAPHTHALENE	6.0E-04	6.0E-04	6.0E-04					N/A
ANTIMONY	3.6E-02	3.6E-02						4.2E-04
CHROMIUM VI	8.9E-03		8.9E-03					2.6E-04
CHROMIUM III	3.0E-04							8.7E-06
IRON	1.7E-01			1.7E-01	1.7E-01			2.0E-03
VANADIUM	3.7E-02							2.2E-03
	HI FOR TARGET ORGAN	4.9E-02	2.4E-02	7.4E-01	1.7E-01	1.2E-02	2.4E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

5.7.1.3 Future Residential Receptor

The estimated total cancer risks for the future lifetime resident assuming exposure to COPCs in surface soil at Site 2 are 8.0E-06 (ingestion), 2.0E-06 (dermal contact), and 1.5E-09 (inhalation of COPCs in fugitive dust). Both the surface soil cancer risk and the groundwater cancer risk are within the 1E-04 to 1E-06 target acceptable risk range. The principal COPC contributing to the surface soil cancer risk is arsenic (ingestion, 99 percent of the cancer risk for this pathway; and dermal contact, 99 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future child resident assuming exposure to COPCs in surface soil at Site 2 are less than 1.0 for ingestion, dermal contact, and inhalation exposure pathways. The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future child resident assuming exposure to COPCs in groundwater at Site 2. (Ingestion exposures contributed the significant portion of risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to surface soil at Site 2 in Tables 5-12 and 5-13, respectively. The amended carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to groundwater at Site 2 in Tables 5-14, 5-15, and 5-15a.

5.7.1.4 Lead Results

Lead was not found above the EPA level of concern (400 mg/kg) in soil samples taken during RI or previous sampling. Lead was not found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken during the 1995 RI but was found at levels exceeding the EPA action level in previous groundwater sampling events. Apparently, turbid samples were responsible for the large fluctuations of metals concentrations found in the same well during different sampling events.

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for background and Site 2 exposures are presented in Appendix I.

5.7.1.5 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 2 for future residential and future industrial receptors assuming exposure to COPCs in groundwater.

TABLE 5-12
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 2
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION - LIFETIME	SURFACE SOIL DERMAL CONTACT - LIFETIME	INHALATION OF COPCS IN FUGITIVE DUST - LIFETIME
BIS(2-ETHYLHEXYL)PHTHALATE	6.7E-09	1.5E-08	1.7E-13
ANTIMONY	N/A	N/A	N/A
ARSENIC	8.0E-06	1.9E-06	6.1E-10
CADMIUM	N/A	N/A	1.3E-11
CHROMIUM VI	N/A	N/A	9.2E-10
CHROMIIUM III	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
TOTAL RISK	8.0E-06	2.0E-06	1.5E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-13
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 2
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION - CHILD	SURFACE SOIL DERMAL CONTACT - CHILD	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
BIS(2-ETHYLHEXYL)PHTHALATE	1.9E-04	3.8E-04	2.9E-09
ANTIMONY	2.1E-02	8.3E-02	3.2E-07
ARSENIC	1.4E-01	3.0E-02	2.2E-06
CADMIUM	6.4E-03	2.5E-02	2.6E-07
CHROMIUM VI	7.0E-03	6.9E-02	1.1E-07
CHROMIIUM III	3.1E-04	3.0E-03	1.6E-03
LEAD	N/A	N/A	N/A

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-14
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,2,4-TRICHLOROBENZENE	N/A	N/A	N/A
1,2-DICHLOROBENZENE	N/A	N/A	N/A
2,4-DINITROTOLUENE	N/A	N/A	N/A
BENZENE	8.6E-07	1.1E-07	1.0E-06
BIS(2-ETHYLHEXYL)PHTHALATE	1.7E-06	6.0E-06	N/A
CHLOROFORM	2.2E-06	1.6E-07	2.9E-05
2,4,6-TRINITROTOLUENE	2.0E-05	1.9E-06	N/A
NAPHTHALENE	N/A	N/A	N/A
ANTIMONY	N/A	N/A	N/A
CHROMIUM VI	N/A	N/A	N/A
CHROMIUM III	N/A	N/A	N/A
IRON	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
TOTAL RISK	2.5E-05	8.2E-06	3.0E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-15
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN							
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2,4-TRICHLOROBENZENE	3.8E-02							3.8E-02	3.7E-03
1,2-DICHLOROBENZENE	6.0E-03							2.8E-03	7.9E-03
2,4-DINITROTOLUENE	1.3E-01	1.3E-01		1.3E-01		1.3E-01		4.8E-03	N/A
BENZENE	N/A	N/A				N/A		N/A	5.9E-02
BIS(2-ETHYLHEXYL)PHTHALATE	2.6E-02			2.6E-02			2.6E-02	7.3E-02	N/A
CHLOROFORM	1.6E-01		1.6E-01	1.6E-01				9.0E-03	N/A
2,4,6-TRINITROTOLUENE	5.7E+00			5.7E+00				4.3E-01	N/A
NAPHTHALENE	6.4E-03	6.4E-03	6.4E-03					N/A	N/A
ANTIMONY	3.8E-01	3.8E-01						1.5E-02	N/A
CHROMIUM VI	9.5E-02		9.5E-02					9.2E-03	N/A
CHROMIUM III	3.2E-03							3.1E-04	N/A
IRON	1.8E+00			1.8E+00	1.8E+00			7.1E-02	N/A
VANADIUM	3.9E-01							7.6E-02	N/A
	HI FOR TARGET ORGANS:	5.2E-01	2.6E-01	7.8E+00	1.8E+00	1.3E-01	2.6E-02		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 5-15a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 2
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2,4-TRICHLOROBENZENE	1.4E-02							2.0E-02	5.7E-04
1,2-DICHLOROBENZENE	2.8E-03							1.9E-03	1.6E-03
2,4-DINITROTOLUENE	6.0E-02	6.0E-02		6.0E-02		6.0E-02		3.2E-03	N/A
BENZENE	N/A	N/A				N/A		N/A	1.2E-02
BIS(2-ETHYLHEXYL)PHTHALATE	1.2E-02			1.2E-02			1.2E-02	4.9E-02	N/A
CHLOROFORM	7.3E-02		7.3E-02	7.3E-02				6.0E-03	N/A
2,4,6-TRINITROTOLUENE	2.7E+00			2.7E+00				2.9E-01	N/A
NAPHTHALENE	3.0E-03	3.0E-03	3.0E-03					N/A	N/A
ANTIMONY	1.8E-01	1.8E-01						1.0E-02	N/A
CHROMIUM VI	4.4E-02		4.4E-02					6.2E-03	N/A
CHROMIUM III	1.5E-03							2.1E-04	N/A
IRON	8.5E-01			8.5E-01	8.5E-01			4.8E-02	N/A
VANADIUM	1.8E-01							5.1E-02	N/A
	HI FOR TARGET ORGANS:	2.4E-01	1.2E-01	3.7E+00	8.5E-01	6.0E-02	1.2E-02		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

Comparison to Background

Aluminum, barium, beryllium, cadmium, copper, lead, mercury, thallium, and zinc were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 5-4 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Consideration of Modified Dermal Absorption and Target Organ Grouping

As discussed in Section 2.4.6.2, groundwater cancer and non-cancer risks were recalculated. The revised HIs are greater than 1.0 for exposure to groundwater by future residential and future industrial receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are greater than 1.0 in several cases. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: liver (7.8 - 2,4,6-trinitrotoluene, iron) and digestive system (iron). For groundwater ingestion by the future industrial receptor, only one target organ was associated with an HI exceeding 1.0: liver (1.2 - 2,4,6-trinitrotoluene, iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are presented in Tables 5-10 and 5-11, respectively. Estimated carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to groundwater at Site 2 in Tables 5-14 and 5-15, respectively.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate non-cancer risks for exposure to COPCs in groundwater for future residential receptors and for the future industrial employee. 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. Based on this evaluation, the estimated central tendency noncarcinogenic HIs are less than 1.0 for the future industrial receptor; however, for the future child resident, the noncarcinogenic HI is greater than 1.0 for the liver (HI of 3.7; principal contributors - 2,4,6-trinitrotoluene, iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks are presented for exposure to groundwater for future industrial receptors in Table 5-11a and for future residential child receptors in Table 5-15a.

5.7.2 Conclusions

Surface soil and groundwater were sampled at Site 2. The potential receptors for this site were current industrial and future industrial and residential receptors. The RME cancer risks associated with the future residential (surface soil and groundwater), the current industrial (surface soil), and the future industrial (surface soil and groundwater) exposure scenarios are in the mid- to lower region of the target acceptable risk range. Arsenic (ingestion of surface soil), 2,4,6-trinitrotoluene (ingestion of groundwater), bis(2-ethylhexyl) phthalate, and chloroform (inhalation of vapors in groundwater) were the major COPCs that contributed to the cancer risks for these exposure scenarios.

RME estimates for noncarcinogenic HIs associated with future industrial (surface soil and groundwater) and future residential (surface soil and groundwater) exposure scenarios exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. 2,4,6-Trinitrotoluene and iron (via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for these exposure scenarios. The RME estimates of non-cancer risk from exposure to groundwater for the future industrial receptor are probably overconservative because associated central tendency non-cancer HIs are less than 1.0. However, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the liver as a target organ. 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.

Metals in groundwater appear to have been measured at concentrations that exist in the formation due to turbid samples from some wells (e.g., MW2-07, which had a sampling endpoint turbidity value of 565 NTU). Lead groundwater concentrations at the site were below the EPA action level for public water supplies and lead soil concentrations were below EPA guidelines. These lead concentrations are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 2 in Table 5-16 for surface soil and groundwater. Table 5-16a presents the relevant central tendency risk estimates associated with potential receptors for groundwater.

TABLE 5-16
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 2
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	1.8E-06	N/A	8.0E-06	N/A	1.4E-02	N/A	1.8E-01	N/A	N/A
	Dermal Contact	5.9E-07	N/A	2.0E-06	N/A	2.6E-02	N/A	2.1E-01	N/A	N/A
	Inhalation of Fugitive Dust	2.5E-09	N/A	1.5E-09	N/A	1.5E-03	N/A	1.6E-03	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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	5.8E-06^	2.5E-05^	N/A	N/A	1.2E+00@	7.8E+00@	N/A	N/A
	Dermal Contact	N/A	2.6E-07^	8.2E-06^	N/A	N/A	2.0E-02^	7.3E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.0E-05^	N/A	N/A	N/A	N/A	7.1E-02^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		2.4E-06	6.1E-06	7.3E-05	-	4.1E-02	1.2E+00	8.9E+00	7.1E-02	-

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.

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TABLE 5-16a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

		Estimated Incremental Cancer Risk				Estimated Hazard Index**				
		Current	Future	Future	Future	Current	Future	Future Resident		Future
Medium	*Exposure* Routes	Industrial Employee	Industrial Employee	Lifetime Resident	Recreational Child	Industrial Employee	Industrial Employee	Child	Adult	Recreational Child
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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	N/R	N/R	N/A	N/A	7.4E-01@	3.7E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	N/R	N/A	N/A	1.7E-02^	4.8E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	-	-	-	-	4.2E+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
** = 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.

5.8 ECOLOGICAL RISK ASSESSMENT

5.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

As described in Section 5.1, Site 2 is an 11-acre open, oval sand pit bordered by a berm. The site is devoid of vegetation, with the exception of a few scattered patches of grasses around the perimeter of the site. Some standing water is present intermittently on the northeastern portion of the site but is of marginal ecological value. Upland areas with Lakewood sand soils are located to the southwest and are dominated by pitch pine, white oak, scarlet oak, and mountain laurel. Wooded wetlands are located to the northeast, east, and southeast of the site. These areas are primarily comprised of red maple, black gum, and *Vaccinium* sp. Many of the red maples are buttressed with fluted root systems, suggesting saturated soils, although surface water is generally not evident in these areas. Water in these areas is present at a depth of 12 inches below ground surface. The site is located on the border of the Hockhockson Brook and Pine Brook Watersheds. The closest surface water body is a small tributary of Pine Brook, located approximately 1/2 mile northeast of Site 2.

Upland and wetland areas surrounding Site 2 provide excellent habitat, primarily for terrestrial receptors. Most species of terrestrial mammals found on NWS Earle are expected to utilize these areas, including white-tailed deer, red and gray fox, and several species of small mammals. Although the upland and wetland areas surrounding Site 2 provide extensive ecological habitat, there is no habitat of value on Site 2. No sensitive habitats, other than the wetlands, or threatened or endangered species are known to occur on or near the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major release pathways from Site 2 are overland runoff and, to a lesser extent, infiltration of contaminants. Precipitation runoff at Site 2 may carry constituents to surface water, sediments, and surface soils in and around the site. However, off-site overland migration is prevented by the large berm surrounding the entire site. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water in the adjacent wetlands; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms. Nonetheless, this migration route is expected to be minimal since surface water is limited in the wetland areas, as are related aquatic receptors. In addition to runoff and infiltration as migration pathways, ordnance demilitarization may

release vapors and soil-bound contaminants into the atmosphere. These contaminants can migrate to surface soils outside the berm via atmospheric deposition.

Exposure Routes

Direct exposure to contaminants in soil for terrestrial ecological receptors, both plant and animal, is possible but is expected to be minimal on the site since no terrestrial habitat or vegetation is present. However, these exposure routes apply to terrestrial receptors outside the berm. Terrestrial receptors may come into contact with contaminants in Site 2 surface water by using it as a source of drinking water, although exposure via this route is assumed to be insignificant. Aquatic or semi-aquatic organisms inhabiting the wetlands to the northeast, east, and southeast may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated prey. However, surface water in the wooded wetland is limited, and an extensive aquatic community is not present.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

All contaminants identified in 1986 Phase II and 1991 Phase III investigations were qualitatively assessed in this ERA. All contaminants detected in more recent surface 1995 RI surface soil samples taken outside the berm were considered preliminary COPCs for quantitative assessment.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

5.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used to screen potential risks to ecological receptors from contaminants in surface soil. Surface soil and terrestrial plant ET values are presented in Tables 2-30 and 2-31, respectively.

5.8.3 Preliminary Exposure Assessment

Representative exposure point contaminant concentrations in surface soil used for screening potential risks to terrestrial animals and plants were obtained from RI surface soil data generated during 1995. The maximum detected contaminant concentrations in surface soil were conservatively used as representative exposure point concentrations. Data from 1986 Phase II and 1991 RI/FS surface water, sediment, and surface soil samples taken inside the berm were not used quantitatively since no viable habitat exists and since the 1995 surface soil samples were adequate to characterize potential ecological risks outside the berm. However, the results of these previous studies are discussed in detail in Section 5.8.3, below. Background concentrations were used in this ERA for qualitative comparison to representative exposure point concentrations and are the maximum values detected in facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

5.8.4 Risk Characterization

For surface soils in the areas outside the berm, aluminum (HQ = 2.82), chromium (HQ = 101), and vanadium (HQ = 2.47) exceeded ET values and were retained as final COPCs (Table 5-17). The only organic detected, bis(2-ethylhexyl)phthalate, was conservatively retained as a final COPC since no suitable ET was available. One inorganic, antimony, was conservatively retained as a final COPC in surface soil since no suitable threshold was available. For terrestrial plants, aluminum (HQ = 33.8), chromium (HQ = 40.5), and vanadium (HQ = 24.6) exceeded ET values and were retained as final COPCs (Table 5-18).

The toxicological properties of all final COPCs in surface soils are summarized in Appendix M.

5.8.3 Summary and Conclusions

Site 2 is a large, open oval sand pit used for the demilitarization of ordnance. The site is entirely surrounded by a tall earthen berm. No aquatic or terrestrial habitat of value is present inside the berm, although some standing water is present in the northeastern section of the site. Wooded upland and wooded wetland habitats surround most of the site. Surface water is scarce in these areas. The upland and wetland areas contain excellent habitat, primarily for terrestrial receptors. Overland migration of contaminants from the berm to habitats that surround the site is precluded by the berm. Groundwater to surface water discharge of contaminants is possible but improbable, since surface water is limited near the site. Ordnance demilitarization may release contaminants into the air, resulting in atmospheric deposition of contaminants to areas outside the berm.

TABLE 5-17
SURFACE SOIL CONTAMINANTS OF POTENTIAL CONCERN - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	8/8	5310	1690	600	2.82	Retained-HQ > 1
Antimony	3/8	ND	0.89	NA		Retained-No suitable threshold available
Arsenic	6/8	14.4	3.4	60	0.06	Eliminated-Does not exceed threshold
Barium	8/8	31	9.8	3000	0.003	Eliminated-Does not exceed threshold
Cadmium	4/8	0.52	0.49	20	0.02	Eliminated-Does not exceed threshold
Chromium	8/8	59.5	40.5	0.4	101	Retained-HQ > 1
Cobalt	1/8	4.27	0.24	1000	2.4E-04	Eliminated-Does not exceed threshold
Copper	8/8	8.4	6.4	50	0.13	Eliminated-Does not exceed threshold
Lead	8/8	39.4	22.1	500	0.04	Eliminated-Does not exceed threshold
Manganese	8/8	182.6	7.1	100	0.07	Eliminated-Does not exceed threshold
Mercury	8/8	0.17	0.052	0.1	0.52	Eliminated-Does not exceed threshold
Nickel	8/8	7.2	1.7	200	0.009	Eliminated-Does not exceed threshold
Silver	1/8	0.67	0.24	50	0.005	Eliminated-Does not exceed threshold
Vanadium	8/8	64	49.3	20	2.47	Retained-HQ > 1
Zinc	2/8	27.6	3.8	200	0.02	Eliminated-Does not exceed threshold
Organics						
Bis(2-ethylhexyl)phthalate	8/8	ND	320	NA		Retained-No suitable threshold available

NA - No suitable benchmark was available.
• - All organic values are in μg/kg.

TABLE 5-18
TERRESTRIAL PLANT CONTAMINANTS OF POTENTIAL CONCERN - SITE 2
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	8/8	5310	1690	50	33.8	Retained-HQ > 1
Antimony	3/8	ND	0.89	5	0.18	Eliminated-Does not exceed threshold
Arsenic	6/8	14.4	3.4	10	0.34	Eliminated-Does not exceed threshold
Barium	8/8	31	9.8	500	0.02	Eliminated-Does not exceed threshold
Cadmium	4/8	0.52	0.49	3	0.16	Eliminated-Does not exceed threshold
Chromium	8/8	59.5	40.5	1	40.5	Retained-HQ > 1
Cobalt	1/8	4.27	0.24	20	0.01	Eliminated-Does not exceed threshold
Copper	8/8	8.4	6.4	100	0.06	Eliminated-Does not exceed threshold
Lead	8/8	39.4	22.1	50	0.44	Eliminated-Does not exceed threshold
Manganese	8/8	182.6	7.1	500	0.01	Eliminated-Does not exceed threshold
Mercury	8/8	0.17	0.052	0.3	0.17	Eliminated-Does not exceed threshold
Nickel	8/8	7.2	1.7	30	0.06	Eliminated-Does not exceed threshold
Silver	1/8	0.67	0.24	2	0.12	Eliminated-Does not exceed threshold
Vanadium	8/8	64	49.3	2	24.65	Retained-HQ > 1
Zinc	2/8	27.6	3.8	50	0.08	Eliminated-Does not exceed threshold
Organics*						
Bis(2-ethylhexyl)phthalate	8/8	ND	320	2.0E+05	0.00	Eliminated-Does not exceed threshold

NA - No suitable benchmark was available.
* - All organic values are in ug/kg.

Surface soil samples taken inside the berm during 1986 Phase II activities were analyzed for explosives and nitrate/nitrite. None of these analytes were detected. Sediment and soil samples were also taken inside the berm during previous RI/FS activities and were analyzed for inorganics, explosives, and cyanide. No explosives were detected, although cadmium, chromium, and iron were detected in slightly elevated levels. The increased levels of iron were determined to be due to natural conditions. Some groundwater samples contained elevated levels of several metals, low levels of some explosives, including nitrocellulose, RDX, and 2,4-DNT. Bis(2-ethylhexyl)phthalate was detected below quantitation limits. Some groundwater samples taken during 1995 RI sampling contained elevated levels of some metals and explosive-related compounds.

Despite the elevated levels of several contaminants in Site 2 groundwater and the slightly elevated levels of chromium and cadmium in some soil samples taken inside the berm, surface soils outside the berm do no appear to have been impacted. HQ values for contaminants detected in surface soils outside the berm were indicative of low potential risk, with the exception of chromium. Chromium had an HQ value indicative of moderately high risk. However, the maximum concentration of chromium detected in surface soils was less than background. Antimony was conservatively retained as a final COPC since no suitable ET was available, but this inorganic was only detected in low levels in three of eight samples. No surface soil ET value was available for bis(2-ethylhexyl)phthalate, but it was only detected at low concentrations. Further, phathalates are ubiquitous in the environment and phthalate toxicosis is rare in fish and wildlife. HQ values for potential risks to terrestrial plants from surface soil contaminants were indicative of low potential risk, with the exception of aluminum, chromium, and vanadium. HQ values for these three inorganics were indicative of low to moderate potential risk. Nonetheless, these contaminants were all detected at concentrations lower than background.

In summary, no significant contaminant migration pathways to habitats outside the berm exist. In addition, HQ values were indicative of low potential risk for terrestrial animal and plant scenarios evaluated in this ERA, with the exception of HQ values for a few inorganics. Yet, the contaminants with elevated HQ values were all present at concentrations lower than background concentrations. Organic contaminants in groundwater are not expected to reach the tributary of Pine Brook, since it is located several hundred yards northeast of Site 2 and they have not been detected in the two furthest downgradient wells. Hence, potential contaminant contributions from Site 2 to the Pine Brook Watershed appear to be negligible. For these reasons, potential risks to ecological receptors associated with Site 2 are low, and further study or remediation based on ecological concerns is considered unwarranted.

5.9 EVALUATION AND RECOMMENDATIONS

5.9.1 Evaluation Summary

As concluded from previous investigations, concentrations of metals found in site surface soils were generally in the range of background.

Metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included aluminum, chromium, iron, manganese, and thallium. Despite efforts to obtain low-turbidity groundwater samples using low-flow pumps and extended pumping times (up to several hours per well), final turbidity below 100 NTU was not achieved on any Site 2 monitoring well sample. Filtered samples generally had lower concentrations of metals.

Chloroform, benzene, and 2,4,6-TNT were found in groundwater at levels above regulatory guidelines.

No metals or explosive compounds were found in surface soil samples taken outside the berm. This indicates no surface impact outside the berm.

The results of the human health risk assessment concluded that calculated non-cancer risks were above guideline limits for ingestion of groundwater.

The ecological risk assessment concluded that there appears to be no adverse ecological impact on the surrounding environment resulting from site operations at this OB/OD unit.

5.9.2 Recommendations

Site operations are regulated under RCRA Subpart X, which requires environmental site monitoring, including groundwater monitoring.

Chloroform could be included in the list of compounds for periodic groundwater monitoring under the RCRA Subpart X permit application.

If demilitarization activities are discontinued, the site should be revegetated to restore the native habitat.

6.0 SITE 3: LANDFILL SOUTHWEST OF "F" GROUP

6.1 SITE BACKGROUND AND PHYSICAL SETTING

The Landfill Southwest of "F" Group is a 5-acre site used from 1960 to 1968 for the disposal of domestic and industrial wastes, the latter consisting of paints and paint thinners, solvents, varnishes, shellac, acids, alcohols, caustics, pesticide containers and rinse water, wood, and small amounts of asbestos. Records indicate that the industrial wastes comprise only a small portion of a total of approximately 4,800 tons of wastes. Figure 6-1 is a map of the site.

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

6.2 PREVIOUS INVESTIGATIONS

6.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site observations. Based on the potential for groundwater impacts to the Kirkwood Aquifer, the site was recommended for a confirmation study.

During the SI in 1986, three monitoring wells were installed. During the RI/FS in 1993, seven test pits were excavated and four additional monitoring wells were installed, one upgradient of the landfill and three downgradient of the landfill. The well depths ranged from 15 to 20 feet. Two soil samples collected from the test pits were analyzed for TCL organics and TAL inorganics. Groundwater from all seven wells was collected and analyzed for full TCL/TAL analytes. Later rounds of groundwater samples were analyzed for VOCs, drinking water metals, and inorganic landfill indicator parameters at a limited number of wells.

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

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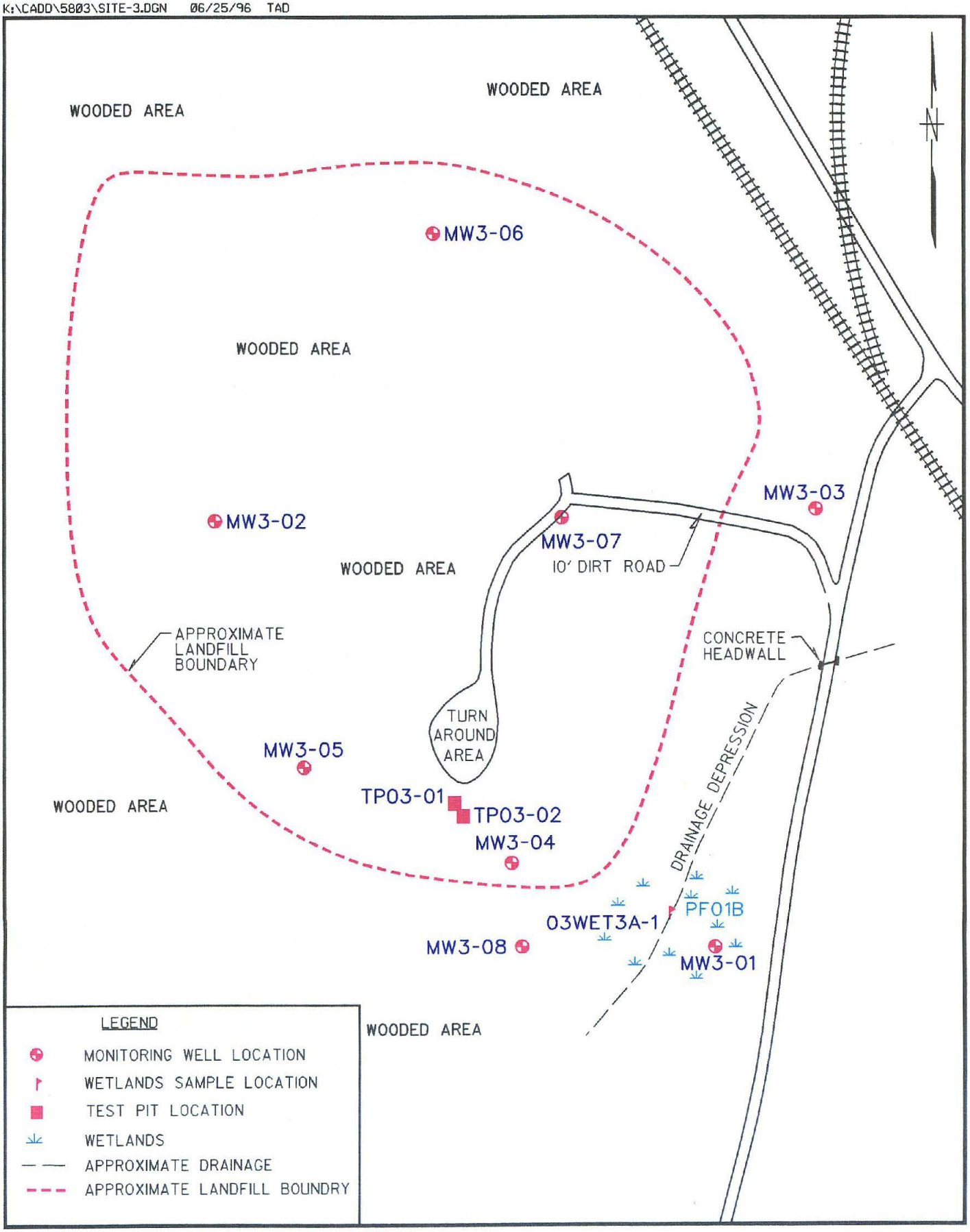

SAMPLE LOCATIONS

SITE 3 - LANDFILL SOUTHWEST OF "F" GROUP

FIGURE 6-1

0 120 240

SCALE IN FEET

Brown & Root Environmental

6.2.2 Summary of Conclusions

Low levels of metals, hydrocarbons, and VOCs were found in groundwater. The RI test pits encountered mostly household trash and debris.

6.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Resample all wells to confirm previous results. Investigate source of volatile organic compounds in groundwater.
- Investigate southern extent of the landfill.
- Compare data to background levels and risk based criteria.
- Determine if wetlands (drainage swale) southeast of the site shows signs of contaminant migration.

6.3 RI FIELD INVESTIGATIONS

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

- Soil gas survey and analysis at 25 locations (Section 6.3.1).
- Excavation of two test pits (Section 6.3.2).
- Drilling and installation of one shallow permanent monitoring well (Section 6.3.3).
- Sampling and analysis of groundwater from monitoring wells (Section 6.3.3).
- Measurement of static-water levels in monitoring wells (Section 6.3.3).
- Sampling and analysis of one surface soil in the wetlands southeast of the landfill (Section 6.3.4).

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

6.3.1 Soil Gas Survey

A soil gas survey was performed in late May and early June 1995 to identify the potential source of VOCs previously detected at the site. Twenty-seven soil gas samples were collected from a grid with spacing of 25 feet at the southeast end of the landfill. The locations of the soil gas points are shown on Figure 6-2. One soil gas sample was collected at each of the 25 points (although soil gas point 03 SG 09 was sampled twice), and one duplicate was collected. The samples were taken near the soil/water interface at 5.5 to 8 feet bgs. The samples were collected from approximately 1 foot above the water table.

The 27 soil gas samples were analyzed in EFS' (Environmental Field Services) on-site PhotoVac 10S plus field GC laboratory for BTEX, TCE, and, PCE analyses (for full results, see Appendix B). Table 6-1 contains soil gas analytical results. Figure 6-2 presents positive analytical results at sampling points. The results of soil gas analyses were used for screening purposes and therefore were not validated.

Based on the soil gas results, one new monitoring well MW3-08 was installed southwest of existing monitoring well MW3-04.

6.3.2 Test Pit

Two test pits (03 TP 01 and 03 TP 02) were excavated in June 1995 in an attempt to better define the extent of fill at the site and to determine if the area contains landfill material that may be contributing to the VOCs and SVOCs that were detected in a monitoring well during the site investigation. The test pits were placed in the turn-around area south of the landfill. Figure 6-2 shows the approximate test pit locations. A backhoe was used to excavate an area approximately 14 feet long by 4 feet wide by 10 feet deep for excavation 03 TP 01. The material encountered in 03 TP 01 generally consisted of fill debris (plastic, wood, old newspaper, and glass bottles) near the surface, then 1 to 5 feet of damp, yellowish-brown silty sand, which was underlain by a layer of ordinary municipal trash, and then by gray silty sand. The municipal trash was approximately 2 feet thick. The excavation area for test pit 03 TP 02 was 14 feet long by 6 feet by 9 feet deep. The material encountered during excavation 03 TP 02 generally consisted of 2 to 5 feet of yellowish-brown silty sand, underlain by a layer of ordinary municipal trash, underlain by gray silty sand. The municipal trash was between 2 and 4 feet thick and consisted of plastic, wood, newspapers, glass bottles, tin cans, oil filters, antifreeze bottles, and other containers. Test pit log sheets and test pit photos are in Appendix E. The material in the backhoe bucket was screened with an HNu. No sustained HNu readings were recorded, so no samples were collected in either test pit.

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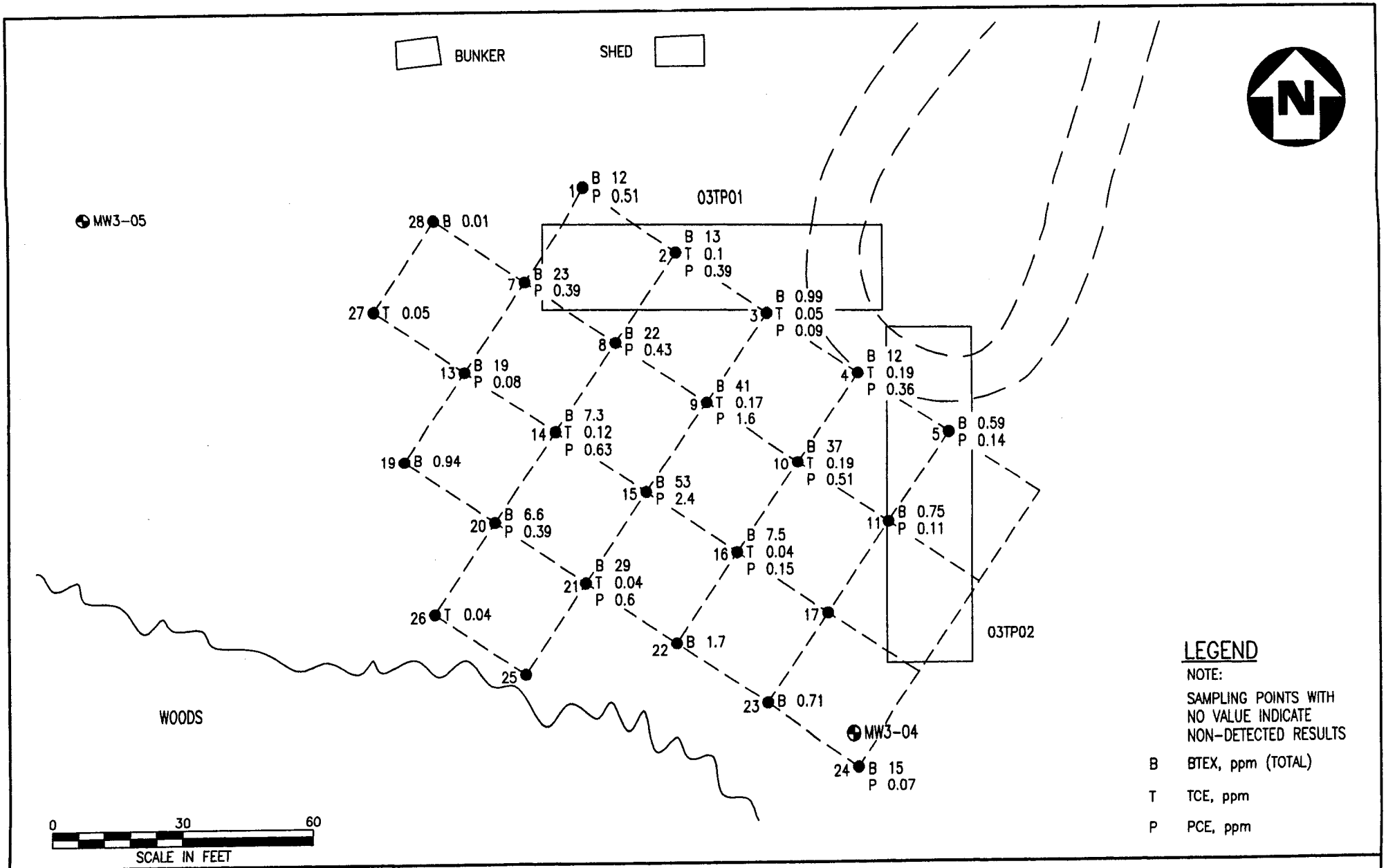

FIGURE 6-2

SOIL GAS AND TEST PIT LOCATIONS
SITE 3 – LANDFILL SOUTHEAST OF "F" GROUP
NWS EARLE, COLTS NECK, NEW JERSEY

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Table 6-1
Site 3 Soil Gas Sample Analysis Summary
NWS Earle, Colts Neck, New Jersey

Sample ID	Depth of Sample (Feet)	Total BTEX (ppm)	TCE (ppm)	PCE (ppm)
03 SG 01	8	12	nd	0.51
03 SG 02	8	13	0.1	0.39
03 SG 03	8	0.99	0.05	0.09
03 SG 04	8	12	0.19	0.36
03 SG 05	8	0.59	nd	0.14
03 SG 07	8	23	nd	0.39
03 SG 08	8	22	nd	0.43
03 SG 09	8	41	0.17	1.6
03 SG 10	8	37	0.19	0.51
03 SG 11	8	0.75	nd	0.11
03 SG 13	8	19	nd	0.08
03 SG 14	8	7.3	0.12	0.63
03 SG 15	8	53	nd	2.4
03 SG 16	8	7.5	0.04	0.15
03 SG 17	8	nd	nd	nd
03 SG 19	7.5	0.94	nd	nd
03 SG 20	5.6	6.6	nd	0.39
03 SG 21	8	29	0.04	0.6
03 SG 22	8	1.7	nd	nd
03 SG 23	8	0.7	nd	nd
03 SG 24	8	15	nd	0.07
03 SG 25	8	nd	nd	nd
03 SG 26	8	nd	0.04	nd
03 SG 27	8	nd	0.05	nd
03 SG 28	8	0.01	nd	nd

NOTE: Soil gas locations on Figure 6-1 (soil gas grid) are designated by the suffix of the sample ID number (e.g., sample 03 SG 01 was collected at grid location 1 on Figure 6-1)

6.3.3 Permanent Monitoring Wells, Groundwater Sampling, and Static-Water-Level Measurements

Shallow Permanent Monitoring Well Installation

One additional shallow permanent monitoring well (MW3-08) was installed at the site in July 1995 (Figure 6-1) to further define the limit of groundwater contamination at the site. The location of the monitoring well was based upon the results of the soil gas survey. The boring had a total depth of 20 feet, and water was encountered at approximately 8.5 feet below grade during drilling. The boring was then completed as a cased well, screened across the water table. Table 6-2 summarizes monitoring well characteristics.

Subsurface soil samples were collected continuously from ground surface to the water table by driving a 2-inch O.D. by 24-inch-length split-barrel sampler. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining or odors) and for lithologic description. Stains and odors were not observed in the MW3-08 boring. HNu readings were 0 ppm throughout the boring. A soil boring log sheet was prepared for the boring to evaluate subsurface lithologies (see Appendix C).

The well was constructed with 2-inch-diameter, flush-jointed and threaded, NSF-certified Schedule 40, PVC well casing and 2-inch-diameter, Schedule 40, 0.10-foot slotted PVC well screen fitted with a PVC bottom cap. A 15-foot screen was installed in the well. The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 1 foot above the top of screen. A 2-foot annular seal, consisting of bentonite pellets, was placed on top of the filter pack. The remainder of the well annulus was backfilled with a cement grout to a height of approximately 1 foot below the ground surface. The well was completed with a 2-foot-high stick-up surrounded at ground level by a 4- by 4-foot concrete pad keyed 1 foot into the well annulus. Monitoring well construction sheets are in Appendix C.

An attempt was made to develop the well 6 days after installation. However, the well was found to be dry.

Groundwater Sampling

Sampling and analysis of groundwater were attempted in the newly installed well and the existing wells. Four of the monitoring wells (MW3-02, MW3-04, MW3-07, and MW3-08) were dry. Of the four remaining monitoring wells, two (MW3-05 and MW3-06) were sampled in July 1995 using dedicated low-flow pumps. Field measurements collected during purging were pump flow rate, water-level measurements, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, the wells were purged using the micro-purge protocol to reduce turbidity, until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purge and sample process.

Table 6-2
Site 3 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW3-01	23	NS	115.92	NS	4	8 to 23	6 to 23	1/7/86
MW3-02	25	NS	124.87	NS	4	10 to 25	8 to 25	1/6/86
MW3-03	23	NS	124.40	NS	4	8 to 23	6 to 23	1/2/91
MW3-04	14.60	120.63	122.16	122.90	4	4.60 to 14.60	4 to 15[3]	1/30/91
MW3-05	17.75	123.23	124.90	NS	4	5 to 17.75	4 to 18[3]	2/5/91
MW3-06	19.00	123.86	125.65	NS	4	5.25 to 19	3 to 19.5[3]	2/11/91
MW3-07	19.80	122.73	124.50	NS	4	4.8 to 19.8	3.8 to 20.5[3]	1/29/91
MW3-08	20	116.11	118.22	118.84	2	5 to 20	4 to 20	7/5/95

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 6-4 for more accurate water-level measurements.
(2) In feet above mean sea level.
(3) Filter pack extends below the screened interval.
NS Not surveyed.

Monitoring wells MW3-01 and MW3-03 were sampled using the bailer method. Standard protocol for purging by bailers was used, as described in Section 3.2.3 of the work plan, when no other method could be utilized. Both wells were purged dry, allowed to recharge, and sampled 2 days later. TCL VOC samples were collected using a teflon bailer. TCL SVOCs, TAL metals, and TCL pesticides/PCBs were collected using a peristaltic pump and polyethylene tubing.

All groundwater samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TAL metals, and TCL pesticides/PCBs analysis. Samples 03 GW 01 and 03 GW 03 were also submitted for dissolved TAL metals analyses. Sample log sheets are presented in Appendix D.

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of measurements was collected on August 7, 1995, the second on October 17, 1995. Static-water levels were measured from the top of PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 93.39 to 111.73 feet above MSL during the first round of measurements. Only one well was not dry during the second round of measurements. Water-level measurements are summarized in Table 6-3.

6.3.4 Wetlands Surface Soil Sample

One surface soil sample (03 SDWET3A-1) was collected from the wetlands area near MW3-01 in August 1995 to determine if the landfill has contributed to wetlands contamination. The wetlands surface soil sample consisted of black humus mixed with sand. Sample log sheets are presented in Appendix D.

The surface soil sample was collected and submitted to Lancaster Laboratory for TCL VOC, TCL SVOCs, TAL metals, and TCL pesticides/PCBs analyses. The sample was collected 0 to 6 inches bgs using a stainless-steel trowel and placed directly into the appropriate bottleware. The surface vegetation was removed before sampling.

Table 6-3
Site 3 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

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

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

6.4 SITE CHARACTERISTICS

6.4.1 Geology

Regional mapping places Site 3 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Kirkwood and Vincentown Formations. Assuming a portion of the Kirkwood Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered white and yellowish-brown, very fine- to fine-grained sand with minor silt and clay layers, dark gray silt, and clay (probably representative of the Kirkwood Formation) and glauconitic, medium- to coarse-grained sand (probably representative of the Vincentown Formation). Mainside is located above the updip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation.

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

6.4.2 Hydrogeology

Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 6-3. Groundwater elevations for August 1995 are contoured on Figures 6-3 and 6-4; all but one of the wells was dry in October 1995 (Figure 6-3). The direction of shallow groundwater flow in the aquifer, as indicated by the August groundwater contour map, is toward the southeast. Water levels in general could not be measured in October because all but one of the wells was dry. There is a significant seasonal variation in the elevation of the water table.

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

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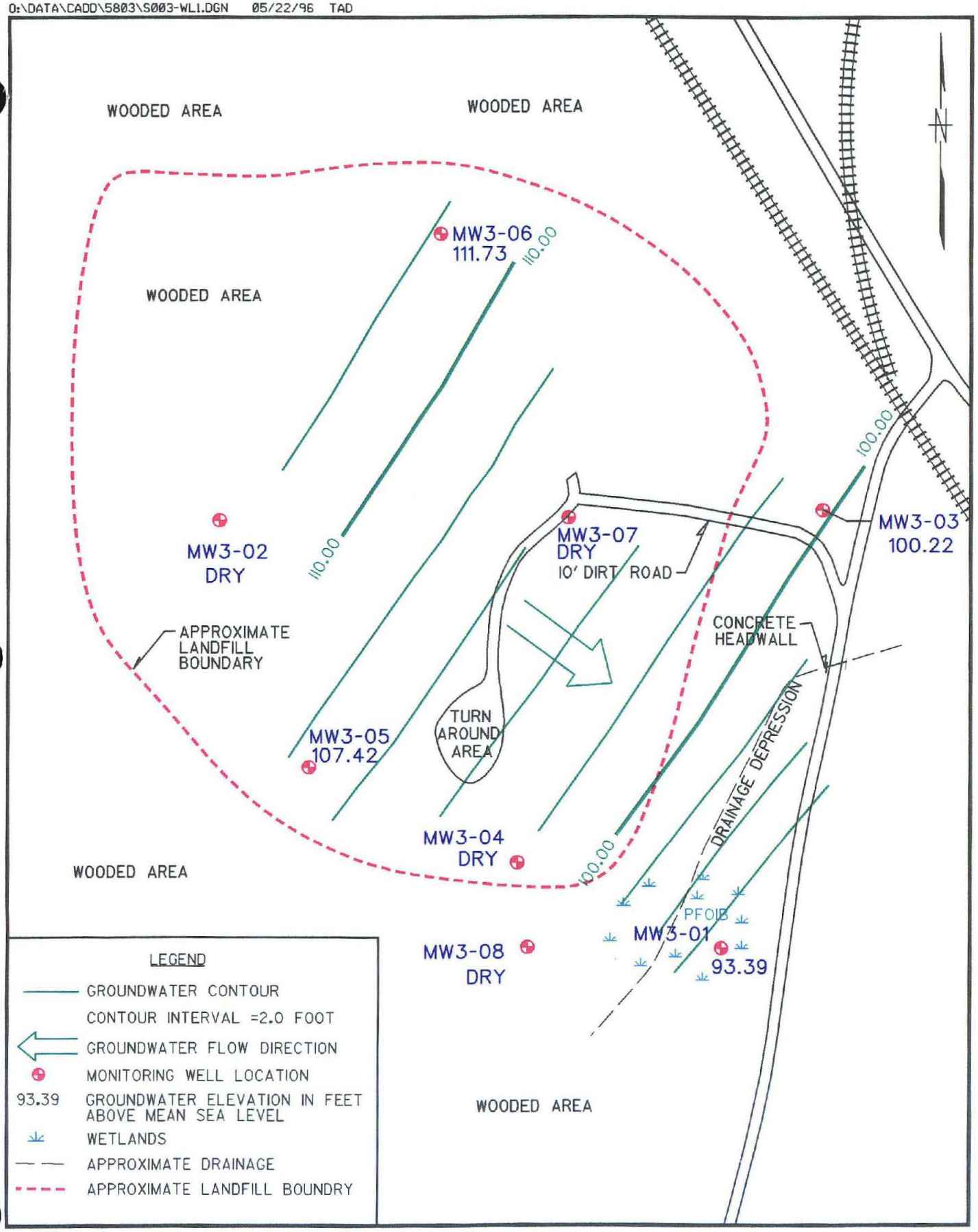

GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 3 - LANDFILL SOUTHWEST OF "F" GROUP

FIGURE 6-3

0 120 240

SCALE IN FEET

Brown & Root Environmental

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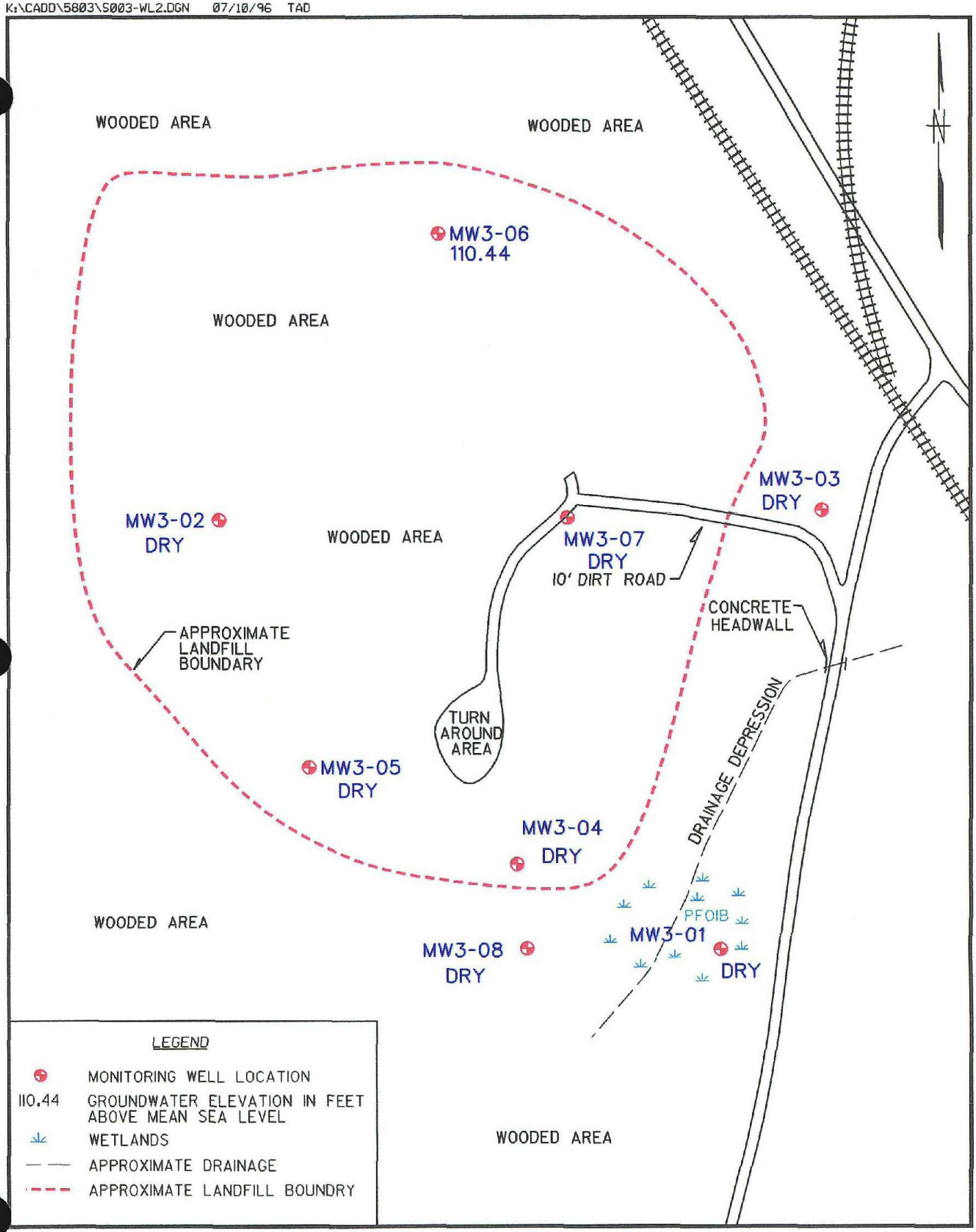

GROUNDWATER CONTOURS MAP OCTOBER 17, 1995

SITE 3 - LANDFILL SOUTHWEST OF "F" GROUP

FIGURE 6-4

0 120 240

SCALE IN FEET

Brown & Root Environmental

6.5 NATURE AND EXTENT OF CONTAMINATION

6.5.1 Sediment

One site-related sediment sample (03 SD WET3A-1) was collected from the drainage swale to determine potential impacts on the wetlands (Figure 6-2). Tables 6-4 and 6-5 present the occurrence and distribution of inorganic and organic chemicals detected in site-related sediment samples and compare them to background as presented in Section 31. Table 6-4a presents a comparison of detected compounds to ARARS and TBCs. Figure 6-5 shows sample locations and concentrations of compounds that exceed ARARS and TBCs.

6.5.1.1 Inorganics

Concentrations of most metals in site-related samples were similar to the range associated with background samples. The following metals were detected at low levels, near the instrument detection limits, in site-related samples but were not found in background samples: antimony, 1.3 mg/kg; cadmium, 2.1 mg/kg; and silver, 0.44 mg/kg.

6.5.1.2 Organics

PAHs including benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, fluoranthene, fluorene, and pyrene were detected in the site-related sediment sample collected at Site 3 at concentrations two to three times higher than the concentrations found in background sediment samples. 4,4'-DDT was detected at a concentration of 19 ug/kg in one background sediment sample and at a concentration of 4 ug/kg in the site-related sediment sample. Alpha-BHC and heptachlor epoxide were also detected in the site-related sediment sample, at concentrations of 0.082 ug/kg and 2.2 ug/kg, respectively.

6.5.2 Groundwater

Four site-related groundwater samples (03 GW 01, 03 GW 03, 03 GW 05, and 03 GW 06) were collected (Figure 6-1). Tables 6-6 and 6-7 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples and compare them to background. Table 6-6a presents a comparison of detected compounds to ARARS and TBCs. Figure 6-5 shows sample locations and concentrations of compounds that exceed ARARS and TBCs.

TABLE 6-4
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 3
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED		
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	839 - 3940	3940	1 / 1	9870	9870
ANTIMONY	NOT DETECTED	-	-	1 / 1	1.3	1.3
ARSENIC	2 / 3	2.4 - 6.2	6.2	1 / 1	6.2	6.2
BARIUM	3 / 3	3.9 - 10.6	10.6	1 / 1	60.8	60.8
BERYLLIUM	1 / 3	0.57 - 0.57	0.57	1 / 1	0.26	0.26
CADMIUM	NOT DETECTED	-	-	1 / 1	2.1	2.1
CALCIUM	3 / 3	179 - 518	518	1 / 1	2570	2570
CHROMIUM	3 / 3	4.3 - 56	56	1 / 1	22.1	22.1
COBALT	1 / 3	2.1 - 2.1	2.1	1 / 1	2.3	2.3
COPPER	3 / 3	1.5 - 13	13	1 / 1	24.3	24.3
IRON	3 / 3	228 - 7650	7650	1 / 1	15000	15000
LEAD	3 / 3	4.6 - 34.3	34.3	1 / 1	89.1	89.1
MAGNESIUM	3 / 3	60.7 - 256	256	1 / 1	545	545
MANGANESE	3 / 3	4.6 - 9.2	9.2	1 / 1	42.3	42.3
MERCURY	1 / 3	0.068 - 0.068	0.068	1 / 1	0.26	0.26
NICKEL	2 / 3	2.1 - 6	6	1 / 1	9.5	9.5
POTASSIUM	2 / 3	86.1 - 681	681	1 / 1	406	406
SILVER	NOT DETECTED	-	-	1 / 1	0.44	0.44
SODIUM	3 / 3	26.6 - 116	116	1 / 1	85.3	85.3
VANADIUM	3 / 3	5.9 - 42.7	42.7	1 / 1	31.7	31.7

Note: Selected COPCs are indicated in boldface type.

TABLE 6-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 03
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'-DDT	1 / 3	19	19	1 / 1	4	4
ALPHA-BHC	NOT DETECTED	-	-	1 / 1	0.082	0.082
HEPTACHLOR EPOXIDE	NOT DETECTED	-	-	1 / 1	2.2	2.2
2-METHYLNAPHTHALENE	NOT DETECTED	-	-	1 / 1	140	140
ACENAPHTHENE	NOT DETECTED	-	-	1 / 1	52	52
ACENAPHTHYLENE	NOT DETECTED	-	-	1 / 1	130	130
ANTHRACENE	NOT DETECTED	-	-	1 / 1	140	140
BENZO(A)ANTHRACENE	2 / 3	140 - 560	560	1 / 1	1300	1300
BENZO(A)PYRENE	2 / 3	160 - 590	590	1 / 1	1400	1400
BENZO(G,H,I)PERYLENE	2 / 3	130 - 380	380	1 / 1	1000	1000
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	1 / 1	82	82
BUTYLBENZYLPHTHALATE	NOT DETECTED	-	-	1 / 1	64	64
CARBAZOLE	NOT DETECTED	-	-	1 / 1	70	70
CHRYSENE	2 / 3	250 - 940	940	1 / 1	1800	1800
DIBENZ(A,H)ANTHRACENE	NOT DETECTED	-	-	1 / 1	240	240
FLUORANTHENE	2 / 3	300 - 1800	1800	1 / 1	2200	2200
FLUORENE	1 / 3	190	190	1 / 1	260	260
INDENO(1,2,3-CD)PYRENE	2 / 3	110 - 310	310	1 / 1	880	880
NAPHTHALENE	NOT DETECTED	-	-	1 / 1	130	130
PHENANTHRENE	2 / 3	200 - 1900	1900	1 / 1	2400	2400
PYRENE	2 / 3	350 - 1900	1900	1 / 1	3400	3400
4,4'-DDT	1 / 3	19	19	1 / 1	4	4
ALPHA-BHC	NOT DETECTED	-	-	1 / 1	0.082	0.082
HEPTACHLOR EPOXIDE	NOT DETECTED	-	-	1 / 1	2.2	2.2

TABLE 6-4a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 3

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	03SDWET3A-1	---	---	---	---	---	---	ARARS & TBCs
LOCATION:	03SDWET3A-1	---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI							
INORGANICS	**mg/kg**							**mg/kg**
aluminum	9870							-
antimony	1.3							2.00 M
arsenic	6.2							8.20 L
barium	60.8 E							40.0 B
beryllium	0.26							-
cadmium	2.1 E							1.20 L
calcium	2570							-
chromium, total	22.1 J							81.0 L
cobalt	2.3							50.0 T
copper	24.3							34.0 L
iron	15000							-
lead	89.1 E							47.0 L
magnesium	545							-
manganese	42.3							460 O
mercury	0.26 E							0.150 L
nickel	9.5							21.0 L
potassium	406							-
selenium	2.1 R							-
silver	0.44							1.00 M
sodium	85.3							-
vanadium	31.7							-
zinc	104 R							150 L
SEMIVOLATILES	**ug/kg**							**ug/kg**
2-methylnaphthalene	140 J							330 F
acenaphthene	52.0 J							620 Q
acenaphthylene	130 E J							44.0 L
anthracene	140 J							330 F
benzo(a)anthracene	1300 E							330 F

TABLE 6-4a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 3

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	03SDWET3A-1	---	---	---	---	---	---	ARARS & TBCs
LOCATION:	03SDWET3A-1	---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI							
SEMIVOLATILES	**ug/kg**							**ug/kg**
benzo(a)pyrene	1400 E							430 L
benzo(b)fluoranthene	2000 E							330 F
benzo(g,h,i)perylene	1000 E							330 F
bis(2-ethylhexyl)phthalate	82.0 J							890000000 S
butylbenzylphthalate	64.0 J							11000 Q
carbazole	70.0 J							330 F
chrysene	1800 E							330 F
dibenz(a,h)anthracene	240 J							330 F
fluoranthene	2200							2900 Q
fluorene	260 J							540 P
indeno(1,2,3-cd)pyrene	880 E							330 F
naphthalene	130 J							480 P
phenanthrene	2400 E							850 Q
pyrene	3400 E							660 L
PESTICIDES	**ug/kg**							**ug/kg**
4,4'-DDE	16.0 E R							2.20 L
4,4'-DDT	4.0 E J							1.60 L
alpha-BHC	0.082 JN							3.70 S
alpha-chlordane	2.1 J							7.00 O
endosulfan I	0.89 R							-
gamma-BHC (Lindane)	0.61 R							-
heptachlor	0.49 R							5.00 O
heptachlor epoxide	2.2 J							5.00 O

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

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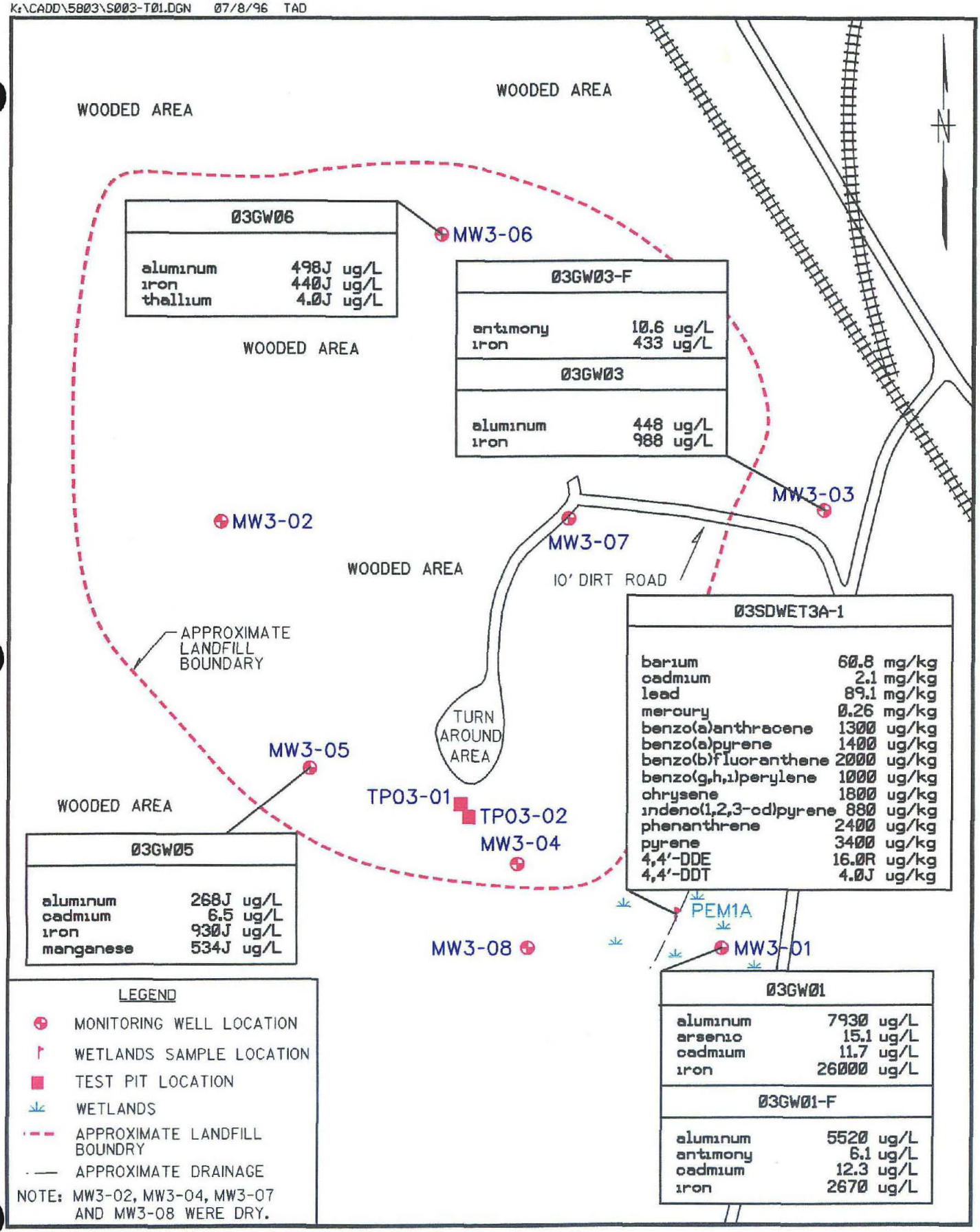

CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 3 - LANDFILL SOUTHWEST OF "F" GROUP

FIGURE 6-5

0 120 240

SCALE IN FEET

Brown & Root Environmental

TABLE 6-6
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 3
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
ALUMINUM	4 / 4	242 - 2030	2030	4 / 4	268 - 7930	6715.02
ARSENIC	NOT DETECTED	-	-	1 / 4	15.1	15.1
BARIUM	4 / 4	16.2 - 78.1	78.1	4 / 4	2.6 - 689	581.36
CADMIUM	1 / 4	0.51 - 0.51	0.51	3 / 4	2.3 - 11.7	11.7
CALCIUM	4 / 4	1070 - 24100	24100	4 / 4	3920 - 7260	7260
CHROMIUM	2 / 4	14.8 - 42.9	42.9	3 / 4	1.3 - 9.8	8.41
COBALT	3 / 4	2.5 - 8.4	8.4	2 / 4	4.4 - 8.4	8.4
COPPER	1 / 4	1.3 - 1.3	1.3	4 / 4	0.79 - 16.3	13.82
IRON	4 / 4	706 - 4600	4600	4 / 4	440 - 26000	21926.85
LEAD	1 / 4	2.3 - 2.3	2.3	1 / 4	5.1	5.1
MAGNESIUM	4 / 4	1000 - 8610	8610	4 / 4	603 - 3240	3240
MANGANESE	4 / 4	14 - 720	720	4 / 4	4.4 - 534	451.42
MERCURY	4 / 4	0.044 - 0.077	0.077	4 / 4	0.008 - 0.12	0.12
NICKEL	4 / 4	3.7 - 11.3	11.3	4 / 4	1.1 - 22.7	22.7
POTASSIUM	4 / 4	639 - 3550	3550	4 / 4	309 - 2270	2270
SODIUM	4 / 4	1980 - 92500	78916.59	4 / 4	3490 - 7460	7460
THALLIUM	NOT DETECTED	-	-	1 / 4	4	4
VANADIUM	3 / 4	1.1 - 42.25	35.58	2 / 4	0.69 - 11.3	9.55
ZINC	4 / 4	3.7 - 30.9	30.9	3 / 4	109 - 623	623

Note : Selected COPCs are indicated in boldface type.

TABLE 6-7
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 03
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
2-BUTANONE	NOT DETECTED	-	-	1 / 4	5	5
GAMMA-CHLORDANE	NOT DETECTED	-	-	1 / 4	0.0081	0.0081

TABLE 6-6a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 3

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	03GW01	03GW01-F	03GW03	03GW03-F	03GW05	03GW06	ARARS & TBCs		
LOCATION:	03GW01	03GW01	03GW03	03GW03	03GW05	03GW06	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	7930 E	5520 E	448 E	152	268 E J	498 E J	-	-	200
antimony	2.7 U	6.1 E	2.7 U	10.6 E	2.7 U	2.7 U	6.00	3.00 a	20.0
arsenic	15.1 E	4.5	3.3 U	3.3 U	3.3 U	3.3 U	50.0	-	8.00
barium	689	34.0	16.5	16.0	41.7	2.6	2000	2000 a	2000
beryllium	0.11 U	0.20	0.11 U	0.11 U	0.11 U	0.11 U	4.00	4000 e	20.0
cadmium	11.7 E	12.3 E	2.3	2.2	6.5 E	0.38 U	5.00	5.00 e	4.00
calcium	3920	3730	4540	4440	6340	7260	-	-	-
chromium, total	9.8	3.1	1.0 U	1.0 U	1.4	1.3	100 *	100 a	100
cobalt	4.4	3.6	0.60 U	0.60 U	8.4	0.60 U	-	-	-
copper	16.3	20.2	0.92	11.9	1.2	0.79	1300	-	1000
iron	26000 E	2670 E	988 E	433 E	930 E J	440 E J	-	-	300
lead	5.1 J	3.1 J	1.5 UJ	1.5 UJ	1.5 U	1.5 U	15.0	-	10.0
magnesium	2560	1740	603	619	807	3240	-	-	-
manganese	43.3	37.2	9.0	11.0	534 E J	4.4	-	-	50.0
mercury	0.12 J	0.13 J	0.11 J	0.10 J	0.0090	0.0080	2.00	2.00 b	2.00
nickel	22.7	20.7	4.3	5.2	8.8	1.1	100	100 a	100
potassium	2270	1810	309	283	1000	497	-	-	-
sodium	7460	7950	3490	3480	4440	4120	-	-	50000
thallium	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	4.0 E J	2.00	0.400 a	10.0
vanadium	11.3	0.61 U	0.61 U	0.61 U	0.61 U	0.69	-	-	-
zinc	623 J	91.3 J	109 J	107 J	259	1.6 U	-	2000 a	5000
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2-butanone	10.0 U	n/a	5.0 J	n/a	10.0 U	10.0 U	-	-	300
PESTICIDES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
gamma-BHC (Lindane)	0.050 U	n/a	0.050 U	n/a	0.0016 R	0.050 U	0.200	0.200 a	0.200
gamma-chlordane	0.050 U	n/a	0.050 U	n/a	0.0081 J	0.050 U	2.00	2.00 a	0.500

TABLE 6-6a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 3
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

6.5.2.1 Inorganics

With the exception of beryllium, the site-related samples also showed the presence of all the metals found in background, in addition to arsenic and thallium. The highest concentrations of metals in Site 3 groundwater samples were detected in the sample collected at 03 GW 01. This well and one other (03 GW 03) required sample filtering in the field. The filtered sample from the downgradient location, 03 GW 01, exhibited fairly high aluminum levels (5,520 ug/L) and also displayed concentrations greater than background ranges for antimony and cadmium. Other metals, such as iron, zinc, and barium, were present at considerably lower levels in the filtered sample. Sample 03 GW 05, collected from a well cross-gradient from the landfill, displayed an elevated level of manganese, and sample 03 GW 06 (an upgradient location) exhibited thallium at a low level.

6.5.2.2 Organics

Due to dry conditions in the summer of 1995, four monitoring wells (MW3-02, MW3-04, MW2-07, and MW3-08) were found to be dry. One of these wells, MW3-04, was found to have high levels of volatile organic compounds during a previous sampling event in March 1991. MW3-04 has been dry in all subsequent sampling events. VOCs detected above the NJDEP GWQS in MW3-04 were acetone (970 ug/L) and xylene (470 ug/L).

2-Butanone (5 ug/L) and gamma-chlordane (0.0081 ug/L) were each detected in one groundwater sample collected at Site 3. Neither of these compounds were detected in background groundwater samples.

6.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 3 is described in this subsection. The various chemicals detected and their transport potential in the environment are discussed in Section 6.6.1. Persistence of detected chemicals in the environment is discussed in Section 6.6.2. Section 6.6.3 presents a brief discussion of contaminant trends.

6.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 3 indicate that a wide variety of semivolatile and pesticide compounds at low levels, in addition to several inorganics, is present in groundwater and sediment. One volatile compound, 2-butanone, was present in groundwater. No soil or surface water samples were

collected at the site. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

One organic groundwater contaminant, 2-butanone, is considered volatile and mobile in the environment (either through soil gas migration or groundwater transport). This compound may have originated at source locations within or near the landfill, which may or may not have been depleted of this contaminant.

This compound is also considered a common laboratory contaminant; however, the application of data validation protocols indicates this compound is not a laboratory artifact. The majority of the detected sediment contaminants are PAHS and phthalate esters, which are characteristically immobile except when present at high concentrations.

Elevated levels of certain metals in groundwater may or may not indicate the potential for groundwater transport for one or more of these metals, depending on the proportion of dissolved versus suspended concentrations that are present. Suspended solids in the unfiltered groundwater samples are suggested by the occurrence of much lower levels in corresponding filtered samples from the same location. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given that geologic conditions conducive to solution channeling or fracture-based flow do not exist. Despite efforts such as installation of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure, at monitoring wells MW3-01 and MW3-03, low-turbidity samples could not be collected. Samples obtained from these two wells were filtered in the field.

6.6.2 Contaminant Persistence

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

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

sediment) are most likely to be transformed in the environment. Higher molecular weight contaminants tend to be less mobile and less prone to chemical transformation.

6.6.3 Observed Chemical Contaminant Trends

Despite their relatively high water solubilities, volatile organics were not detected at significant levels in groundwater. 2-Butanone and the pesticide gamma-chlordane were each detected in only one groundwater sample and were below quantitation limits. Without the benefit of an identified source of the release, accurate discussions about chemical migration potential cannot be made. A single sample location with a concentration below quantitation limits does not conclusively indicate that groundwater has been impacted or that further downgradient transport of the detected compounds is expected.

The presence of suspended solids in sample 03 GW 01 is suggested by elevated turbidity readings and elevated levels of metals such as aluminum, whose common species are relatively insoluble. In the case of 03 GW 01, concentrations of iron and zinc were high in the unfiltered sample; filtered sample results were lower. However, levels of aluminum were still moderately high in the filtered sample, which may be due to a very low pH (less than 4.0). Although unfiltered sample results were used in all calculations for the groundwater risk assessment, in accordance with the recommended conservative approach to this evaluation, the filtered sample results for iron and zinc are more representative of dissolved-phase contamination.

The source of the contamination in the sediment is unknown. The detected compounds are likely the result of runoff and erosional dispersion. It is unknown whether the surface water (not present during sampling) has the same constituents as the sediment; however, PAHs and phthalate esters are relatively immobile in the environment.

6.6.4 Conclusions

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

results and are considered more representative of dissolved-phase concentrations. Risk calculations based on unfiltered arsenic results are considered conservative and slightly over estimated.

6.7 BASELINE RISK ASSESSMENT

This section of the RI report presents the results of the baseline risk assessment for Site 3. The risk assessment was performed using the approach outlined in Section 2.4. Tables 6-8 and 6-9 provide the selected COPCs and representative concentrations of inorganics and organics in site-related sediment and groundwater, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non-cancer risk and greater than 1E-04 for cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 6.7.1.4 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation alternatives are identified for a site.

6.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential receptors, recreational receptors, and industrial receptors).

6.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 3 are within the mid-range of the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or formulate standards and criteria (ARARs). The principal COPC contributing to the groundwater cancer risk is arsenic (via ingestion).

The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future industrial employee assuming exposure to COPCs in groundwater at Site 3. (Ingestion exposures contributed the significant portion of risk.) Therefore, additional risk analysis

TABLE 6-8
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 3
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	9870	NONPARAMETRIC
ANTIMONY	1.3	NONPARAMETRIC
ARSENIC	6.2	NONPARAMETRIC
BARIUM	60.8	NONPARAMETRIC
BERYLLIUM	0.26	NONPARAMETRIC
CADMIUM	2.1	NONPARAMETRIC
COBALT	2.3	NONPARAMETRIC
COPPER	24.3	NONPARAMETRIC
IRON	15000	NONPARAMETRIC
LEAD	89.1	NONPARAMETRIC
MANGANESE	42.3	NONPARAMETRIC
MERCURY	0.26	NONPARAMETRIC
NICKEL	9.5	NONPARAMETRIC
SILVER	0.44	NONPARAMETRIC
4,4'-DDT*	4	NONPARAMETRIC
ALPHA-BHC*	0.082	NONPARAMETRIC
HEPTACHLOR EPOXIDE*	2.2	NONPARAMETRIC
2-METHYLNAPHTHALENE*	140	NONPARAMETRIC
ACENAPHTHENE*	52	NONPARAMETRIC
ACENAPHTHYLENE*	130	NONPARAMETRIC
ANTHRACENE*	140	NONPARAMETRIC
BENZO(A)ANTHRACENE*	1300	NONPARAMETRIC
BENZO(A)PYRENE*	1400	NONPARAMETRIC
BENZO(G,H,I)PERYLENE*	1000	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	82	NONPARAMETRIC
BUTYLBENZYLPHTHALATE*	64	NONPARAMETRIC
CARBAZOLE*	70	NONPARAMETRIC
CHRYSENE*	1800	NONPARAMETRIC
DIBENZ(A,H)ANTHRACENE*	240	NONPARAMETRIC
FLUORANTHENE*	2200	NONPARAMETRIC
FLUORENE*	260	NONPARAMETRIC
INDENO(1,2,3-CD)PYRENE*	880	NONPARAMETRIC
NAPHTHALENE*	130	NONPARAMETRIC
PHENANTHRENE*	2400	NONPARAMETRIC
PYRENE*	3400	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

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TABLE 6-9
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 3 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	6715.02	NORMAL
ARSENIC	15.1	LOGNORMAL
BARIUM	581.36	NORMAL
CADMIUM	11.7	NONPARAMETRIC
COPPER	13.82	NORMAL
IRON	21926.85	NORMAL
LEAD	5.1	LOGNORMAL
MERCURY	0.12	NONPARAMETRIC
NICKEL	22.7	NONPARAMETRIC
THALLIUM	4	LOGNORMAL
ZINC	623	NONPARAMETRIC
2-BUTANONE	5	LOGNORMAL
GAMMA-CHLORDANE	0.0081	LOGNORMAL

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was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are discussed in Section 6.7.1.4 and presented in Tables 6-10 and 6-11, respectively.

Note that arsenic risks are based upon unfiltered data; filtered sample results are lower and would yield a lower and less conservative estimate of risk.

6.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 3. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of these risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 6.7.1 and presented for groundwater in Tables 6-12, 6-12a, 6-13, and 6-13a.

6.7.1.3 Future Recreational Receptor

The estimated total cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 3 are 2.6E-07 (ingestion) and 5.3E-08 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range.

The estimated noncarcinogenic HIs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 3 are 1.2E-02 (ingestion) and 8.6E-03 (dermal contact). Adverse noncarcinogenic health effects are not anticipated when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic adverse effects are presented for future recreational receptors exposed to sediment at Site 3 in Tables 6-14 and 6-15.

6.7.1.4 Lead Results

Lead was not found above the EPA level of concern (400 mg/kg) in soil samples taken during RI or previous sampling. Lead was not found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken during the 1995 RI but was found at levels exceeding the EPA action level in previous groundwater sampling events.

TABLE 6-10
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
2-BUTANONE	N/A	N/A
GAMMA-CHLORDANE	3.7E-08	1.8E-08
ARSENIC	7.9E-05	3.4E-08
CADMIUM	N/A	N/A
IRON	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	7.9E-05	5.2E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-11
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD
2-BUTANONE	8.2E-05				8.2E-05			8.2E-05	8.2E-05	7.0E-08
GAMMA-CHLORDANE	1.3E-03					1.3E-03		1.3E-03	1.3E-03	6.4E-04
ARSENIC	4.9E-01		4.9E-01							2.1E-04
CADMIUM	2.3E-01			2.3E-01						9.4E-04
IRON	7.2E-01					7.2E-01	7.2E-01			5.9E-03
ZINC	2.0E-02	2.0E-02								3.3E-05
HI FOR TARGET ORGANS:		2.0E-02	4.9E-01	2.3E-01	8.2E-05	7.2E-01	7.2E-01	1.4E-03	1.4E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-12
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION -LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
2-BUTANONE	N/A	N/A	N/A
GAMMA-CHLORDANE	1.6E-07	5.7E-07	2.8E-07
ARSENIC	3.4E-04	8.0E-07	N/A
CADMIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	3.4E-04	1.4E-06	2.8E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-12a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION -LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
2-BUTANONE	N/A	N/A	N/A
GAMMA-CHLORDANE	2.3E-08	9.1E-08	1.6E-08
ARSENIC	1.6E-05	3.5E-08	N/A
CADMIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	1.6E-05	1.3E-07	1.6E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-13
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
2-BUTANONE	5.3E-04				5.3E-04			5.3E-04	5.3E-04	2.7E-06	9.8E-05
GAMMA-CHLORDANE	8.6E-03					8.6E-03		8.6E-03	8.6E-03	2.5E-02	N/A
ARSENIC	3.2E+00		3.2E+00							6.6E-03	N/A
CADMIUM	1.5E+00			1.5E+00						2.9E-02	N/A
IRON	4.7E+00					4.7E+00	4.7E+00			1.8E-01	N/A
ZINC	1.3E-01	1.3E-01								1.0E-03	N/A
	HI FOR TARGET ORGAN	1.3E-01	3.2E+00	1.5E+00	5.3E-04	4.7E+00	4.7E+00	9.2E-03	9.2E-03		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-13a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 3
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
2-BUTANONE	2.5E-04				2.5E-04			2.5E-04	2.5E-04	1.8E-06	1.9E-05
GAMMA-CHLORDANE	4.0E-03					4.0E-03		4.0E-03	4.0E-03	1.6E-02	N/A
ARSENIC	5.0E-01		5.0E-01							1.5E-03	N/A
CADMIUM	3.1E-01			3.1E-01						8.6E-03	N/A
IRON	2.2E+00					2.2E+00	2.2E+00			1.2E-01	N/A
ZINC	2.5E-02	2.5E-02								2.8E-04	N/A
	HI FOR TARGET ORGAN	2.5E-02	5.0E-01	3.1E-01	2.5E-04	2.2E+00	2.2E+00	4.3E-03	4.3E-03		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 6-14
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 3
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDT	1.5E-11	3.7E-12
ALPHA-BHC	5.7E-12	1.1E-12
HEPTACHLOR EPOXIDE	2.2E-10	1.1E-10
2-METHYLNAPHTHALENE	N/A	N/A
ACENAPHTHENE	N/A	N/A
ACENAPHTHYLENE	N/A	N/A
ANTHRACENE	N/A	N/A
BENZO(A)ANTHRACENE	1.0E-08	4.1E-09
BENZO(A)PYRENE	1.1E-07	1.5E-07
BENZO(G,H,I)PERYLENE	N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	1.3E-11	5.0E-12
BUTYLBENZYLPHTHALATE	N/A	N/A
CARBAZOLE	1.5E-11	3.0E-12
CHRYSENE	1.4E-10	5.7E-11
DIBENZ(A,H)ANTHRACENE	1.9E-08	3.8E-08
FLUORANTHENE	N/A	N/A
FLUORENE	N/A	N/A
INDENO(1,2,3-CD)PYRENE	7.0E-09	2.8E-09
NAPHTHALENE	N/A	N/A
PHENANTHRENE	N/A	N/A
PYRENE	N/A	N/A
ALUMINUM	N/A	N/A
ANTIMONY	N/A	N/A
ARSENIC	1.0E-07	4.2E-09
BARIUM	N/A	N/A
BERYLLIUM	1.2E-08	4.9E-08
CADMIUM	N/A	N/A
COBALT	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
NICKEL	N/A	N/A
SILVER	N/A	N/A
TOTAL RISK	2.6E-07	2.5E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 6-15
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 3
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDT	1.0E-06	2.5E-07
ALPHA-BHC	NA	NA
HEPTACHLOR EPOXIDE	2.2E-05	1.1E-05
2-METHYLNAPHTHALENE	NA	NA
ACENAPHTHENE	1.1E-07	4.4E-08
ACENAPHTHYLENE	NA	NA
ANTHRACENE	6.0E-08	1.8E-08
BENZO(A)ANTHRACENE	NA	NA
BENZO(A)PYRENE	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	5.2E-07	2.1E-07
BUTYLBENZYLPHTHALATE	4.1E-08	8.1E-09
CARBAZOLE	NA	NA
CHRYSENE	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA
FLUORANTHENE	7.0E-06	2.8E-06
FLUORENE	8.3E-07	3.3E-07
INDENO(1,2,3-CD)PYRENE	NA	NA
NAPHTHALENE	4.2E-07	1.6E-07
PHENANTHRENE	NA	NA
PYRENE	1.4E-05	4.4E-06
ALUMINUM	1.3E-03	1.0E-03
ANTIMONY	4.2E-04	3.3E-04
ARSENIC	2.6E-03	1.1E-04
BARIUM	1.1E-04	1.1E-04
BERYLLIUM	6.6E-06	2.6E-05
CADMIUM	5.4E-04	4.3E-04
COBALT	4.9E-06	3.9E-06
COPPER	7.8E-05	5.1E-06
IRON	6.4E-03	5.1E-03
LEAD	NA	NA
MANGANESE	1.1E-03	1.4E-03
MERCURY	1.1E-04	6.3E-05
NICKEL	6.1E-05	1.6E-05
SILVER	1.1E-05	2.2E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for background and Site 3 exposures are presented in Appendix I.

6.7.1.5 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 3 for future residential and future industrial receptors assuming exposure to COPCs in groundwater.

Comparison to Background

Aluminum, barium, copper, lead, mercury, nickel, and thallium were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 6-6 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Consideration of Modified Dermal Absorption and Target Organ Grouping

As discussed in Section 2.4.6.2, groundwater cancer and non-cancer risks were recalculated using a modified gastrointestinal absorption factor for one chemical. After these steps, the final RME cancer risks are still above the 1E-04 to 1E-06 target acceptable range for the future residential receptor (3.4E-04, via groundwater ingestion). The cancer risk associated with the future industrial (groundwater) exposure scenario is within the mid-range of the target acceptable risk range. Arsenic is the principal COPC contributing to the groundwater RME cancer risks.

The revised HIs are greater than 1.0 for exposure to groundwater by future residential and future industrial receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are less than 1.0 for each affected organ for the future industrial receptor but are greater than 1.0 in some cases for the residential child. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: liver and digestive system (4.7 - iron), skin (3.2 - arsenic), and kidney (1.5 - cadmium).

Estimated carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are presented in Tables 6-10 and 6-11, respectively. Estimated carcinogenic and noncarcinogenic risks are presented for future residential receptors exposed to groundwater at Site 3 in Tables 6-12 and 6-13, respectively.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate cancer and non cancer risks for exposure to COPCs in groundwater for future residential receptors. 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. Based on this evaluation, the estimated total central tendency cancer risks are within the mid-range of the target acceptable risk range; however, the noncarcinogenic HI is greater than 1.0 for some target organs. For groundwater ingestion by the future residential child, a central tendency HI of 2.2 was calculated for the liver and digestive system (attributable to iron in both cases). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks are presented for exposure to groundwater for future residential receptors in Table 6-12a; central tendency noncarcinogenic risks are presented for exposure to groundwater for the future residential child in Table 6-13a.

6.7.2 Conclusions

Sediment and groundwater were sampled at Site 3. The potential receptors for this site were future industrial, residential, and recreational receptors. The RME cancer risk associated with the future residential (groundwater) exposure scenario is greater than 1E-04, the upper end of the target risk range. Arsenic (via ingestion of groundwater) is the major COPC that contributed to this cancer risk. However, the RME estimate for the future residential receptor is probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

Noncarcinogenic HQs associated with the future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Arsenic, cadmium, and iron (via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for this exposure scenario. In addition, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the liver and digestive systems as target organs. Arsenic risks (carcinogenic and non-carcinogenic) are based on unfiltered data. However, filtered results, which are considered more representative of dissolved-phase concentrations, are approximately one-third of the unfiltered concentration and would yield a commensurate reduction in the estimated risk.

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

The amended risk assessment procedure did not result in the elimination of all non-cancer risks above guideline limits. Although iron by groundwater ingestion remained with an HQ above one, consideration must be given to the lower levels of iron in filtered data because the risk assessment conclusions are based on results of both quantitative and qualitative risk assessment methodologies. Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 3 in Table 6-16 for sediment and groundwater. Table 6-16a presents the relevant central tendency risk estimates associated with residential receptors for groundwater.

6.8 ECOLOGICAL RISK ASSESSMENT

6.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 3 is approximately 5 acres in size and is slightly higher in elevation than most of the surrounding areas. The site is covered with grasses, brush, and some trees. Scattered bare areas are present, along with some scattered debris. The surrounding areas are predominantly upland, characterized by pitch pine, scarlet oak, and white oak. Forested wetlands are located southeast of the site, although water in these wetlands is ephemeral. Upland habitat adjacent to the landfill changes rapidly to red maple and black gum in the wetlands area. A small drainage depression runs under the access road to the east and flows into the wetlands in a southwestward direction. The wetlands are located several feet lower in grade than the landfill and receive most of the runoff from the site. The surface water body closest to Site 3 is the East Branch of Mingamahone Brook, located approximately 800 feet to the west. As a result, Site 3 is located in the Mingamahone Brook Watershed. The nearest RI site is Site 27, about 1 mile to the northwest. The landfill area provides limited terrestrial habitat, and the areas around Site 3 provide excellent habitat, primarily for terrestrial receptors. Most mammals found on the installation, such as white-tailed deer, red fox, gray fox, and several species of small mammals, are expected to use these areas, as are avian species found on the base that are attracted to wooded areas. No sensitive habitats, other than the wetlands, and no threatened or endangered species are known to occur on or around the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major contaminant release pathways from the landfill are overland runoff and infiltration of contaminants. Overland runoff from precipitation may carry constituents to nearby surface waters, sediments, and soils, primarily to the wetlands. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the

TABLE 6-16
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 3
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	2.6E-07	N/A	N/A	N/A	N/A	1.3E-02
	Dermal Contact	N/A	N/A	N/A	2.5E-07	N/A	N/A	N/A	N/A	8.6E-03
Groundwater	Ingestion	N/A	7.9E-05^	3.4E-04^	N/A	N/A	7.2E-01@	4.7E+00@	N/A	N/A
	Dermal Contact	N/A	5.2E-08^	1.4E-06^	N/A	N/A	7.7E-03^	2.4E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	2.8E-07^	N/A	N/A	N/A	N/A	9.8E-05^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	7.9E-05	3.4E-04	5.1E-07	-	7.3E-01	4.9E+00	9.8E-05	2.1E-02

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 6-16a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 3
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	N/R	1.6E-05^	N/A	N/A	N/R	2.2E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	1.3E-07^	N/A	N/A	N/R	1.5E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	1.6E-08^	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	1.6E-05	-	-	-	2.3E+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
** = 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.

site may eventually discharge to wetland surface water; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic or semi-aquatic organisms. Groundwater flow at the site is generally southeastward toward the wetlands. However, the ephemeral water levels and wooded nature of the site preclude the existence of an extensive aquatic community in the wetlands.

Exposure Routes

Terrestrial receptors at Site 3 may be exposed to surface soil contaminants via incidental ingestion of soil or by ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants in Site 3 surface water by using it for drinking, although this pathway is generally insignificant. Terrestrial vegetation may also be exposed to contaminants in soils at Site 3. However, since the wetlands near the site provide substantially more habitat of better quality than the landfill, related exposure routes of main concern pertain to the wetlands. Therefore, risks to terrestrial plants and terrestrial receptors from surface soil exposure at Site 3 were not investigated. Aquatic and semi-aquatic organisms inhabiting the nearby wetlands may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated prey. Aquatic and semi-aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were all contaminants detected in 1995 RI activities for this site. In particular, contaminants detected in Site 3 wetland sediments were considered preliminary COPCs. Soil and groundwater samples from 1993 RI/FS activities and groundwater samples taken as part of 1995 RI activities were qualitatively assessed.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

6.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminants in sediments. Sediment ET values are presented in Table 2-29.

6.8.3 Preliminary Exposure Assessment

Contaminant concentrations in sediments used as representative exposure point concentrations for this initial screening were obtained from data generated during 1995 RI activities. Since only one sediment sample was collected, the detected contaminant concentrations in that sample were used as representative exposure point concentrations. The sample was taken in the wetland area expected to receive the most potential overland runoff and erosion from the site. Two 1993 RI/FS test pit soil samples, 1993 RI/FS groundwater samples, and 1995 RI groundwater samples were evaluated qualitatively. Background concentrations presented for comparative purposes were maximum values detected in facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

6.8.4 Risk Characterization

Three inorganics, cadmium, lead, and mercury, exceeded most conservative ET values for sediment and were retained as final COPCs but did not exceed less conservative values (Table 6-17). Barium (HQ = 1.52) exceeded the only ET value available for that inorganic. Aluminum, beryllium, and vanadium were conservatively retained as final COPCs since no suitable ETs were available. Several organics exceeded most conservative ET values but did not exceed less conservative values, including 4,4-DDT, and some PAHs. Phenanthrene and pyrene exceeded most conservative ETs and slightly exceeded less conservative ETs. The toxicological properties of final COPCs are summarized in Appendix M.

6.8.5 Summary and Conclusions

Habitat on the landfill is somewhat limited and of marginal quality. However, upland habitats surround most of the landfill, and forested wetland habitats are present to the southeast. The forested wetland and upland areas contain excellent habitat, primarily for terrestrial receptors. Since the wetlands are considered sensitive habitats and receive runoff from the landfill, since habitats in the wetlands are of better quality than the landfill, and since groundwater flows in the direction of the wetlands, wetland habitats were the focus of this assessment.

TABLE 6-17
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 3
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Representative Concentration (mg/kg)	Ecotox Threshold (mg/kg)[1]	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Inorganics						
Aluminum	1/1	3940	9870	NA		Retained-No suitable threshold available
Antimony	1/1	ND	1.3	2.0	0.65	Eliminated-Does not exceed threshold
Arsenic	1/1	6.2	6.2	8.20	0.76	Eliminated-Does not exceed threshold
Barium	1/1	10.6	60.8	40	1.52	Retained-HQ > 1
Beryllium	1/1	0.57	0.26	NA		Retained-No suitable threshold available
Cadmium	1/1	ND	2.1	1.2/9.6	1.75/0.22	Retained-HQ > 1
Chromium	1/1	56	22.1	81	0.27	Eliminated-Does not exceed threshold
Cobalt	1/1	2.1	2.3	50	0.05	Eliminated-Does not exceed threshold
Copper	1/1	13	24.3	34	0.71	Eliminated-Does not exceed threshold
Lead	1/1	34.3	89.1	47/218	1.90/0.41	Retained-HQ > 1
Manganese	1/1	9.2	42.3	460	0.09	Eliminated-Does not exceed threshold
Mercury	1/1	0.07	0.26	0.15/0.71	1.73/0.37	Retained-HQ > 1
Nickel	1/1	6	9.5	21	0.45	Eliminated-Does not exceed threshold
Silver	1/1	ND	0.44	1.0	0.44	Eliminated-Does not exceed threshold
Vanadium	1/1	42.7	31.7	NA		Retained-HQ > 1
Organics[3]						
2-Methylnapthalene	1/1	ND	140	330	0.42	Eliminated-Does not exceed threshold
4,4'-DDT	1/1	19	4.0	1.6/46	2.5/0.09	Retained-HQ > 1
Acenapthene	1/1	ND	52	620	0.08	Eliminated-Does not exceed threshold
Acenapthylene	1/1	ND	130	330	0.39	Eliminated-Does not exceed threshold
Alpha-BHC	1/1	ND	0.082	3.70	0.02	Eliminated-Does not exceed threshold
Anthracene	1/1	ND	140	330	0.42	Eliminated-Does not exceed threshold
Benzo(a)anthracene	1/1	560	1300	330/1600	3.9/0.81	Retained-HQ > 1
Benzo(a)pyrene	1/1	590	1400	430/1600	3.26/0.88	Retained-HQ > 1
Benzo(g,h,i)perylene	1/1	380	1000	330/1700	3.03/0.59	Retained-HQ > 1
Bis(2-ethylhexyl)phthalate	1/1	ND	82	8.90E+08	0.0	Eliminated-Does not exceed threshold
Butylbenzylphthalate	1/1	ND	64	11000	0.0	Eliminated-Does not exceed threshold
Carbazole	1/1	ND	70	330	0.21	Eliminated-Does not exceed threshold
Chrysene	1/1	940	1800	330/2800	5.45/0.64	Retained-HQ > 1
Dibenzo(a,h)anthracene	1/1	ND	240	330	0.73	Eliminated-Does not exceed threshold
Fluoranthene	1/1	1800	2200	2900	0.76	Eliminated-Does not exceed threshold

TABLE 6-17
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 3
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Representative Concentration (mg/kg)	Ecotox Threshold (mg/kg)[1]	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Fluorene	1/1	190	260	540	0.48	Eliminated-Does not exceed threshold
Heptachlor Epoxide	1/1	ND	2.0	5.0	0.4	Eliminated-Does not exceed threshold
Indeno(1,2,3-cd)pyrene	1/1	310	880	330.00/1700	2.67/0.52	Retained-HQ > 1
Napthalene	1/1	ND	130	480.00	0.27	Eliminated-Does not exceed threshold
Phenanthrene	1/1	1900	2400	850/1500	2.80/1.60	Retained-HQ > 1
Pyrene	1/1	1900	3400	660/2600	5.20/1.30	Retained-HQ > 1

ND = None detected
NA = No suitable benchmark was available
1 When two values are presented, the left value is the most conservative available and the right value is a less conservative value, if available. In these instances, two HQ values are presented.
2 Contaminants were retained as final COPCs if the most conservative ET value available was exceeded.
3 All organic values are in ug/kg

The 1993 RI/FS test pit soil samples indicated the presence of low levels of some PAHs, including fluoranthene and pyrene, and low levels of some VOCs. An elevated level of barium was also detected in one sample. Groundwater samples from 1993 RI/FS activities contained some elevated levels of arsenic, 1,4-dichlorobenzene, 4-methylphenol, and naphthalene. Groundwater samples from 1995 RI activities contained elevated levels of some metals and low levels of 2-butanone and gamma-chordane.

HQ values for inorganics in the 1995 RI sediment sample were indicative of low potential risk. Aluminum, beryllium, and vanadium were conservatively retained as final COPCs since no suitable ETs were available. Aluminum was detected above background, but beryllium and vanadium were detected at concentrations lower than background. HQ values for organics were indicative of low potential risk, with the exception of pyrene and phenanthrene, two PAHs. Concentrations of these compounds exceeded most and less conservative ET values.

For the most part, HQ values for contaminants detected in the wetland sediment sample were low, but several PAHs were detected. In addition, pyrene and phenanthrene exceeded most and less conservative ETs. The concentration of aluminum was also elevated, but, since no suitable ET value was available and only one sample was taken, the significance of the concentration cannot be fully evaluated. Most final COPCs in sediments were either not detected or were present at low levels in groundwater, suggesting that overland migration is the major potential contaminant migration pathway. The wetlands area is not extensive, the distance from the site to any surface water is several hundred feet, and the drainage ditch does not lead to a major surface water body. Nonetheless, the increased levels of aluminum and PAHs and the full nature and extent of other contaminants in the wetlands cannot be fully ascertained from the one sediment sample taken. For these reasons, additional sediment samples should be taken in the wetland area to adequately assess related potential ecological risks associated with Site 3. A sample could also be taken upstream in the drainage ditch to investigate potential upstream contaminant contributions. Additional surface water samples may not be appropriate since water is ephemeral in the wetlands and drainage ditch. Also, additional soils samples could be taken on the southeastern edge of landfill, or between the landfill and wetlands, to investigate potential contaminant runoff from the landfill.

6.9 EVALUATION AND RECOMMENDATIONS

6.9.1 Evaluation Summary

Metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included aluminum, antimony, arsenic, cadmium, and iron.

Organic compounds found at concentrations above regulatory guidelines in previous investigations were not found. This may be due to the lack of groundwater in several monitoring wells, including MW3-04, which previously contained xylene and acetone at levels above regulatory guidelines. However, considering

all the data collected over the years, there does not appear to be any trend identified to suggest that a concentrated VOC source is hidden in the Site 3 landfill.

Test pits confirmed the presence of municipal type waste in the southern extent of the site as delineated in Figure 6-1.

Results of human health risk assessment concluded that calculated non-cancer risks were above guideline limits for ingestion of groundwater.

Ecological risk assessment concluded that one sediment sample was not sufficient to determine potential ecological impact from metals, PAHs, and other compounds present in the wetland area.

6.9.2 Recommendations

Additional investigation upstream and downgradient of the wetlands appears necessary to fully gauge impacts from the site.

7.0 SITE 4: LANDFILL WEST OF "D" GROUP

7.1 SITE BACKGROUND AND PHYSICAL SETTING

The landfill west of "D" group is a 5-acre site that, from 1943 to 1960, was used for the disposal of domestic and industrial wastes. At this site, wastes were burned in trenches and then buried. Industrial wastes disposed at Site 4 consist of demolition wastes, pesticide and herbicide containers, paint residues, and rinsewaters. Industrial wastes apparently comprise only a small portion of the approximately 10,200 tons of waste estimated to have been disposed at the site. Other wastes that may have been disposed in the landfill were discarded containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and asbestos.

The site is an open area surrounded by woodlands. The landfill is primarily covered with a sandy soil and is not closed with an impermeable cap. Erosion of the cover is present on the eastern side of the landfill. The site is moderately vegetated with grasses and some scrub pines, although there are a few bare areas with no vegetation. The site is bordered by Macassar Road to the west and by an unpaved road to the north, east, and south. The ground surface slopes downward to the southeast from approximately 170 feet above MSL near MW4-01 to approximately 150 feet above MSL at MW4-06. Along the southeastern portion of the site, the fill face is approximately 25 feet high but tapers to the original ground surface. A broad, low-lying wetland extends from the eastern portion of the site beyond the unpaved boundary road. Surface water and groundwater flow is to the east and east-southeast toward the wetland, based on measured groundwater levels. Figure 7-1 is a map of the site.

7.2 PREVIOUS INVESTIGATIONS

7.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site observations. Based on the potential for groundwater impacts and the documented disposal of hazardous wastes, the site was recommended for a confirmation study.

During the 1986 SI, three monitoring wells were installed, groundwater samples were collected and analyzed, and two on-site springs were sampled. The RI/FS field investigation included test pit excavation, surface water and sediment sampling, and installation of three additional monitoring wells. Six test pits were excavated to characterize the waste materials. The waste consisted primarily of metal scrap such as steel banding, pipes, and empty metal trash barrels. Lumber, concrete, brick, and other construction debris were also encountered. No anomalous organic vapor readings were detected in any of the test pits.

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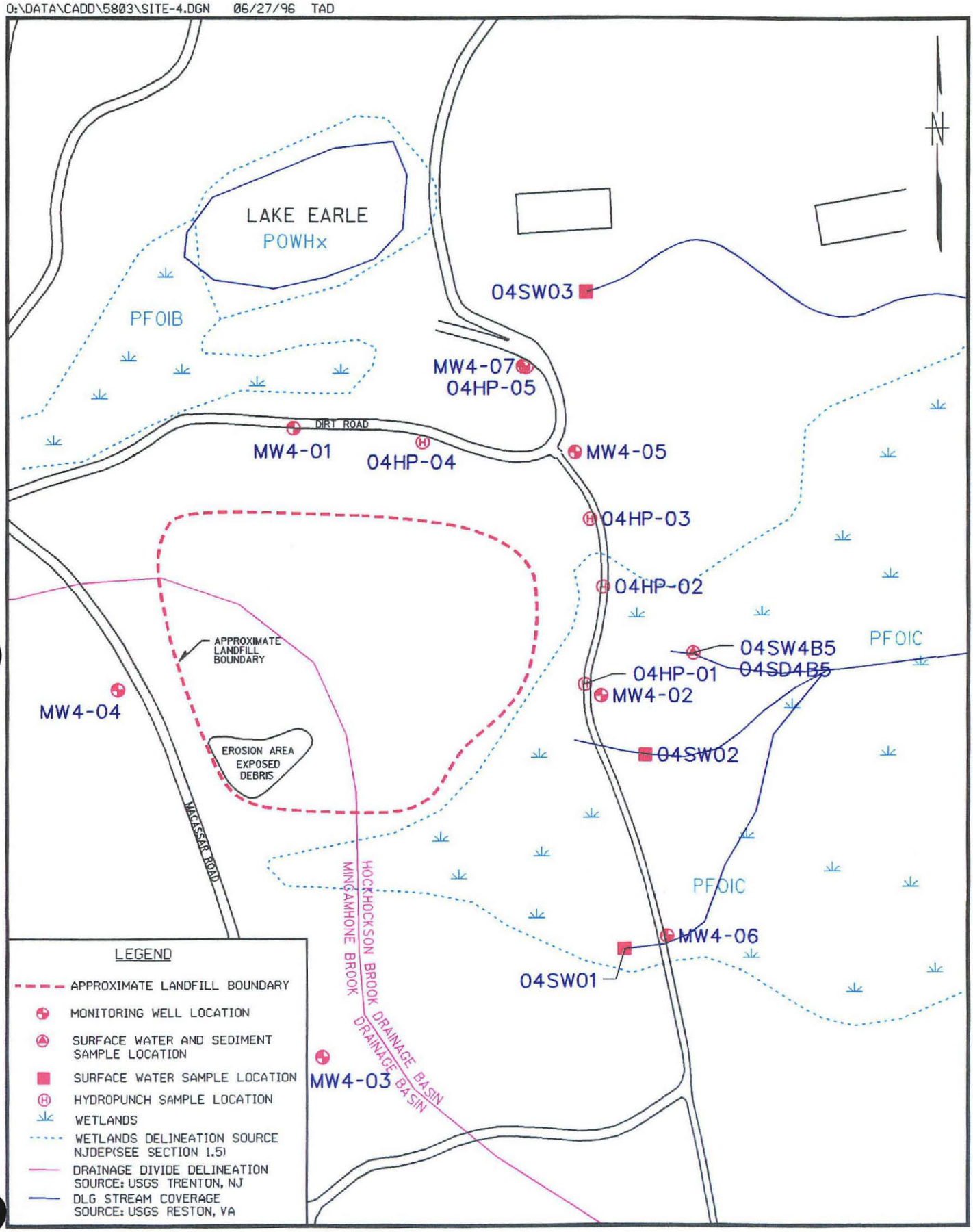

SAMPLE LOCATIONS

SITE 4 - LANDFILL WEST OF "D" GROUP

0 200 400

SCALE IN FEET

FIGURE 7-1

Brown & Root Environmental

In two of the test pits, samples were collected and analyzed for full TCL/TAL analytes and TPH. One SVOC compound [bis(2-ethylhexyl) phthalate] was detected in Test Pit 3. The pesticide 4,4'-DDT (13 ug/kg) and TPH (2,100 mg/kg) were detected in Test Pit 2. No other pesticides or PCBs were detected in either sample.

During the 1993 SI, four surface water and sediment samples were collected from the spring-fed stream and drainage along the southeastern portion of the site. Sediment samples contained very low levels of VOCs, SVOCs, and elevated levels of metals and Aroclor 1260 (1.4 mg/kg). No other PCB or pesticide compounds were found. The surface water samples were analyzed for VOCs and TPH. No VOCs were detected that were not also identified in blanks. No TPH was detected.

In 1993, groundwater samples were collected from all SI and RI/FS wells. One round was analyzed for full TCL/TAL compounds. DCE was detected in MW4-02 and MW4-05 at 20 ug/L and 7 ug/L, respectively, and TCE was found at 14 ug/L in MW4-05 during the first sampling round. A second and third round were analyzed for VOCs, drinking water metals, and landfill indicator parameters. VOCs such as methylene chloride and acetone, which are commonly associated with laboratory contamination, were detected in some samples. TCE at concentrations of 78 ug/L and 46 ug/L, respectively, and DCE at concentrations of 33 ug/L and 21 ug/L, respectively, exceeded the comparison regulatory standards in the sample from MW4-05 in the second and third sampling rounds. DCE at concentrations of 13 ug/L and 8 ug/L, respectively, were detected in MW4-02 during the second and third sampling rounds. No pesticides or PCBs were detected. Lead was detected at a concentration of 17.3 ug/L at MW4-04. Results of the landfill parameters indicated slightly elevated levels of COD and sulfates in the downgradient wells, MW4-02 and MW4-05, relative to the upgradient well, MW4-04.

7.2.2 Summary of Conclusions

The SI found low levels of several compounds in surface water, metals were found in groundwater, and ethylhexylphthalate was found in one well. The RI test pits encountered mostly scrap metal and construction debris. Subsurface soils had elevated levels of petroleum hydrocarbons. Groundwater and surface water samples showed low levels of metals and semivolatile and volatile organic compounds.

7.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Resample all wells to confirm previous results. Investigate deeper groundwater to determine if vertical migration has occurred.

- Compare data to background levels and risk based criteria.

- Sample additional downgradient springs to determine if wetlands or surface drainage show signs of contaminant migration.

7.3 RI FIELD INVESTIGATION

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 4:

- Sampling and analysis of groundwater samples from five hydropunch locations (Section 7.3.1).

- Sampling and analysis of surface water and sediment sampling (Section 7.3.2).

- Drilling and installation of one shallow permanent monitoring well (Section 7.3.3).

- Measurement of static-water levels in the wells (Section 7.3.3).

- Sampling and analysis of groundwater from the newly installed well and existing wells (Section 7.3.3).

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of hydropunch sample locations, surface water and sediment sample locations, surface soil sample locations, the newly installed monitoring wells, and selected existing wells. Surveying notes are provided in Appendix F.

7.3.1 Hydropunch Groundwater Sampling

B&R Environmental collected eight hydropunch groundwater samples from five locations in June 1995 to determine where and at what depth any additional permanent monitoring wells should be located. Figure 7-1 shows the sampling locations. An attempt was made at three hydropunch locations (04 HP 01 through 04 HP 03) to collect a groundwater sample from the water table, a mid-depth interval sample, and a sample at approximately 40 feet below the initial water level. In some instances, the particular interval was not producing water and a sample was not collected.

The eight groundwater samples were designated 04 HP 01-0508, 04 HP 02-1013, 04 HP 02-2528, 04 HP 03-1518, 04 HP 03-2730, 04 HP 03-3942, 04 HP 04, and 04 HP 05. Sample designations include the screened interval depth. For example, in sample 04 HP 01-0508, the borehole was stopped at 5 feet and the hydropunch was driven to 8 feet. The samples were submitted to Lancaster Laboratories for TCL VOCs, TCL SVOCs, ammonia, phosphate, COD, TOC, nitrate/nitrite, turbidity, chloride, and BOD analyses. Hydropunch analytical results were used as field screening for well placement decision making and therefore have not been validated using the full EPA procedure. Table 7-1 contains the hydropunch sampling characteristics. Table 7-2 contains the hydropunch analytical results summary.

Based on the results of the hydropunch sample analysis, which showed low concentrations of semivolatiles at varying depths and one shallow sample with low estimated concentrations of TCE (5 ug/L) and 1,1,1-TCA (2 ug/L), the planned RI program was changed from a combination of three new wells (two deep and one shallow) to one well downgradient of the estimated location of TCE in groundwater. It was apparent from the hydropunch results that the low levels of VOC of concern in the shallow groundwater had not penetrated to the deeper groundwater.

7.3.2 Surface Water and Sediment Sampling

Surface Water Sampling

B&R Environmental collected two surface water samples (04 SW 01 and 04 SW 03) in June 1995. Surface water sample 04 SW 02 was changed from its originally planned location due to dry conditions and was collected in August 1995. The surface water samples were taken to determine the effect of the landfill on surface water. One wetlands surface water sample (04 SW 4B5) was collected in June 1995 to determine if the landfill has contributed to wetlands contamination. 04 SW 4B5 was collected from the same location as Wet-4B5 shown in the RI work plan. Sample log sheets are presented in Appendix D. Figure 7-1 shows sample locations.

The four surface water samples were submitted to Lancaster Laboratory for TCL VOC, TCL SVOC, TAL metals, nitrite/nitrate, turbidity, chloride, ammonia, phosphate, TOC, COD, BOD, and TCL pesticides/PCBs analyses. Sample log sheets are presented in Appendix D.

Sediment Sampling

B&R Environmental collected one sediment sample (04 SED 4B5) in June 1995 to determine if the landfill had contributed to wetlands contamination and submitted the sample to Lancaster Laboratories for analysis.

Table 7-1
Site 4 Hydropunch Groundwater Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Hydropunch Sample Number	Ground Surface Elevation(1)	Approximate Depth to Water(2)	Screened Interval Depth(2) (feet)
04 HP 01-0508	150.60	3.5	5 to 8
04 HP 02-1013	153.70	6.5	10 to 13
04 HP 02-2528	153.70	22.5	25 to 28
04 HP 03-1518	157.80	12	15 to 18
04 HP 03 2730	157.80	13.5	27 to 30
04 HP 03-3942	157.80	31	39 to 42
04 HP 04	169.00	19.5	21.5 to 24.5
04 HP 05	162.40	15	14 to 17

(1) in feet above MSL.
(2) in feet below grade; reading obtained during hydropunch installation.

Table 7-2
Landfill West of "D" Group
Hydropunch Groundwater Analysis
Analytical Results (Not Validated)

		04 HP 03 (18 Feet) Sample Results		04 HP 01 (8 Feet) Sample Results		04 HP 03 (30 Feet) Sample Results		04 HP 03 (42 Feet) Sample Results	
VOLATILE ORGANICS	CRQL	UG/L		UG/L		UG/L		UG/L	
ACETONE	10			10	U	25	U	15	U
TRICHLOROETHENE	10	2	J						
1,2-DICHLOROETHENE (TOTAL)	10			5	J				
SEMIVOLATILE ORGANICS	CRQL	UG/L		UG/L		UG/L		UG/L	
BIS(2-ETHYLHEXYL)PHTHALATE	10	16	U	10	U	12	U	37	
PHENANTHRENE	10					9	J	7	J
ANTHRACENE	10					2	J	2	J
FLUORANTHENE	10					3	J	3	J
PYRENE	10					5	J	4	J
BENZO(A)ANTHRACENE	10					1	J	1	J
CHRYSENE	10					1	J	1	J
BENZO(A)PYRENE	10							1	J
MISCELLANEOUS PARAMETERS		UNITS	RESULT	UNITS	RESULT	UNITS	RESULT	UNITS	RESULT
AMMONIA NITROGEN		MG/L	1 U	MG/L	1	MG/L	0.2 J	MG/L	0.2 J
NITRATE NITROGEN		MG/L	0.22 J	MG/L	0.1 J	MG/L	0.25 J	MG/L	0.5 U
CHLORIDE		MG/L	5	MG/L	9	MG/L	6	MG/L	5
BOD		MG/L	5 U	MG/L	11 U	MG/L	13 U	MG/L	72
TOC		MG/L	3	MG/L	27	MG/L	5	MG/L	4
COD		MG/L	110	MG/L	390	MG/L	400	MG/L	15000
TURBIDITY		NTU	9100	NTU	21400	NTU	7700	NTU	17600
TOTAL PHOSPHOROUS AS PO4		MG/L	0.8 U	MG/L	5.2	MG/L	1.2 U	MG/L	3.3
NITRITE NITROGEN		MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U

		04 HP 05 (18 Feet) Sample Results		04 HP 02 (13 Feet) Sample Results		04 HP 02 (28 Feet) Sample Results		04 HP 04 (21 Feet) Sample Results	
VOLATILE ORGANICS	CRQL	UG/L		UG/L		UG/L		UG/L	
ACETONE	10	10	U	13	U	10	U	10	U
TRICHLOROETHENE	10			5	J				
1,2-DICHLOROETHENE (TOTAL)	10								
1,1,1-TRICHLOROETHANE	10			2	J				
SEMIVOLATILE ORGANICS	CRQL	UG/L		UG/L		UG/L		UG/L	
BIS(2-ETHYLHEXYL)PHTHALATE	10	860		12	U	65		10	U
PHENANTHRENE	10	3	J	10	J			5	J
ANTHRACENE	10			1	J				
FLUORANTHENE	10	2	J	5	J			2	J
PYRENE	10	3	J	8	J			3	J
BENZO(A)ANTHRACENE	10			2	J				
CHRYSENE	10			2	J				
BENZO(A)PYRENE	10			1	J				
PHENOL	10	1	J	1	J			2	J
DI-N-BUTYLPHTHALATE	10	2	J						
BENZO(K)FLUORANTHENE	10			1	J				
MISCELLANEOUS PARAMETERS		UNITS	RESULT	UNITS	RESULT	UNITS	RESULT	UNITS	RESULT
AMMONIA NITROGEN		MG/L	1 U	MG/L	0.1 J	MG/L	1 U	MG/L	1 U
NITRATE NITROGEN		MG/L	0.46 J	MG/L	0.7	MG/L	0.5	MG/L	0.34 J
CHLORIDE		MG/L	12	MG/L	6	MG/L	6	MG/L	7
BOD		MG/L	31	MG/L	7 U	MG/L	5 U	MG/L	12 U
TOC		MG/L	7	MG/L	11	MG/L	3	MG/L	7
COD		MG/L	400	MG/L	220	MG/L	90	MG/L	200
TURBIDITY		NTU	47000	NTU	19400	NTU	9200	NTU	24800
TOTAL PHOSPHOROUS AS PO4		MG/L	1.7	MG/L	3.6	MG/L	1.9	MG/L	3.9
NITRITE NITROGEN		MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U	MG/L	0.5 U

NOTE: DATA IN THIS TABLE HAS NOT BEEN VALIDATED BECAUSE THE DATA WAS USED FOR FIELD SCREENING ONLY

U – NOT DETECTED RESULT (DETECTION/QUANTITATION LIMIT LISTED)

J – POSITIVE VALUE IS ESTIMATED AND LESS THAN QUANTITATION LIMIT

The sediment sample was collected from the same location as the surface water 04 SW 4B5 sample location. Sample log sheets are presented in Appendix D.

The sediment sample was collected using a stainless-steel trowel from 0 to 6 inches below the sediment/water interface and consisted of white sand with some silt and gravel. The sediment material was placed directly into the required bottleware via the stainless-steel trowel. The sediment sample was analyzed for TCL VOC, TCL SVOC, TAL metals, nitrite/nitrate, chloride, ammonia, phosphate, COD, TOC, and moisture.

7.3.3 Permanent Monitoring Well Installation, Static-Water-Level Measurements, and Groundwater Sampling

Monitoring Well Installation

B&R Environmental installed one additional permanent monitoring well (MW4-07) at the site in July 1995 to determine the validity of the 860 ppb detection of bis(2-ethylhexyl)phthalate in 04 HP 05 and to provide an additional piezometer for groundwater flow direction characterization (Figure 7-1). The location of the well was based upon the results of the hydropunch activities in June 1995. The boring had a total depth of 25 feet, and water was encountered at approximately 15.5 feet below grade during drilling. The boring was drilled to approximately 8 feet below the water table and completed as a cased well, screened across the water table. The monitoring well characteristics are summarized in Table 7-3.

Subsurface soil samples were collected continuously from the ground surface to the water table by driving a 2-inch O.D. by 24-inch-long split-barrel sampler. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors) and for lithologic description. HNu readings were 0 ppm throughout the MW4-07 boring. The field team prepared a soil boring log to evaluate subsurface lithologies (see Appendix C).

The well was constructed with 2-inch I.D., flush-jointed and threaded, NSF-certified, Schedule 40 PVC well casing and 0.10-foot slotted PVC well screen fitted with a PVC bottom cap. A 10-foot screen was installed in the well. The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 2 feet above the top of the screen. An approximately 2-foot-thick annular seal, consisting of bentonite pellets, was placed on top of the filter pack. The remainder of the well annulus was backfilled with a bentonite/cement grout to a height approximately 1 foot below the ground surface.

A 4- by 4-foot concrete pad was placed at the ground surface, keyed approximately 1 foot into the well annulus. The well was completed with a 2-foot-high standpipe. The monitoring well construction sheet is in Appendix C.

Table 7-3
Site 4 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW4-01	30	170.00	171.65	171.81	4	15 - 30	12.5 - 30	1/9/86
MW4-02	18	NS	151.23	NS	4	3 - 18	2.5 - 18	1/9/86
MW4-03	25	NS	164.87	NS	4	10 - 25	8 - 25	1/10/86
MW4-04	35	178.53	180.15	NS	4	15 - 35	13 - 35.5[3]	2/8/91
MW4-05[4]	26	164.26	164.15	164.26	4	11 - 26	8 - 26.5[3]	2/20/91
MW4-06	13.7	146.51	148.62	NS	4	3.7 -13.7	2 - 14.5[3]	2/25/91
MW4-07	24	162.52	164.50	165.22	2	14 - 24	12 - 25[3]	7/12/95

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 7-4 for more accurate water-level measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.
(4) Well is flush mounted.

The well was developed a minimum of 24 hours after installation with a submersible pump. Groundwater temperature, pH, conductivity, dissolved oxygen, salinity, and turbidity were monitored during development.

The well was developed until removed water was visibly clear of suspended solids. A total of approximately 105 gallons of water were removed from MW4-07.

Static-Water-Level Measurements

In order to define groundwater flow directions and horizontal and vertical groundwater gradients, B&R Environmental collected two rounds of static-water-level measurements. The first round of water-level measurements was collected on August 7, 1995, and the second round on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 144.43 to 152.33 feet above MSL during the first round of measurements and from approximately 144.13 to 151.11 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 7-4.

Groundwater Sampling

Groundwater samples were obtained from the newly installed well (MW4-07) and from five of the six existing monitoring wells (MW4-01, MW4-02, and MW4-04 through MW4-06) to determine groundwater quality in the aquifer and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. Six monitoring wells (MW4-01, MW4-02, MW4-04, MW4-05, MW4-06, and MW4-07) were sampled in July and August 1995. MW4-3 was dry and therefore not sampled. Field measurements collected during purging were pump rate flow, water-level measurements, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, the wells were purged using the micro-purge protocol to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure that little or no drawdown in water levels occurred throughout the purge and sample process.

The field team submitted six groundwater samples (04 GW 01, 04 GW 02, 04 GW 04, 04 GW 05, 04 GW 06, and 04 GW 07) to Lancaster Laboratories for TCL VOC, TCL SVOC, TAL metals, ammonia, phosphate, TOC, COD, nitrite/nitrate, BOD, chloride, and sulfate analyses. Sample log sheets are presented in Appendix D.

Table 7-4
Site 4 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to WaterTable[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1]	Top of PVC Riser[2] (feet)	Elevation of Water Table[2]
MW4-01	21.65	171.65	150.00	22.47	171.65	149.18
MW4-02	3.85	151.23	147.38	4.51	151.23	146.72
MW4-03	Dry	164.87	-	Dry	164.87	-
MW4-04	27.82	180.15	152.33	29.04	180.15	151.11
MW4-05	17.39	164.15	146.76	18.12	164.15	146.03
MW4-06	4.19	148.62	144.43	4.49	148.62	144.13
MW4-07	17.59	164.50	146.91	18.41	164.50	146.09

(1) In feet below grade
(2) In feet above mean sea level

7.4 SITE CHARACTERISTICS

7.4.1 Geology

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

7.4.2 Hydrogeology

Groundwater in the Cohansey aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations are summarized in Table 7-4. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 7-2 and 7-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the east and east-southeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

The hydraulic conductivity calculated for MW4-04 is 4.48×10^{-4} cm/sec (1.27 ft/day).

7.5 NATURE AND EXTENT OF CONTAMINATION

7.5.1 Sediment

One site-related sediment sample (04 SD 4B5) was collected at Site 4 (Figure 7-1).

Tables 7-5 and 7-6 present the occurrence and distribution of inorganic and organic chemicals detected in site-related sediment samples and compare them to background as presented in Section 31. Tables 7-5a and 7-5b present a comparison of detected compounds to ARARs and TBCs. Figure 7-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

7.5.1.1 Inorganics

Concentrations of metals in the site-related sediment sample were similar to background ranges.

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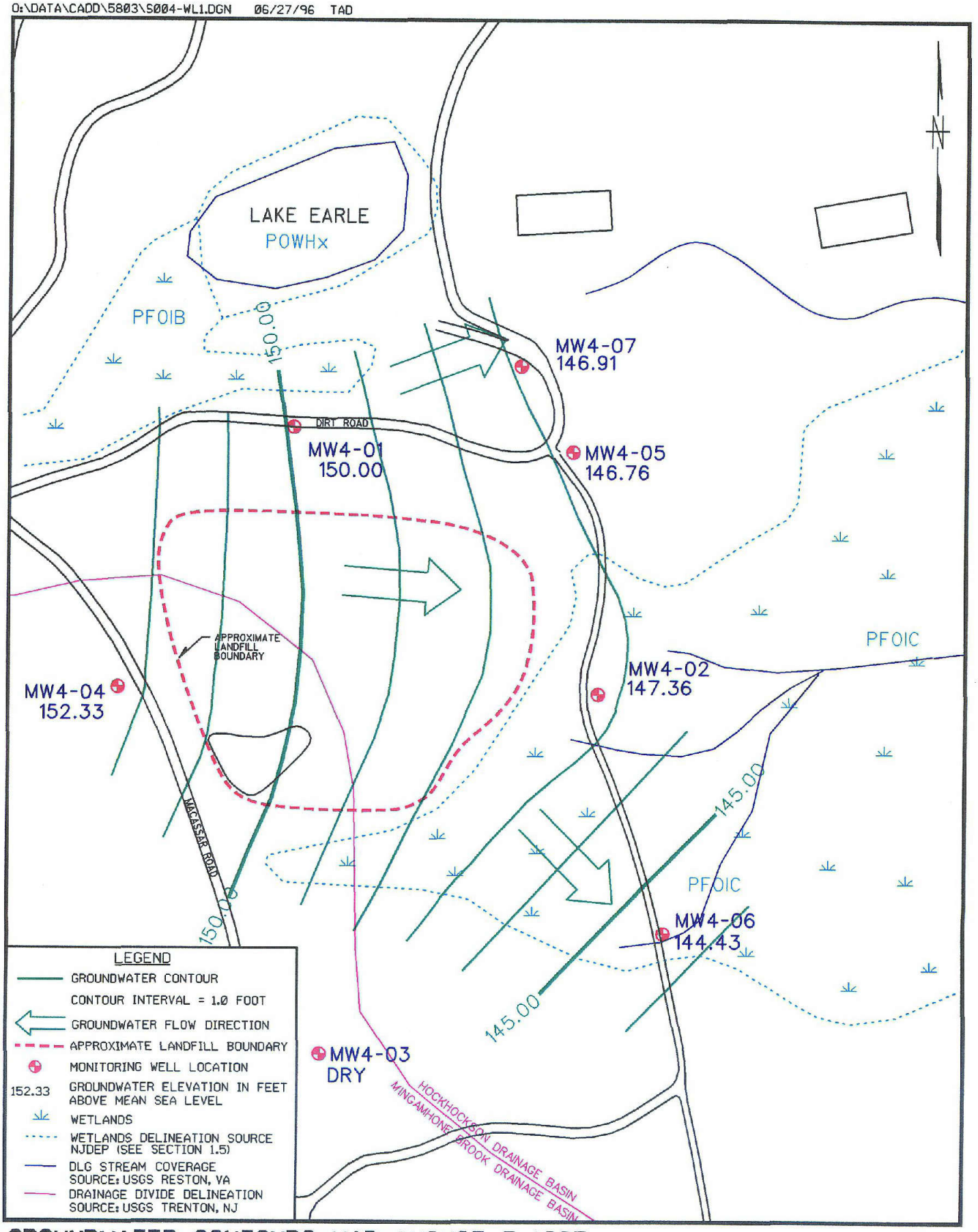

GROUNDWATER CONTOURS MAP AUGUST 7, 1995

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 7-2

0 200 400

SCALE IN FEET

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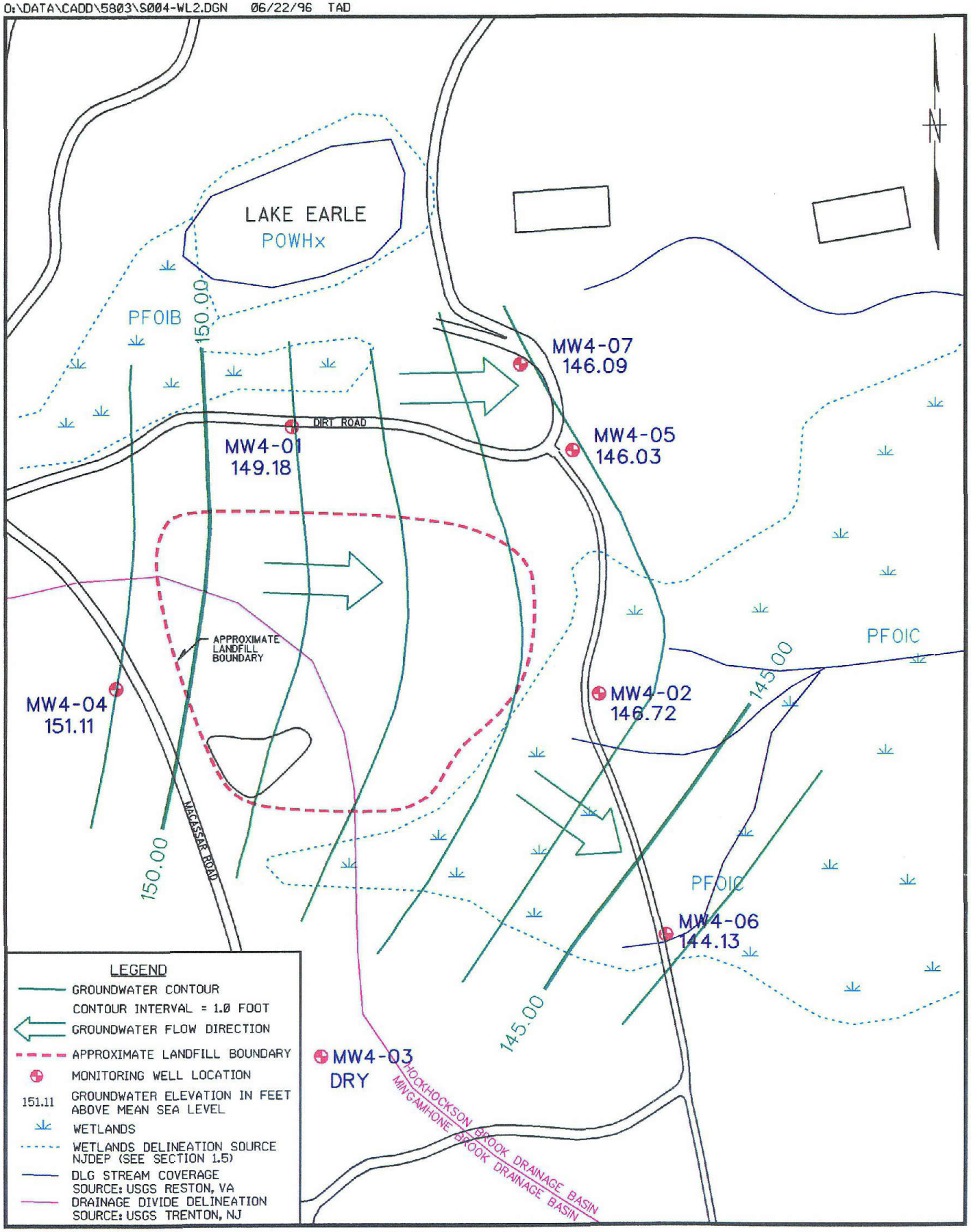

GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 7-3

0 200 400

SCALE IN FEET

Brown & Root Environmental

TABLE 7-5
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 4
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	1 / 1	1030	1030	NO	1030
ARSENIC	2 / 3	2.4 - 6.2	5.95	1 / 1	0.81	0.81	NO	0.81
BARIUM	3 / 3	3.9 - 10.6	14.07	1 / 1	10.8	10.8	NO	10.8
CALCIUM	3 / 3	179 - 518	685.33	1 / 1	334	334	NO	334
CHROMIUM	3 / 3	4.3 - 56	43.13	1 / 1	1.8	1.8	NO	1.8
COPPER	3 / 3	1.5 - 13	12.47	1 / 1	1.6	1.6	NO	1.6
IRON	3 / 3	228 - 7650	6578.67	1 / 1	1710	1710	NO	1710
LEAD	3 / 3	4.6 - 34.3	30.60	1 / 1	9.3	9.3	NO	9.3
MAGNESIUM	3 / 3	60.7 - 256	306.47	1 / 1	65.2	65.2	NO	65.2
MANGANESE	3 / 3	4.6 - 9.2	13.80	1 / 1	24.2	24.2	YES	24.2
SODIUM	3 / 3	26.6 - 116	115.27	1 / 1	50.1	50.1	NO	50.1
VANADIUM	3 / 3	5.9 - 42.7	36.93	1 / 1	3	3	NO	3
ZINC	3 / 3	14.2 - 26.9	37.33	1 / 1	4.4	4.4	NO	4.4

Note: Selected COPCs are indicated in boldface type.

TABLE 7-6
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 04
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
NITROBENZENE	NOT DETECTED	-	-	1 / 1	66	66

TABLE 7-5a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	04SD4B5	---	---	---	---	---	---	ARARS & TBCs
LOCATION:	04SD4B5	---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI							
INORGANICS	**mg/kg**							**mg/kg**
aluminum	1030							-
arsenic	0.81							8.20 L
barium	10.8							40.0 B
calcium	334							-
chromium, total	1.8							81.0 L
copper	1.6							34.0 L
iron	1710							-
lead	9.3 J							47.0 L
magnesium	65.2							-
manganese	24.2 J							460 O
sodium	50.1							-
vanadium	3.0							-
zinc	4.4 J							150 L
SEMIVOLATILES	**ug/kg**							**ug/kg**
nitrobenzene	66.0 E J							8.00 W

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

TABLE 7-5b

COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		04SD4B5		---	---	---	---	---	---	ARARS & TBCs
LOCATION:		04SD4B5		---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:		1995 RI								
MISCELLANEOUS										
chemical oxygen demand	mg/kg	41000								-
chloride	mg/kg	10.0	J							-
moisture	%	37.1								-
nitrate nitrogen	mg/kg	0.80	J							-
total organic carbon	mg/kg	2400								-
total phosphorus as PO4	mg/kg	330								-

TABLE 7-5b
COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

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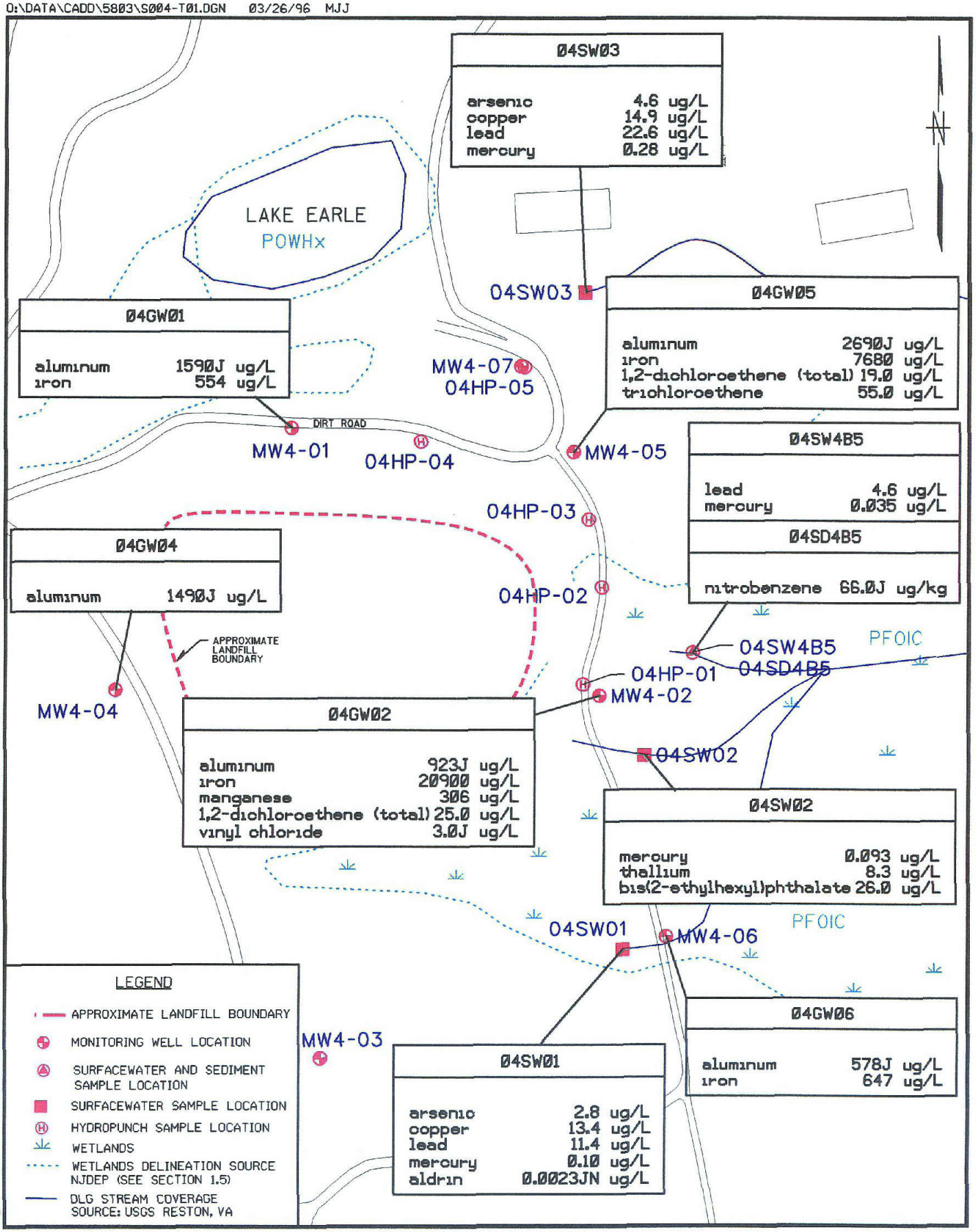

CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 7-4

0 200 400

SCALE IN FEET

Brown & Root Environmental

7.5.1.2 Organics

Nitrobenzene (66 ug/kg) was detected in the site-related sediment sample collected at Site 4. This compound was not detected in background sediment samples.

7.5.1.3 Miscellaneous Parameters

The Site 4 sediment analyses consisted of COD, chlorides, moisture, nitrates, TOC, and total phosphorus as phosphate. None of these indicator parameters exceeded the range detected in background samples to suggest any evidence of influence from the landfill on wetlands contamination.

7.5.2 Groundwater

Six site-related groundwater samples (04 GW 01, 04 GW 02, and 04 GW 04 through 04 GW 07) were collected at Site 4 (Figure 7-1). Tables 7-7 and 7-8 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples and compare them to background. Tables 7-7a and 7-7b present a comparison of detected compounds to ARARs and TBCs. Figure 7-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

7.5.2.1 Inorganics

Concentrations of most site-related metals were similar to background levels. The site-related samples showed the presence of all the metals found in background samples. Barium and zinc were detected in upgradient well sample 04 GW 01 and also in downgradient well 04 GW 05 at levels greater than background. Iron was detected in downgradient well sample 04 GW 02 at levels greater than background. Beryllium was detected at levels greater than background but near the instrument detection limit in upgradient well sample 04 GW 04 (1.6 ug/L).

7.5.2.2 Organics

1,2-Dichloroethene (19 ug/L to 25 ug/L) and TCE (1 ug/L to 55 ug/L) were each detected in two groundwater samples collected at Site 4. Chloroform (1 ug/L) and vinyl chloride (3 ug/L) were each detected in one groundwater sample. 04 GW 05 exhibited the highest levels of TCE, with the highest level of 1,2-DCE and vinyl chloride present in 04 GW 02. Neither of these compounds were detected in background groundwater samples. Hydropunch samples taken indicate that VOCs had not migrated vertically in measurable quantities.

TABLE 7-7
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY
(~~mg~~/kg)
(µg/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	REPRESENTATIVE CONCENTRATION
ALUMINUM*	11 / 11	287 - 7870	5097.82	6 / 6	107 - 2690	1229.67	NO	2690
BARIUM	11 / 11	2.6 - 518	229.60	6 / 6	12.6 - 961	256.17	YES	580.96
BERYLLIUM*	4 / 11	0.21 - 1.6	0.49	2 / 6	0.75 - 1.6	0.43	NO	1.6
CADMIUM*	5 / 11	0.6 - 1.9	1.21	4 / 6	0.44 - 0.84	0.49	NO	0.84
CALCIUM	11 / 11	506 - 17200	8306.55	6 / 6	506 - 55000	11841.00	YES	29314.88
CHROMIUM	NOT DETECTED	-	-	3 / 6	1.3 - 5.4	1.76	YES	3.35
COBALT	6 / 11	0.7 - 10.1	4.06	2 / 6	0.69 - 1.1	0.50	NO	0.77
COPPER*	9 / 11	0.79 - 13.5	6.53	6 / 6	1 - 18.3	5.62	NO	11.43
IRON	11 / 11	153 - 7690	4197.09	6 / 6	75.3 - 20900	5001.55	YES	11849.29
LEAD*	3 / 11	2.1 - 3	2.44	3 / 6	2.4 - 3	1.68	NO	3
MAGNESIUM	11 / 11	273 - 27400	8449.64	6 / 6	273 - 22000	4436.33	NO	11522.02
MANGANESE	11 / 11	3.3 - 65	46.18	6 / 6	12.8 - 306	69.77	YES	165.10
MERCURY	11 / 11	0.005 - 0.12	0.12	6 / 6	0.005 - 0.079	0.03	NO	0.079
NICKEL	10 / 11	0.81 - 25.5	11.98	5 / 6	1 - 4.6	2.15	NO	4.6
POTASSIUM	11 / 11	350 - 3245	2810.55	6 / 6	350 - 9080	2214.33	NO	5008.89
SODIUM	11 / 11	1850 - 11650	8449.09	6 / 6	2290 - 5210	3393.33	NO	4431.78
VANADIUM	10 / 11	0.69 - 42.25	16.48	1 / 6	7.1	1.44	NO	7.1
ZINC*	6 / 9	3.7 - 348	178.61	5 / 6	4 - 558	161.55	NO	363.17

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

TABLE 7-8
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 04
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
1,2-DICHLOROETHENE (TOTAL)	NOT DETECTED	-	-	2 / 6	19 - 25	25
CHLOROFORM	NOT DETECTED	-	-	1 / 6	1	1
TRICHLOROETHENE	NOT DETECTED	-	-	2 / 6	1 - 55	29.78
VINYL CHLORIDE	NOT DETECTED	-	-	1 / 6	3	3

TABLE 7-7a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	04GW01	04GW02	04GW04	04GW05	04GW06	04GW07	ARARS & TBCs		
LOCATION:	04GW01	04GW02	04GW04	04GW05	04GW06	04GW07	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	1590 E J	923 E J	1490 E J	2690 E J	578 E J	107	-	-	200
barium	498 J	12.6	22.1	961 J	22.9	20.4	2000	2000 a	2000
beryllium	0.75	0.11 U	1.6	0.11 U	0.11 U	0.11 U	4.00	4000 e	20.0
cadmium	0.44	0.84	0.38 U	0.81	0.44	0.38 U	5.00	5.00 e	4.00
calcium	3670	55000	506	6190	1420	4260	-	-	-
chromium, total	2.4	1.3	1.0 U	5.4	1.0 U	1.0 U	100 *	100 a	100
cobalt	0.60 U	0.60 U	0.60 U	1.1	0.60 U	0.69	-	-	-
copper	9.8	1.1	1.8	18.3	1.0	1.7	1300	-	1000
iron	554 E	20900 E	153	7680 E	647 E	75.3	-	-	300
lead	2.4	1.5 U	1.5 U	3.0	2.4	1.5 U	15.0	-	10.0
magnesium	1410	22000	273	1180	735	1020	-	-	-
manganese	18.4	306 E	12.8	28.2	28.1	25.1	-	-	50.0
mercury	0.021	0.022	0.0050	0.060	0.010	0.079 J	2.00	2.00 b	2.00
nickel	2.3	0.75 U	2.4	2.2	1.0	4.6	100	100 a	100
potassium	613	9080	350	1660	503	1080	-	-	-
sodium	3030	5210	3600	2290	3130	3100	-	-	50000
vanadium	0.61 U	0.61 U	0.61 U	7.1	0.61 U	0.61 U	-	-	-
zinc	381	1.6 U	19.0	558	4.0	6.5	-	2000 a	5000
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,2-dichloroethene (total)	10.0 U	25.0 E	10.0 U	19.0 E	10.0 U	10.0 U	70.0 a	70.0 a	10.0
chloroform	10.0 U	10.0 U	10.0 U	10.0 U	1.0 J	10.0 U	100	100 e	6.00
trichloroethene	10.0 U	1.0 J	10.0 U	55.0 E	10.0 U	10.0 U	5.00	-	1.00
vinyl chloride	10.0 U	3.0 E J	10.0 U	10.0 U	10.0 U	10.0 U	2.00	10.0 e	5.00

TABLE 7-7a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

. - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

• - Criteria are for total chromium.

•• - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

. - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 7-7b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	04GW01		04GW02		04GW04		04GW05		04GW06		04GW07		ARARS & TBCs		
LOCATION:	04GW01		04GW02		04GW04		04GW05		04GW06		04GW07		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
MISCELLANEOUS	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	mg/L	mg/L
ammonia nitrogen	1.0	U	0.20	J	1.0	U	1.0	U	1.0	U	1.0	U	-	30.0	0.500
biochemical oxygen demand	4.0		4.0		1.3	J	3.0		1.6	J	1.3	J	-	-	-
chemical oxygen demand	9.0		24.0		3.0	J	8.0		7.0	U	4.0	J	-	-	-
chloride	7.0		10.0		9.0		5.0		7.0		8.0		-	-	250
nitrate nitrogen	0.50	U	0.50	U	0.50	U	0.16	J	0.50	U	0.15	J	10.0	10.0	-
sulfate	20.0		40.0		12.0		12.0		10.0		11.0		500	-	250
total organic carbon	1.0		8.0		1.0		2.0		1.0		0.60	J	-	-	-
total phosphorus as PO4	0.10	J	0.20	U	0.20	U	0.40		0.20	U	0.20	U	-	-	-

TABLE 7-7b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

7.5.2.3 Miscellaneous Parameters

The Site 4 groundwater samples analyses included ammonia nitrogen, BOD, COD, chlorides, sulfates, and TOC.

Sample 04 GW 02 revealed levels of COD, sulfate, and TOC greater than those detected in upgradient sample 04 GW 04 and greater than background ranges. However, results are considerably below the concentration range associated with concentrated landfill leachate (Chian and DeWalle, 1976; Brunner and Keller, 1972; and ASCE, 1976). These finds are consistent with the generally low-level detections of these indicator parameters during the previous 1993 sampling investigation.

7.5.3 Surface Water

Four site-related surface water samples (04 SW 01 through 04 SW 03 and 04 SW 4B5) were collected at Site 4 (Figure 7-1). Tables 7-9 and 7-10 present the occurrence and distribution of inorganic and organic chemicals detected in site-related surface water samples and compare them to background. Tables 7-9a and 7-9b present a comparison of detected compounds to ARARs and TBCs. Figure 7-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

7.5.3.1 Inorganics

Metals detected in site-related surface water samples at concentrations notably greater than background ranges include the following: aluminum at 1,220 ug/L in 04 SW 01 and 04 SW 03; iron at 15,500 ug/L in 04 SW 02 and 9,020 ug/L in 04 SW 04; lead at 22.6 ug/L in 04 SW 03; and manganese at 383 ug/L in 04 SW 04 and 333 ug/L in 04 SW 02. Arsenic was detected in 04 SW 03 at a low level (near the instrument detection limit) but was not detected in background surface water samples.

7.5.3.2 Organics

Aldrin (0.0023 ug/L), dieldrin (0.0008 ug/L), and bis(2-ethylhexyl) phthalate (26 ug/L) were each detected in a site-related surface water sample collected at Site 4. None of these compounds were detected in background surface water samples.

7.5.3.3 Miscellaneous Parameters

The Site 4 surface water sample analyses included ammonia nitrogen, BOD, COD, chloride, nitrate, nitrite, sulfate, TOC, phosphate, and turbidity. Samples 04 SW 01 and 04 SW 03 revealed COD levels slightly greater than background ranges. However, these levels are in the lower end of the range associated with landfill leachate (Chian and DeWalle, 1976; Brunner and Keller, 1972; and ASCE, 1976).

TABLE 7-9
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 4
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	4 / 4	193 - 1220	691.50	NO	1220
ARSENIC	NOT DETECTED	-	-	2 / 4	2.8 - 4.6	2.58	YES	4.6
BARIUM	3 / 3	16.3 - 34	53.73	4 / 4	23.2 - 52.9	35.08	NO	52.9
BERYLLIUM	2 / 3	0.22 - 0.33	0.41	2 / 4	0.22 - 0.24	0.15	NO	0.24
CALCIUM	3 / 3	462 - 10100	9128.00	4 / 4	3430 - 59500	24032.50	YES	59500
CHROMIUM	3 / 3	0.72 - 2.6	2.71	2 / 4	0.68 - 4.6	1.53	NO	3.94
COBALT	3 / 3	0.81 - 1.9	2.54	2 / 4	1 - 1.1	0.68	NO	1.1
COPPER	2 / 3	1.1 - 9.8	7.40	3 / 4	10.9 - 14.9	9.90	YES	14.9
IRON	3 / 3	160 - 702	1040.00	4 / 4	2030 - 16200	8480.00	YES	16200
LEAD	1 / 3	4.4	3.43	3 / 4	4.6 - 22.6	9.84	YES	22.6
MAGNESIUM	3 / 3	369 - 2770	2525.33	4 / 4	1060 - 15500	6665.00	YES	15500
MANGANESE	3 / 3	14 - 55.5	59.93	4 / 4	19.3 - 383	191.25	YES	383
MERCURY	2 / 3	0.023 - 0.028	0.04	4 / 4	0.035 - 0.28	0.13	YES	0.28
NICKEL	3 / 3	2.1 - 7.1	8.60	3 / 4	1 - 4.4	2.14	NO	4.4
POTASSIUM	2 / 3	251 - 1850	1482.33	4 / 4	940 - 4330	2580.00	YES	4330
SILVER	1 / 3	0.86	0.99	1 / 4	1	0.53	NO	1
SODIUM	NOT DETECTED	-	-	1 / 4	3930	3195.00	YES	3930
THALLIUM	2 / 3	3.5 - 5.5	7.00	1 / 4	8.3	3.20	NO	8.3
VANADIUM	2 / 3	0.89 - 0.9	1.32	3 / 4	1.1 - 9.7	3.23	YES	9.7
ZINC	3 / 3	7.6 - 29.4	32.67	3 / 4	17.3 - 35.4	20.38	NO	35.4

Note: Selected COPCs are indicated in boldface type.

TABLE 7-10
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE WATER AT SITE 04
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
ALDRIN	NOT DETECTED	-	-	1 / 1	0.0023	0.0023
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	1 / 1	26	26
DIELDRIN	NOT DETECTED	-	-	1 / 1	0.0008	0.0008

TABLE 7-9a

COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	04SW01	04SW02	04SW03	04SW4B5	ARARS & TBCs				
LOCATION:	04SW01	04SW02	04SW03	04SW4B5	AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Criteria Freshwater Chronic Aquatic Life	NJDEP Surface Water Criteria for Protection of Human Health
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI					
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	1220 J	193	1000 J	353 J	-	-	-	-	-
arsenic	2.8 E	3.3 U	4.6 E	2.5 U	189	0.0180	0.140	-	0.0170
barium	34.8	52.9	29.4	23.2	-	-	-	-	2000
beryllium	0.24	0.11 U	0.13 U	0.22	-	-	-	-	-
calcium	3430	59500	6300	26900	-	-	-	-	-
chromium, total	0.68	1.0 U	4.6	0.67 U	209 +	-	-	-	160
cobalt	0.60 U	0.60 U	1.1	1.0	-	-	-	-	-
copper	13.4 E	0.77 U	14.9 E	10.9	11.0 +	-	-	-	-
iron	2030	9600	16200	6090	-	-	-	-	-
lead	11.4 E	1.5 U	22.6 E	4.6 E	3.20 +	-	-	-	5.00
magnesium	1080	15500	1060	9020	-	-	-	-	-
manganese	29.7	333	19.3	383	-	-	-	-	-
mercury	0.10 E	0.093 E	0.28 E	0.035 E	0.0120	0.140	0.150	-	-
nickel	2.8	0.75 U	4.4	1.0	160 +	610	4600	-	516
potassium	940	3910	1140	4330	-	-	-	-	-
silver	0.63 U	0.94 U	1.0	0.63 U	1.90	-	-	-	164
sodium	3530 R	3930	10800 R	3370 R	-	-	-	-	-
thallium	3.0 U	8.3 E	3.0 U	3.0 U	-	1.70	6.30	-	1.70
vanadium	1.8	0.61 U	9.7	1.1	-	-	-	-	-
zinc	28.0 J	1.6 U	35.4 J	17.3	101 +	-	-	-	-
SEMIVOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
bis(2-ethylhexyl)phthalate	10.0 U	26.0 E	10.0 U	10.0 U	3.00	1.80	5.90	-	1.76
PESTICIDES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aldrin	0.0023 E JN	n/a	0.050 U	0.050 U	-			-	
dieldrin	0.10 U	n/a	0.10 U	0.0008 E JN	-	-	-	0.00190	
endosulfan sulfate	0.0007 R	n/a	0.10 U	0.10 U	-	0.950	2.00	-	0.930

TABLE 7-9a
COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L.

TABLE 7-9b

COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		04SW01		04SW02		04SW03		ARARS & TBCs				
LOCATION:		04SW01		04SW02		04SW03		AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Freshwater Chronic Aquatic Life	NJDEP Surface Water Protection of Human Health
DATA SOURCE:		1995 RI		1995 RI		1995 RI						
MISCELLANEOUS												
ammonia nitrogen	mg/L	1.0	U	1.0	U	0.20	E J	-	-	-	0.0200 &	-
biochemical oxygen demand	mg/L	7.0		5.0	J	5.0		-	-	-	-	-
chemical oxygen demand	mg/L	80.0		18.0		120		-	-	-	-	-
chloride	mg/L	8.0	R	6.0		6.0	R	-	-	-	230	230
sulfate	mg/L	n/a		40.0		n/a		-	-	-	-	-
total organic carbon	mg/L	6.0		6.0		12.0		-	-	-	-	-
total phosphorus as PO4	mg/L	0.50	R	0.20	U	0.90	R	-	-	-	-	-
turbidity	ntu	7.0		n/a		25.0		-	-	-	-	-

SAMPLE NUMBER:		04SW4B5		---		---		ARARS & TBCs				
LOCATION:		04SW4B5		---		---		AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Freshwater Chronic Aquatic Life	NJDEP Surface Water Protection of Human Health
DATA SOURCE:		1995 RI										
MISCELLANEOUS												
ammonia nitrogen	mg/L	1.0	U					-	-	-	0.0200 &	-
biochemical oxygen demand	mg/L	1.1	J					-	-	-	-	-
chemical oxygen demand	mg/L	41.0						-	-	-	-	-
chloride	mg/L	5.0	R					-	-	-	230	230
sulfate	mg/L	n/a						-	-	-	-	-
total organic carbon	mg/L	4.0						-	-	-	-	-
total phosphorus as PO4	mg/L	0.40	R					-	-	-	-	-
turbidity	ntu	2.3						-	-	-	-	-

TABLE 7-9b
COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L

& - Value represents the more stringent of criteria for freshwaters classified as FW2-NT, FW2-TP, and FW2-TM

7.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 4 is described in this subsection. Various detected chemicals and their transport potential in the environment are discussed in Section 7.6.1.

Persistence of detected chemicals in the environment is discussed in Section 7.6.2. Section 7.6.3 presents a brief discussion of contaminant trends.

7.6.1 Detected Chemicals and Transport Potential

Halogenated volatiles were detected in Site 4 in groundwater samples. One semivolatile, nitrobenzene, was present in sediment. Inorganics were detected in groundwater and sediment samples, but most element concentrations were within the ranges found in background samples. No surface soil or subsurface soil samples were collected at Site 4. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

All detected organic groundwater contaminants are volatile and characteristically mobile in the environment (either through soil gas migration or groundwater transport) and may have originated at landfill source locations not identified in this investigation or from source locations that have since been depleted of these contaminants. The chlorinated ethenes detected in groundwater have been associated with degradation of PCE and TCE (Cline and Viste, 1983).

Nitrobenzene was detected in one sediment sample at a low concentration. In contrast to most semivolatile compounds, nitrobenzene is considered water soluble and does not bind as strongly to organic matter in sediment. This compound is therefore considered fairly mobile in the environment. Sediment containing nitrobenzene may be subject to leaching to groundwater or surface water transport through erosional dispersion or leachate migration.

Arsenic and lead were detected at low levels in one site-related surface water sample. The presence of elevated levels of aluminum suggests that suspended solids, rather than dissolved metals, represent a significant portion of the total metals in this sample. Iron and manganese were also detected at elevated levels in two surface water samples. The corresponding sediment samples did not reveal elevated levels of metals.

The presence of suspended solids in groundwater samples 04 GW 01, 04 GW 02, and 04 GW 05 is suggested by elevated aluminum levels and turbidity readings. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given that conditions conducive to solution channeling or fracture-based flow do not exist. Despite efforts such as installation

of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure at these wells, low-turbidity samples could not be collected.

7.6.2 Contaminant Persistence

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

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

1,1-DCE and 1,2-DCE are associated with degradation of PCE and TCE (Cline and Viste, 1983) and may further degrade to vinyl chloride. Concentrations of the parent compounds (TCE and PCE) may diminish over time, depending upon the presence of contaminated source materials that could continue to leach new product into groundwater. Nitrobenzene, like other monocyclic aromatics, is considered susceptible to biodegradation in the environment. The rate of degradation depends on several factors including nutrients, oxygen, moisture, carbon source, pH, and the presence of appropriate acclimatized microorganisms.

7.6.3 Observed Chemical Contaminant Trends

TCE and its degradation products (1,2-DCE and vinyl chloride) were detected in the groundwater. The locations and levels detected are consistent with historical data. This investigation and the 1993 sampling revealed that TCE is present at the highest concentrations in MW4-05. This well is located to the east (hydrologically downgradient) and adjacent to the northwestern edge of the landfill. Both investigations also indicate that 1,2-DCE is the VOC present at the highest levels in MW4-02. This well is also located downgradient (east) of the landfill, approximately 400 feet south of MW4-05.

None of the organic compounds that were detected in groundwater were detected in surface water or sediments at the site. Leaching from unknown source locations within the site into groundwater is

considered the primary transport pathway for organics at this site, based on the expected mobility of the chemicals detected in groundwater.

The concentrations of aluminum, barium, and zinc in downgradient well MW4-05 were similar to those in upgradient well MW4-01, which indicates that these constituents are probably not site related. The presence of suspended solids in these wells and in downgradient well MW4-02, where iron was detected at an elevated level, is suggested by elevated turbidity readings and/or aluminum levels.

The source of the nitrobenzene contamination in the sediment is unknown. The detected contamination is likely the result of runoff and erosional dispersion. The different pattern of organic contamination in surface water could indicate that surface water concentrations and contaminant depositional processes have varied over time. This compound was not detected in sediments or other media during a 1993 investigation.

7.6.4 Conclusions

Releases of chlorinated ethenes from the landfill to the groundwater have occurred. Groundwater data from the current investigation are consistent with historical data and indicate that chlorinated ethenes are present in two downgradient monitoring wells located along the eastern side of the landfill. Chloroform was detected at a trace level, below quantitation limits, in the well located downgradient of the landfill; however, since this compound was not detected in previous investigations, the significance of a single detection at trace levels is questionable. No other organic compounds were detected in groundwater; however, the pattern of observed sediment contamination suggests that a more diverse variety of organic compounds is present at this site than is indicated by the results from groundwater monitoring alone.

Nitrobenzene was detected in one sediment sample at a low concentration. Sediment containing nitrobenzene may be subject to leaching to groundwater or surface water transport through erosional dispersion or leachate migration.

Concentrations of lead and arsenic were slightly greater in sample 04 SW 03 than those found in background surface water samples. The presence of elevated levels of aluminum (Al) suggests that suspended solids, rather than dissolved metals, represent a significant portion of the total metals in this sample. The corresponding sediment sample did not contain elevated levels of metals.

The presence of low-solubility species in the MW4-01, MW4-02, and MW4-05 groundwater samples (e.g., Al) suggests that the detected groundwater concentrations of barium, beryllium, iron, and zinc may represent suspended species. Of the metals present at elevated levels, only iron exhibited downgradient concentrations notably greater than levels found in upgradient wells.

7.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 4. The risk assessment was performed using the approach outlined in Section 2.4. Tables 7-11 through 7-13 provide the selected COPCs and representative concentrations of inorganics and organics in site-related sediment, groundwater, and surface water, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than the guideline target acceptable cancer risk range and greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 7.7.1.5 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

7.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential receptors, recreational receptors, and industrial receptors).

7.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 4 are 4.5E-05 (ingestion) and 1.1E-06 (dermal contact). The total groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or to formulate standards and criteria (ARARs). The principal COPCs contributing to the groundwater cancer risk are beryllium (ingestion, 53 percent of the cancer risk for this pathway; and dermal contact, 89 percent of the cancer risk for this pathway) and vinyl chloride (ingestion, 44 percent of the cancer risk for this pathway; and dermal contact, 11 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future industrial employee assuming exposure to COPCs in groundwater at Site 4 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic health effects are not expected when the HQs are less than 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial receptors exposed to groundwater at Site 4 in Tables 7-14 and 7-15, respectively.

TABLE 7-11
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ARSENIC	0.81	NONPARAMETRIC
BARIUM	10.8	NONPARAMETRIC
LEAD	9.3	NONPARAMETRIC
MANGANESE	24.2	NONPARAMETRIC
NITROBENZENE*	66	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

TABLE 7-12
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 4 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	2690	NONPARAMETRIC
BARIUM	580.96	NORMAL
BERYLLIUM	1.6	LOGNORMAL
CADMIUM	0.84	NONPARAMETRIC
COPPER	11.43	NORMAL
IRON	11849.29	NORMAL
LEAD	3	LOGNORMAL
ZINC	363.17	NORMAL
1,2-DICHLOROETHENE (TOTAL)	25	LOGNORMAL
CHLOROFORM	1	LOGNORMAL
TRICHLOROETHENE	29.78	NORMAL
VINYL CHLORIDE	3	LOGNORMAL

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TABLE 7-13
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE WATER - SITE 4 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	1220	NONPARAMETRIC
ARSENIC	4.6	NONPARAMETRIC
BARIUM	52.9	NONPARAMETRIC
BERYLLIUM	0.24	NONPARAMETRIC
CHROMIUM	3.94	NORMAL
COPPER	14.9	LOGNORMAL
IRON	16200	NONPARAMETRIC
LEAD	22.6	NONPARAMETRIC
MANGANESE	383	NONPARAMETRIC
MERCURY	0.28	NONPARAMETRIC
SILVER	1	NONPARAMETRIC
THALLIUM	8.3	LOGNORMAL
VANADIUM	9.7	NONPARAMETRIC
ZINC	35.4	NONPARAMETRIC
ALDRIN	0.0023	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE	26	NONPARAMETRIC
DIELDRIN	0.0008	NONPARAMETRIC

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TABLE 7-14
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 4
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A
CHLOROFORM	2.1E-08	2.1E-10
TRICHLOROETHENE	1.1E-06	2.2E-08
VINYL CHLORIDE	2.0E-05	1.1E-07
ALUMINUM	N/A	N/A
BARIUM	N/A	N/A
BERYLLIUM	2.4E-05	9.9E-07
CADMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	4.5E-05	1.1E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-15
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 4
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,2-DICHLOROETHENE (TOTAL)	2.7E-02	2.5E-04
CHLOROFORM	9.8E-04	9.6E-06
TRICHLOROETHENE	4.9E-02	9.2E-04
VINYL CHLORIDE	N/A	N/A
ALUMINUM	2.6E-02	2.2E-04
BARIUM	8.1E-02	8.3E-04
BERYLLIUM	3.1E-03	1.3E-04
CADMIUM	1.6E-02	1.3E-04
COPPER	2.8E-03	1.9E-06
IRON	3.9E-01	3.2E-03
LEAD	N/A	N/A
ZINC	1.2E-02	1.9E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

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7.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 3. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of these risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 7.7.1.4 and presented in Tables 7-16, 7-16a, 7-17, 7-17a.

7.7.1.3 Future Recreational Receptor

The estimated individual total cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 4 are 1.3E-08 (ingestion) and 5.6E-10 (dermal contact). The cancer risks for exposure to COPCs in surface water during wading at Site 4 are 9.2E-08 (ingestion) and 1.2E-07 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range. This surface water cancer risk is also below the 1E-04 to 1E-06 target acceptable risk range.

The estimated noncarcinogenic HQs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 4 are less than 1.0 for ingestion and dermal contact exposure pathways.

The estimated noncarcinogenic HQs for exposure to COPCs in surface water during wading at Site 4 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic health effects are not anticipated when the HQs are below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented in Tables 7-18 and 7-19, respectively, for future recreational receptors exposed to sediment at Site 4. Estimated carcinogenic risks and noncarcinogenic HQs are presented in Tables 7-20 and 7-21, respectively, for future recreational receptors exposed to surface water at Site 4.

7.7.1.4 Lead Results

Lead was found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken in previous investigations but was not found at levels exceeding the EPA action level during the 1995 RI. Lead surface water concentrations were greater than the EPA guideline range; however, this would not adversely affect the future recreational receptor exposed to surface water because of very low ingestion rates (based on volume ingested per event and exposure frequency).

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for background and Site 4 exposures are presented in Appendix I.

TABLE 7-16
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 4
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
CHLOROFORM	9.1E-08	6.6E-09	1.2E-06
TRICHLOROETHENE	4.9E-06	6.9E-07	2.6E-06
VINYL CHLORIDE	8.5E-05	3.4E-06	1.7E-05
BARIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
TOTAL RISK	9.0E-05	4.1E-06	2.1E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-16a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 4
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
CHLOROFORM	1.3E-08	1.1E-09	6.7E-08
TRICHLOROETHENE	7.0E-07	1.1E-07	1.5E-07
VINYL CHLORIDE	1.2E-05	5.4E-07	1.0E-06
BARIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
TOTAL RISK	1.3E-05	6.5E-07	1.2E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-17
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 4
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN								
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHENE (TOTAL	1.8E-01	1.8E-01		1.8E-01					9.7E-03	N/A
CHLOROFORM	6.4E-03		6.4E-03	6.4E-03					3.7E-04	N/A
TRICHLOROETHENE	3.2E-01	3.2E-01				3.2E-01			3.5E-02	N/A
VINYL CHLORIDE	N/A			N/A		N/A			N/A	N/A
BARIUM	5.3E-01	5.3E-01			5.3E-01		5.3E-01	5.3E-01	2.6E-02	N/A
IRON	2.5E+00			2.5E+00	2.5E+00				9.8E-02	N/A
	HI BY TARGET ORGAN	1.0E+00	6.4E-03	2.7E+00	3.1E+00	3.2E-01	5.3E-01	5.3E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-17a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 4
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHENE (TOTAL	3.5E-02	3.5E-02		3.5E-02					2.8E-03	N/A
CHLOROFORM	3.0E-03		3.0E-03	3.0E-03					2.4E-04	N/A
TRICHLOROETHENE	1.5E-01	1.5E-01				1.5E-01			2.4E-02	N/A
VINYL CHLORIDE	N/A			N/A		N/A			N/A	N/A
BARIUM	2.5E-01	2.5E-01			2.5E-01		2.5E-01	2.5E-01	1.7E-02	N/A
IRON	1.2E+00			1.2E+00	1.2E+00				6.6E-02	N/A
	HI BY TARGET ORGAN	4.3E-01	3.0E-03	1.2E+00	1.4E+00	1.5E-01	2.5E-01	2.5E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-18
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 4
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
NITROBENZENE	N/A	N/A
ARSENIC	1.3E-08	5.6E-10
BARIUM	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
TOTAL RISK	1.3E-08	5.6E-10

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-19
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 4
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
NITROBENZENE	1.7E-05	4.0E-06
ARSENIC	3.5E-04	1.4E-05
BARIUM	2.0E-05	2.0E-05
LEAD	NA	NA
MANGANESE	6.2E-04	8.2E-04

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-20
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 4
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALDRIN	4.3E-10	4.2E-10
BIS(2-ETHYLHEXYL)PHTHALATE	4.0E-09	9.6E-08
DIELDRIN	1.4E-10	1.5E-09
ALUMINUM	N/A	N/A
ARSENIC	7.6E-08	3.7E-09
BARIUM	N/A	N/A
BERYLLIUM	1.1E-08	5.3E-08
CHROMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	9.1E-08	1.5E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 7-21
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 4
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALDRIN	9.8E-06	9.7E-06
BIS(2-ETHYLHEXYL)PHTHALATE	1.7E-04	4.0E-03
DIELDRIN	2.0E-06	2.2E-05
ALUMINUM	1.6E-04	1.5E-04
ARSENIC	2.0E-03	9.6E-05
BARIUM	9.7E-05	1.1E-04
BERYLLIUM	6.1E-06	2.9E-05
CHROMIUM	1.0E-04	2.3E-04
COPPER	4.8E-05	3.7E-06
IRON	6.9E-03	6.4E-03
LEAD	N/A	N/A
MANGANESE	9.8E-03	1.5E-02
MERCURY	1.2E-04	7.9E-05
SILVER	2.6E-05	6.0E-06
THALLIUM	1.3E-02	1.2E-02
VANADIUM	1.8E-04	8.2E-04
ZINC	1.5E-05	2.8E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

7.7.1.5 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 4 for future residential receptors assuming exposure to COPCs in groundwater.

Comparison to Background

Aluminum, beryllium, cadmium, copper, lead, and zinc were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 7-7 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

As discussed in Section 2.4.6.2, groundwater cancer and non-cancer risks were recalculated for future residential receptors. After these steps, the final RME cancer risks are approximately 1E-04, the upper end of the 1E-04 to 1E-06 target acceptable risk range. Vinyl chloride (via ingestion of groundwater and inhalation while showering) is the principal COPC contributing to the total RME cancer risk for the future residential receptor. Estimated RME carcinogenic risks are presented for future residential receptors exposed to groundwater at Site 4 in Table 7-16.

Consideration of Target Organ Grouping

The revised HIs are greater than 1.0 for exposure to groundwater by future residential child receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are greater than 1.0 in certain cases. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: digestive system (3.1 - iron and barium) and liver (2.7 - iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. RME noncarcinogenic risks are presented for future residential receptors exposed to groundwater at Site 4 in Table 7-17.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate cancer and non-cancer risks for exposure to COPCs in groundwater for future residential receptors. 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. Based on this evaluation, the estimated total central tendency cancer risks are within the mid-range of the target acceptable risk range; however, the noncarcinogenic HI is greater than 1.0 for some target organs. For groundwater ingestion by the future residential child, a central tendency HI of 1.2 was calculated for the liver and a value of 1.4 for the digestive system (chiefly attributable to iron in both cases). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic and noncarcinogenic risks are presented for exposure to groundwater for future residential receptors in Tables 7-16a and 7-17a, respectively.

7.7.2 Conclusions

Sediment, groundwater, and surface water were sampled at Site 4. The potential receptors considered for this site were future industrial, residential, and recreational receptors. The RME cancer risk associated with the future residential (groundwater) exposure scenario was approximately 1E-04, the upper end of the target acceptable risk range. However, the RME estimate for the future residential receptor is probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range. Vinyl chloride (via ingestion of groundwater and inhalation during showering) was the major COPC that contributed to the cancer risk for this exposure scenario.

RME estimates for noncarcinogenic HIs associated with the future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Iron and barium (both via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for this exposure scenario. Central tendency risk estimates for residential exposure to groundwater yielded also yielded HIs greater than 1.0 for the same target organs and COPCs.

Lead groundwater concentrations at the site were below EPA guidelines. These lead concentrations are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99). Lead surface water concentrations were greater than the guideline range; however, this would not adversely affect the future recreational receptor exposed to surface water because of very low ingestion rates.

Risk characterization results (total RME cancer risks and total RME noncarcinogenic HIs) are presented for all potential receptors at Site 4 in Table 7-22 for sediment, groundwater, and surface water. Table 7-22a presents the relevant central tendency risk estimates associated with future residential receptors for groundwater.

The amended risk assessment procedure did not result in the elimination of all cancer and non-cancer risks above guideline limits. Iron by groundwater ingestion remained with an HQ slightly above one.

TABLE 7-22
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 4
NWS EARLE, COLTS NECK, NEW JERSEY

Medium	Exposure Routes	Estimated Incremental Cancer Risk				Estimated Hazard Index***				
		Current Industrial Employee	Future Industrial Employee	Future Lifetime Resident	Future Recreational Child	Current Industrial Employee	Future Industrial Employee	Future Resident Child	Future Resident Adult	Future Recreational Child
Surface Soil	Incidental Ingestion	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Dermal Contact	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
Subsurface Soil	Incidental Ingestion	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Dermal Contact	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	1.3E-08	N/A	N/A	N/A	N/A	1.0E-03
	Dermal Contact	N/A	N/A	N/A	5.6E-10	N/A	N/A	N/A	N/A	8.6E-04
Groundwater	Ingestion	N/A	4.5E-05	9.0E-05^	N/A	N/A	6.0E-01	3.1E+00@	N/A	N/A
	Dermal Contact	N/A	1.1E-06	4.1E-06^	N/A	N/A	5.7E-03	1.7E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	2.1E-05^	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	9.1E-08	N/A	N/A	N/A	N/A	3.3E-02
	Dermal Contact	N/A	N/A	N/A	1.5E-07	N/A	N/A	N/A	N/A	4.0E-02
TOTAL		-	4.6E-05	1.2E-04	2.6E-07	-	6.1E-01	3.3E+00	-	7.4E-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 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
^ - Value from amended risk assessment
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

TABLE 7-22a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 4
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	N/R	1.3E-05^	N/A	N/A	N/R	1.4E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	6.5E-07^	N/A	N/A	N/R	1.1E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	1.2E-06^	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		-	-	1.5E-05	-	-	-	1.5E+00	-	-

N/A = Not applicable because this media is not associated with this potential receptor
N/S = Not sampled
N/R = Central Tendency calculation not required
* = During Showering, Adult Residents Only
** = 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
^ - Value from amended risk assessment
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

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7.8 ECOLOGICAL RISK ASSESSMENT

7.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

The 5-acre landfill proper is located on top of a small hill. Although a few bare areas are present on the landfill, some upland vegetation is present, which is dominated by pitch pine. Some bare areas on the landfill contain exposed debris, such as metal wastes. As stated in Section 7.1, the area slopes down approximately 20 feet in elevation in a southeastward direction from the northwestern portion of the landfill to the dirt road east of the landfill. As a result, surface water from the landfill drains in an east/southeast direction to wetlands immediately east and southeast of the landfill area, mainly via a small stream that exits the site to the east. The pitch pine areas grade quickly into the wetland, which is bordered by a fringe of red maple. The interior of the wetland is characterized as a Phragmites marsh with saturated Atsion sand soils. The wetland is drained by a branch of Hockhockson Brook. Hence, Site 4 is located in the Hockhockson Brook Watershed. Lake Earle, a small, man-made impoundment, is located 300 feet north of the landfill. The habitat adjacent to Lake Earle is dominated by sweetgum, wax myrtle, and blueberry.

Terrestrial habitat on the landfill is limited in quantity and quality, and the adjacent uplands and wetlands provide excellent habitat for semi-aquatic and terrestrial receptors. Upland areas and "edge areas," areas where various habitat types meet, on and near the site provide habitat for many upland mammals, such as white-tailed deer, red fox, and small mammals. The interior of the upland areas also provides habitat for the gray fox. The wetlands contain low water levels and areas that are intermittently dry, precluding the existence of an extensive aquatic community. However, these areas provide excellent habitat for semi-aquatic receptors, such as amphibians and small fish, and aquatic invertebrates. Lake Earle provides excellent habitat for aquatic receptors and contains several species of fish. Waterfowl and wading birds also may utilize the lake. No threatened or endangered species or sensitive habitats, other than wetlands, are known to occur on or near Site 4.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The potential contaminant release pathways from the landfill are overland runoff/erosion and infiltration of contaminants. Overland runoff from precipitation may carry constituents to the adjacent wetlands as a result of site topography. It is unlikely that Lake Earle receives any contaminant inputs from the landfill via overland runoff/erosion since surface drainage from the landfill is to the east/southeast, and Lake Earle is located 300 feet to the north. However, contaminant migration into wetland surface waters and sediments of the Hockhockson Brook Watershed is possible. In addition to overland runoff as a potential migration pathway, infiltrating precipitation may cause the contamination of subsurface soil and

groundwater. Upon infiltrating the soil column and reaching the water table, contaminants may be carried with the flow of groundwater to downgradient locations. Groundwater from the site flows toward the wetlands east and southeast of the landfill and may eventually discharge to surface water (some seeps are evident in this area); contaminants may be subsequently deposited in wetland sediments and can accumulate in the tissues of semi-aquatic organisms inhabiting the wetlands. Contaminated groundwater discharge to Lake Earle is unlikely since Lake Earle is located 300 feet due north of the northern edge of the landfill, and groundwater flow associated with landfill is to the east/southeast.

Exposure Routes

Terrestrial receptors at Site 4 may be exposed to contaminants via incidental ingestion of surface soil, or ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants present in Site 4 wetlands by using them for drinking, although this pathway is generally insignificant. Terrestrial vegetation in the upland areas may also be exposed to contaminants in soils at Site 4. However, since the wetlands provide substantially more extensive and more viable habitat than the uplands on the landfill, the contaminant exposure routes of main concern are aquatic. Therefore, evaluation of contaminant exposure routes for terrestrial plants and animals at Site 4 was not applicable. Aquatic or semi-aquatic organisms inhabiting the nearby wetlands may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated prey. Aquatic organisms may also be exposed to constituents from contaminated groundwater flowing into surface water.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

All contaminants detected during the 1986 SI and in 1993 RI/FS activities for this site were considered preliminary COPCs for qualitative assessment. All contaminants detected during more recent 1995 RI activities were considered preliminary COPCs for quantitative assessment, as described in Section 7.8.2.1 below. In particular, contaminants detected in Site 4 surface water and sediments were considered preliminary COPCs.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

7.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential risks to ecological receptors from contaminants in surface water and sediments. Surface water and sediment ET values are presented in Tables 2-28 and 2-29, respectively.

7.8.3 Preliminary Exposure Assessment

Representative exposure point contaminant concentrations in surface water and sediment used for this initial screening were obtained from RI surface water and sediment data generated during the summer and fall of 1995. The maximum detected contaminant concentrations in surface water and sediment were conservatively used as representative exposure point concentrations. Data from 1986 SI and 1993 RI/FS surface water and sediment samples were not used quantitatively since those samples contained mostly non-detects and the elevated contaminant concentrations that were present were detected in only in one sample. However, the results of the 1986 SI and 1993 RI/FS surface water and sediment sampling are discussed in detail in Section 7.8.3, below. Background concentrations were used in this ERA for qualitative comparison to representative exposure point concentrations, and are the maximum values detected in facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

7.8.4 Risk Characterization

For inorganics in Site 4 surface waters, aluminum (HQ = 14.02), barium (HQ = 13.56), copper (HQ = 1.35), lead (HQ = 9.04), manganese (HQ = 4.79), silver (HQ = 83.3), and thallium (HQ = 2.08) exceeded ET values and were retained as final COPCs (Table 7-23). No organics in surface water had HQs greater than one. In sediments, no constituents exceeded ET values (Table 7-24). Aluminum and vanadium were conservatively retained as final COPCs since no suitable ET values were available. The toxicological properties of all final COPCs in surface water and sediment are summarized in Appendix M.

7.8.5 Summary and Conclusions

Limited upland habitat exists on the site, but wetland habitats adjacent to the landfill are more extensive and are considered more sensitive. Overland runoff/erosion of contaminants from the landfill area to the wetlands is possible, as is migration into the Hockhockson Brook Watershed. Groundwater cannot be assessed quantitatively from an ecological standpoint, but potential groundwater contaminant inputs to the wetland areas are possible. If contaminants have reached surface water via groundwater, they will be accounted for in the evaluation of wetland surface water and sediments. Hence, aquatic habitats were the

TABLE 7-23

SURFACE WATER CONTAMINANTS OF POTENTIAL CONCERN - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentation (ug/L)	Representative Concentration (ug/L)	Ecotox Threshold (ug/L)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	4/4	409.0	1220.00	87.00	14.02	Retained-HQ > 1
Arsenic	2/4	ND	4.60	190.00	0.02	Eliminated-Does not exceed threshold
Barium	4/4	34.0	52.90	3.90	13.56	Retained-HQ > 1
Beryllium	2/4	0.33	0.24	5.10	0.05	Eliminated-Does not exceed threshold
Chromium	2/4	2.6	3.94	10.00	0.39	Eliminated-Does not exceed threshold
Cobalt	2/4	1.9	1.10	3.00	0.37	Eliminated-Does not exceed threshold
Copper	3/4	9.8	14.90	11.00	1.35	Retained-HQ > 1
Lead	3/4	4.4	22.60	2.50	9.04	Retained-HQ > 1
Manganese	4/4	55.5	383.00	80.00	4.79	Retained-HQ > 1
Mercury	4/4	0.028	0.28	1.30	0.22	Eliminated-Does not exceed threshold
Nickel	3/4	7.1	4.40	160.00	0.03	Eliminated-Does not exceed threshold
Silver	1/4	0.86	1.00	0.01	83.33	Retained-HQ > 1
Thallium	1/4	5.5	8.30	4.00	2.08	Retained-HQ > 1
Vanadium	3/4	0.9	9.70	19.00	0.51	Eliminated-Does not exceed threshold
Zinc	3/4	29.4	35.40	100.00	0.35	Eliminated-Does not exceed threshold
Organics						
Aldrin	1/1	ND	0.0023	0.30	0.00	Eliminated-Does not exceed threshold
Bis(2-ethylhexyl)phthalate	1/1	ND	26.00	32.00	0.81	Eliminated-Does not exceed threshold
Dieldrin	1/1	ND	0.008	0.06	0.01	Eliminated-Does not exceed threshold

ND = Not Detected

TABLE 7-24

SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 4

NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentation (mg/kg)	Representative Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	1/1	3940.0	1030.0	NA		Retained-No suitable threshold available
Arsenic	1/1	6.2	0.81	8.20	0.10	Eliminated-Does not exceed threshold
Barium	1/1	10.6	10.8	40.0	0.27	Eliminated-Does not exceed threshold
Chromium	1/1	56.0	1.8	81.0	0.02	Eliminated-Does not exceed threshold
Copper	1/1	13.0	1.6	34.0	0.05	Eliminated-Does not exceed threshold
Lead	1/1	34.3	9.3	47.0	0.20	Eliminated-Does not exceed threshold
Manganese	1/1	9.2	24.2	460.0	0.05	Eliminated-Does not exceed threshold
Vanadium	1/1	42.7	3.0	NA		Retained-No suitable threshold available
Zinc	1/1	26.9	4.4	150.0	0.03	Eliminated-Does not exceed threshold
Organics*						
Nitrobenzene	1/1	ND	66.0	8000.0	0.00	Eliminated-Does not exceed threshold

NA = No suitable benchmark was available

* nitrobenzene values are in ug/kg

focus of this assessment. Consequently, exposure routes of main concern are for aquatic and semi-aquatic receptors that potentially inhabit the wetland areas. Contaminant inputs to Lake Earle are not considered likely since surface drainage and groundwater do not flow toward the lake.

Two surface water samples were collected in the wetlands southeast of the site as part of the Site 4 SI study. Only N-nitrosodiphenylamine was identified in the samples. Four surface water and four sediment samples were taken as part of 1993 RI/FS work at Site 4. Sampling locations were located in the wetlands area and in the drainage area that runs along the southeastern edge of the site to investigate possible contaminant runoff or groundwater to surface water migration from the landfill. The surface water samples were analyzed for VOCs and TPH. The only VOCs detected were also present in blank samples, and no TPH was detected. Sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and organics. Of these four sediment samples, one was collected closest to the landfill, in the drainageway at the landfill's southern edge, west of the wetlands. This area receives much of the runoff from the landfill, although aquatic habitat is limited at the sampling location. This sample contained elevated levels of iron, chromium, cadmium, lead, and the PCB mixture Aroclor 1260. However, these contaminants were either not detected or were present at much lower concentrations in the next sample downstream, which was taken in the wetlands. The sediment samples taken farthest from the site, also in the wetlands, contained non-detects for all organics, non-detects for most inorganics, and low levels of the inorganics detected. These data suggest a lack of significant contaminant migration from the landfill to the wetlands.

The four surface water samples and one sediment sample taken as part of 1995 RI samples supplemented the 1993 samples. Groundwater samples were also collected. All the surface water samples were taken in the wetlands east of the landfill to confirm whether or not contaminants have migrated downgradient. The sediment sample was taken at a location in the wetlands likely to receive the greatest amount of runoff from the landfill. These 1995 RI samples were used to obtain representative exposure point concentrations. Some inorganics had HQs greater than one in Site 4 surface waters and had high frequencies of detection. However, the HQs for these contaminants were indicative of relatively low potential risk, with the exception of silver, which had an HQ indicative of relatively high potential risk. Nonetheless, silver was detected in only one sample and was present only slightly above background in that sample. The elevated HQ value is most likely more a function of the only ET available for this inorganic, which appears to be excessively conservative when compared to background concentrations of silver in various data sets. The potential for a cumulative toxic effect may exist for these metals, but such an effect is unlikely at the relatively low concentrations present. No contaminants in sediments were found to pose any risk to ecological receptors, and no COPCs in surface water exceeded ET values in sediments. Moreover, the organics detected in groundwater were not detected in wetland surface water or sediments. Aluminum and vanadium were conservatively retained as final COPCs in sediments since no suitable ET values were available, but both of these inorganics were detected at low concentrations that were below background.

The results of this screening, combined with the results of the 1986 SI and 1993 RI/FS study, indicate that contaminant concentrations in surface water and sediments in the wetlands area are relatively low, as are the associated potential ecological risks. Contaminants do not appear to be significantly migrating to surface water and sediment in the wetlands via overland runoff and/or groundwater to surface water discharge. Significant contaminant inputs from future discharge are unlikely since the landfill has been inactive since 1960 and any effects of discharge would most likely have already occurred. As a result, contaminant inputs into the Hockhockson Brook Watershed from Site 4 also appear to be negligible. For these reasons, contaminants at Site 4 appear to pose no significant potential risks to ecological receptors on or around the site and, therefore, further ecological study based on ecological risk concerns is not indicated. Remediation at Site 4 based on ecological concerns appears unnecessary, although additional cover material (soil) placed on the areas of exposed debris could help facilitate plant growth, expedite primary succession, minimize erosion, and improve the appearance of the landfill.

7.9 EVALUATION AND RECOMMENDATIONS

7.9.1 Evaluation Summary

Metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included aluminum, iron, and manganese.

Organic compounds found in groundwater at concentrations above regulatory guidelines include 1,2-dichloroethene and trichloroethene. These compounds were also found in previous investigations. Migration of VOCs to deeper aquifer levels was investigated during the 1995 RI by hydropunch techniques and found to be not occurring. After significant investigation, over more than a decade, no concentrated source of VOCs has been found. It is unlikely that a concentrated source of VOC contamination exists in the former disposal material.

Samples taken from surface water and sediment contain a variety of compounds at concentrations below human health risk levels.

Results of human health risk assessment concluded that calculated non-cancer risks were above guideline limits for ingestion of groundwater.

Ecological risk assessment concluded that contaminants do not appear to be significantly migrating to surface water and sediment in the wetlands via overland runoff and/or groundwater to surface water discharge at a level of ecological concern. Significant contaminant inputs from future discharge are unlikely since the landfill has been inactive since 1960 and any effects of discharge would most likely have already occurred. Contaminant inputs to Lake Earle are not considered likely since surface drainage and groundwater do not flow toward the lake.

7.9.2 Recommendations

EPA guidance "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 the disposition of this site.

8.0 SITE 5: LANDFILL WEST OF ARMY BARRICADES

8.1 SITE BACKGROUND AND PHYSICAL SETTING

The landfill west of the Army Barricades is a 13-acre site that was used from 1968 to 1978 for the disposal of domestic and industrial wastes. The majority of the waste was domestic waste, consisting of paper, glass, and plastics. Industrial wastes consisted of wood, pesticide containers, pesticide, rinsewaters, and discarded containers of paint, paint thinner, solvents, varnishes, shellacs, acids, alcohols, caustics, and small amounts of asbestos. Figure 8-1 is a map of the site.

The site is characterized as an open area moderately vegetated with grasses and scrub pines and surrounded by woodlands. A narrow forested wetland is located to the west along the railroad tracks. A loose sand from the surrounding area was used as the cover material. An impermeable cap was not used for closure. The site is located approximately 1,000 feet southwest of Site 2 (Active Ordnance Demilitarization Site) and is accessible via a dirt road along the northwestern border. Railroad tracks run along the southwestern boundary, and the wetland is located to the west between the dirt access road and the railroad tracks. Topography across the site slopes gently to the southwest from approximately 115 feet to 105 feet above MSL. Groundwater flow is generally to the northeast (at a slight gradient), based on measured groundwater levels.

8.2 PREVIOUS INVESTIGATIONS

8.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site observations. Based on the potential for groundwater impacts and the documented disposal of industrial wastes, the site was recommended for a confirmation study.

During the 1986 SI, four monitoring wells were installed at the site. During the 1993 RI/FS, four test pits were excavated and four additional monitoring wells were installed. The test pits were excavated to characterize the wastes that had been disposed at the site. A layer of trash, ranging in thickness from 6 to 13 feet, was encountered in all four test pits. The trash consisted of foam rubber, glass, paper, plastic, metal scrap materials, lumber, concrete, bricks, and other construction debris. The cover material was thin to non-existent. Groundwater was not encountered in the test pits. Elevated organic vapor readings (HNu) were detected in one of the four test pits (TP5-1). Two soil samples were analyzed for full TCL/TAL analytes, and low levels of metals, semivolatiles, volatiles, and one pesticide were detected.

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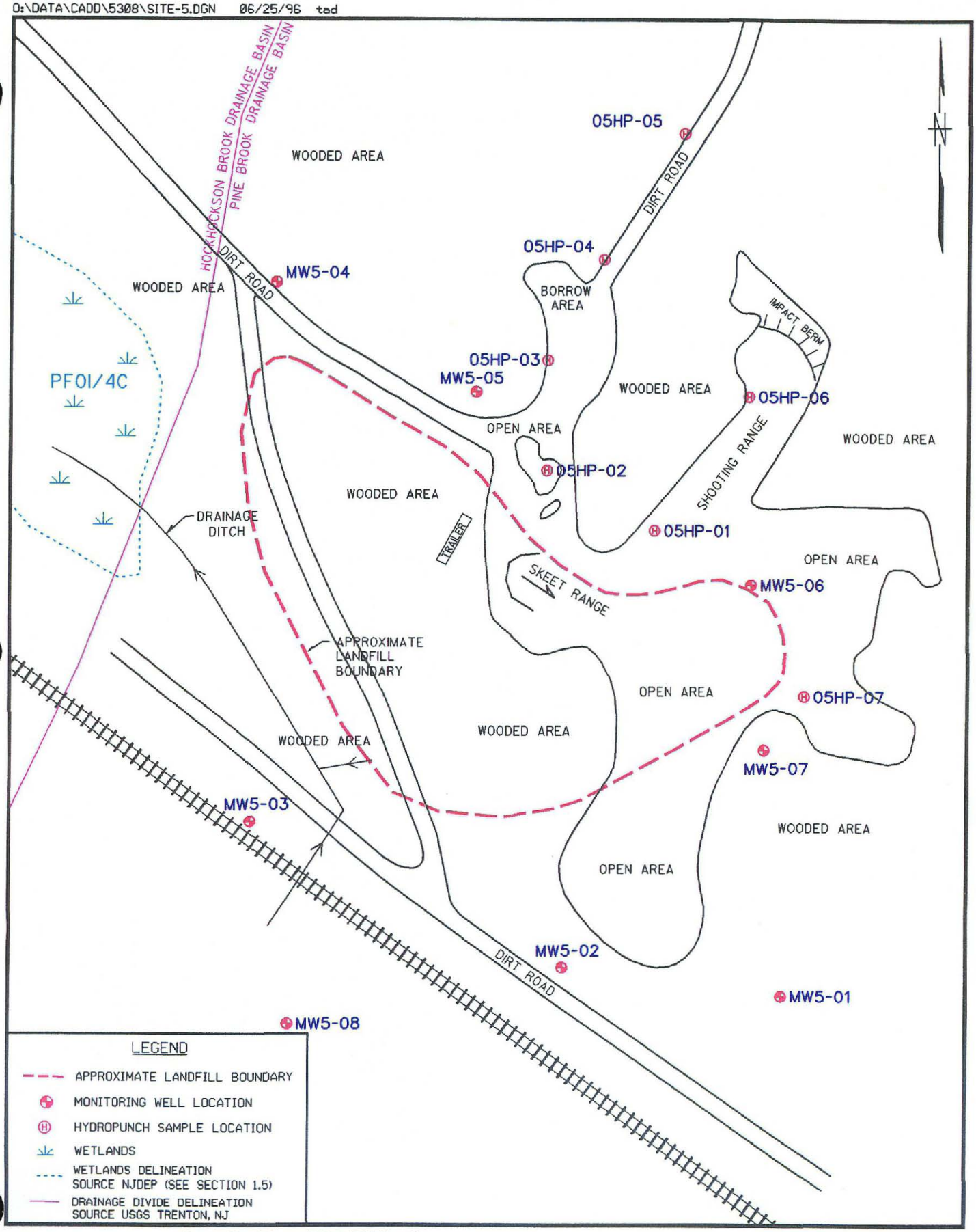


SAMPLE LOCATIONS

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

FIGURE 8-1

0 150 300

SCALE IN FEET

Brown & Root Environmental

Groundwater samples were collected from all SI and RI/FS wells during the 1993 RI/FS and analyzed for TCL/TAL analytes, cyanide, VOCs, drinking water metals, and landfill indicator parameters. Chloroform was detected in wells MW5-04 and MW5-08 (an upgradient well). Other contaminants of concern were beryllium, chromium, cadmium, and, to a lesser extent, lead, which was detected in several wells. Lead and chromium were highest in MW5-06. VOCs including dichloroethene (DCE), TCE, and benzene were also detected in MW5-06. Results of samples from the landfill parameters indicated elevated levels of sulfate. No distinction was made between the upgradient well (MW5-08) and downgradient wells for other landfill parameters.

8.2.2 Summary of Conclusions

Low levels of metals and volatile organic compounds were found in groundwater. The RI test pits encountered mostly trash and construction debris. Subsurface soils had elevated levels of xylene, toluene, and chromium.

The wetlands west of the site were not sampled because groundwater flows to the northeast and overland flow from the landfill area is negligible. Most of the flow to the wetlands comes through a drainage pipe from the south side of the railroad tracks. A lesser amount of runoff does come from ponding along the access road.

8.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Sample existing wells using low-flow technique to determine if metals concentrations in previous samples were due to turbidity.
- Compare data to background levels and risk-based criteria.
- Sample additional downgradient groundwater to determine lateral extent of impact.

8.3 RI FIELD INVESTIGATION

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

- Sampling and analysis of groundwater samples from seven hydropunch locations (Section 8.3.1).

- Sampling and analysis of groundwater from eight existing monitoring wells (Section 8.3.2).

- Measurement of static-water levels in the wells (Section 8.3.2).

A survey was conducted to establish the horizontal locations and vertical elevations of the hydropunch sample locations and selected existing wells. Surveying notes are provided in Appendix F.

8.3.1 Hydropunch Groundwater Sampling

B&R Environmental collected seven hydropunch groundwater samples (05 HP 01 through 05 HP 07) in June 1995 to determine lateral extent of groundwater impact downgradient of the landfill and to locate additional monitoring wells if required. Figure 8-1 shows sampling locations.

B&R Environmental submitted the seven groundwater samples (05 HP 01 through 05 HP 07) to Lancaster Laboratories for quick-turnaround TCL VOC analysis. Table 8-1 summarizes the hydropunch data. Table 8-2 contains the unvalidated hydropunch sample analyses results. Sample logs are provided in Appendix D.

Hydropunch analytical data were used for field screening purposes to determine lateral extent of groundwater impact downgradient of the landfill. Based on the results of hydropunch sampling and analysis, it was decided that no additional monitoring wells would be installed during this RI field program because existing wells were deemed sufficient to characterize groundwater lateral contamination.

8.3.2 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of water-level measurements was collected on August 7, 1995 and the second on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) and recorded to the nearest 0.01 foot.

Water-table elevations ranged from approximately 88.97 to 90.68 feet above MSL during the first round of measurements and from approximately 87.89 to 89.51 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 8-3. Monitoring well characteristics are summarized in Table 8-3a.

Table 8-1
Site 5 Hydropunch Groundwater Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Hydropunch Sample Number	Total Depth[1] (feet)	Ground Surface Elevation[2]	Approximate Depth to Water[1] (feet)	Screened Interval Depth[1] (feet)
05 HP 01	25	112.1	22.4	22 to 25
05 HP 02	25	111.1	21.5	22 to 25
05 HP 03	25	109.6	19.5	22 to 25
05 HP 04	25.5	113.2	22	22.5 to 25.5
05 HP 05	26	109.5	21.6	23 to 26
05 HP 06	25	113.6	24	22 to 25
05 HP 07	25	112.2	22	22 to 25

(1) In feet below grade; reading obtained during hydropunch installation.
(2) In feet above mean sea level.

Table 8-2
Landfill West of Army Barricades
Hydropunch Groundwater Analysis
Analytical Results (Not Validated)

VOLATILE ORGANICS	CRQL	05 HP 03 (25 Feet) Sample Results UG/L	05 HP 04 (25.5 Feet) Sample Results UG/L	05 HP 05 (26 Feet) Sample Results UG/L	
CHLOROETHANE	10	2 J			
ACETONE	10	10 U	10 U	10 U	
1,2-DICHLOROETHENE (TOTAL)	10	3 J			
BENZENE	10	5 J			
CHLOROBENZENE	10	4 J			
ETHYLBENZENE	10	24			
XYLENE (TOTAL)	10	75			

VOLATILE ORGANICS	CRQL	05 HP 06 (25 Feet) Sample Results UG/L	05 HP 07 (25 Feet) Sample Results UG/L	05 HP 01 (25 Feet) Sample Results UG/L	05-HP-02 (25 Feet) Sample Results UG/L
ACETONE	10	10 U	10 U	10 U	31 U
METHYLENE CHLORIDE	10		2 J	2 J	1 J
1,2-DICHLOROETHENE (TOTAL)	10	4 J	1 J	7 J	1 J
BENZENE	10	1 J	1 J	4 J	2 J
TRICHLOROETHENE	10		2 J		
TOLUENE	10	1 J			7 J
VINYL CHLORIDE	10			1 J	4 J
CHLOROBENZENE	10			13	3 J
CHLOROETHANE	10				1 J
XYLENE (TOTAL)	10				1 J

NOTE: DATA IN THIS TABLE HAS NOT BEEN VALIDATED BECAUSE THE USE OF THE DATA WAS FOR FIELD SCREENING ONLY

U -- NOT DETECTED RESULT (DETECTION/QUANTITATION LIMIT LISTED)

J -- POSITIVE VALUE IS ESTIMATED AND LESS THAN QUANTITATION LIMIT

Table 8-3
Site 5 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1]	Top of PVC Riser[2] (feet)	Elevation of Water Table[2]
MW5-01	18.03	107.64	89.61	19.16	107.64	88.48
MW5-02	22.73	112.83	90.10	23.85	112.83	88.98
MW5-03	18.46	108.65	90.19	19.59	108.65	89.06
MW5-04	15.55	104.52	88.97	16.63	104.52	87.89
MW5-05	21.72	110.92	89.20	22.80	110.92	88.12
MW5-06	27.07	116.15	89.08	28.10	116.15	88.05
MW5-07	23.44	112.84	89.40	24.51	112.84	88.33
MW5-08	18.49	109.17	90.68	19.66	109.17	89.51

(1) In feet below grade
(2) In feet above mean sea level

Table 8-3a
Site 5 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW5-01	29	NS	107.64	NS	4	14 - 29	12 - 29	2/20/86
MW5-02	28	NS	112.83	NS	4	13 - 28	11 - 28	1/21/86
MW5-03	32	NS	108.65	NS	4	17 - 32	15 - 32	3/3/86
MW5-04	27	NS	104.82	NS	4	12 - 27	10 - 27	2/19/86
MW5-05	28.50	109.15	110.92	116.29	4	13.5 - 28.5	12 - 29[3]	1/18/91
MW5-06	33	114.86	116.15	NS	4	18 - 33	17 - 33.5[3]	1/23/91
MW5-07	29	110.83	112.84	NS	4	14 - 29	12 - 29	1/24/91
MW5-08	24.5	107.19	109.17	NS	4	9 - 24.5	7 - 25[3]	2/13/91

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.
(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.
NS Not surveyed.

Groundwater Sampling

B&R Environmental collected groundwater samples from the eight existing monitoring wells (MW5-01 through MW5-08) located at Site 5. The groundwater samples were analyzed to determine the groundwater quality upgradient and downgradient of the landfill and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. The eight existing wells were sampled in July 1995; however, MW5-08 (05 GW 08) was sampled two times for BOD analysis because the original samples' holding time for BOD analysis was missed. Field measurements collected during purging were pump rate (L/min), water-level, Ph, conductivity, temperature, turbidity, dissolved oxygen, and salinity.

Prior to sampling, B&R Environmental purged the wells using the micro-purge protocol to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purging and sampling processes.

The eight groundwater samples (05 GW 01 through 05 GW 08) were submitted to Lancaster Laboratories for TCL VOC, TAL metals, turbidity, chloride, sulfates, nitrite/nitrate, BOD, TOC, COD, phosphate, and ammonia analyses. Sample log sheets are presented in Appendix D.

8.4 SITE CHARACTERISTICS

8.4.1 Geology

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

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

8.4.2 Hydrogeology

Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 8-3. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 8-2 and 8-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

Based upon the boring log descriptions, well MW5-06 is screened in the Kirkwood Formation, wells MW5-02 and MW5-03 are screened across the contact between the Kirkwood and Vincentown Formations, and wells MW5-01, MW5-04, MW5-05, MW-07 and MW5-08 are screened in the Vincentown Formation. The hydraulic conductivities calculated for MW5-02 (Kirkwood and Vincentown Formation), MW5-06 (Kirkwood Formation), and MW5-07 (Vincentown Formation) are 3.18×10^{-4} cm/sec (0.90 ft/day), 6.46×10^{-4} cm/sec (1.83 ft/day), and 2.08×10^{-4} cm/sec (0.59 ft/day), respectively.

8.5 NATURE AND EXTENT OF CONTAMINATION

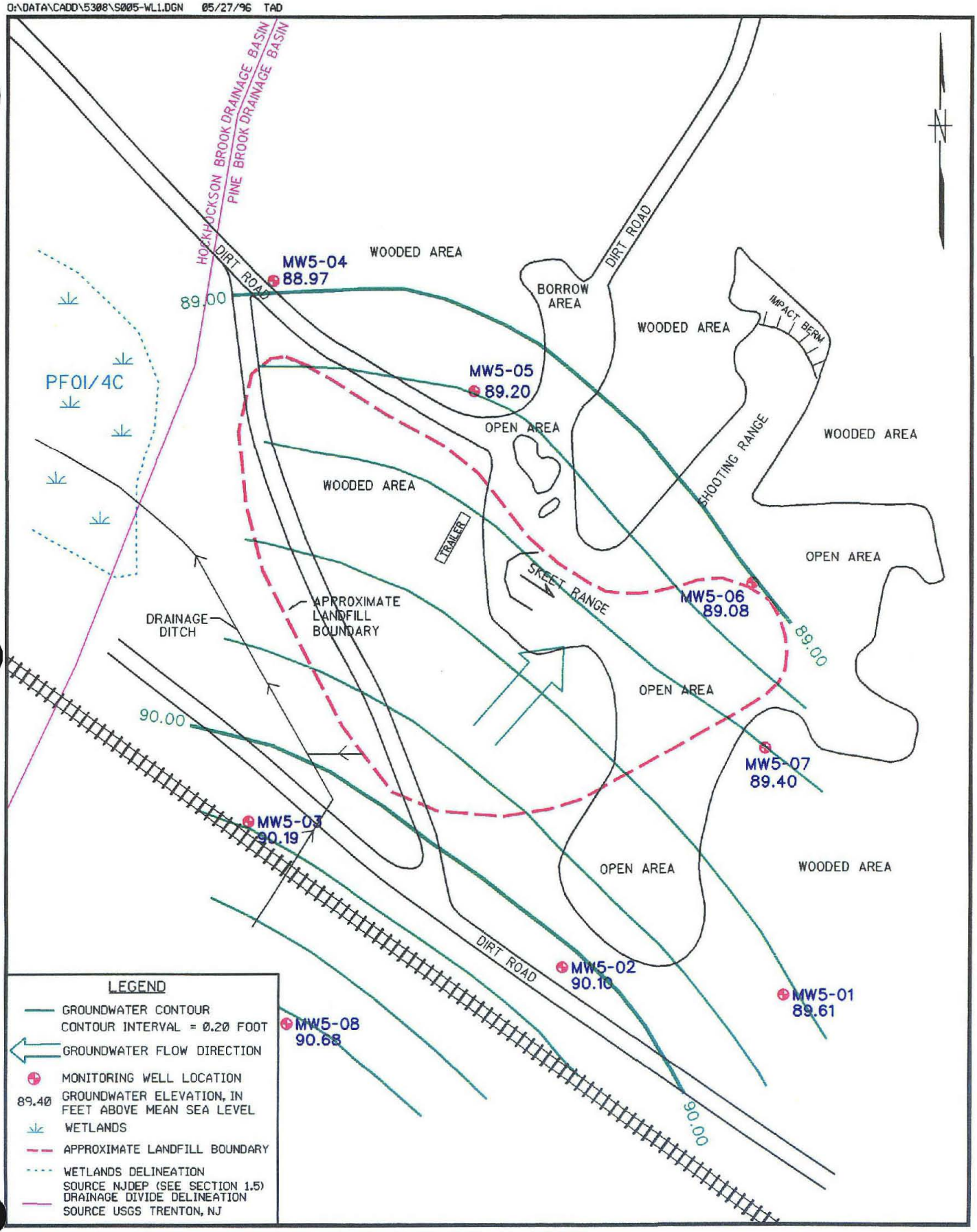
8.5.1 Groundwater

Eight site-related groundwater samples (05 GW 01 through 05 GW 08) were collected at Site 5 (Figure 8-1). Tables 8-4 and 8-5 present the occurrence and distribution of inorganic and organic chemicals detected in background and site-related groundwater samples and compare them to background as presented in Section 31. Table 8-4a presents a comparison of detected compounds to ARARs and TBCs. Figure 8-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs. Seven hydropunch samples were also taken as a screening tool to determine if existing groundwater monitoring wells were sufficient to characterize lateral extent of groundwater contamination.

8.5.1.1 Inorganics

The site-related samples showed the presence of all the metals listed above in addition to arsenic and thallium. Aluminum, arsenic, cadmium, and cobalt were detected in sample 05 GW 07 at levels greater than background. Iron and cadmium were also detected at levels greater than background in 05 GW 06 and aluminum was detected at levels greater than background in 05 GW 02. Beryllium was detected at levels greater than background but near the instrument detection limit in sample 05 GW 07 (1.6 ug/L). Thallium was detected at low levels in 05 GW 01 and 05 GW 02 but was not found in background samples.

O:\DATA\CADD\5308\S005-WL1.DGN 05/27/96 TAD



GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

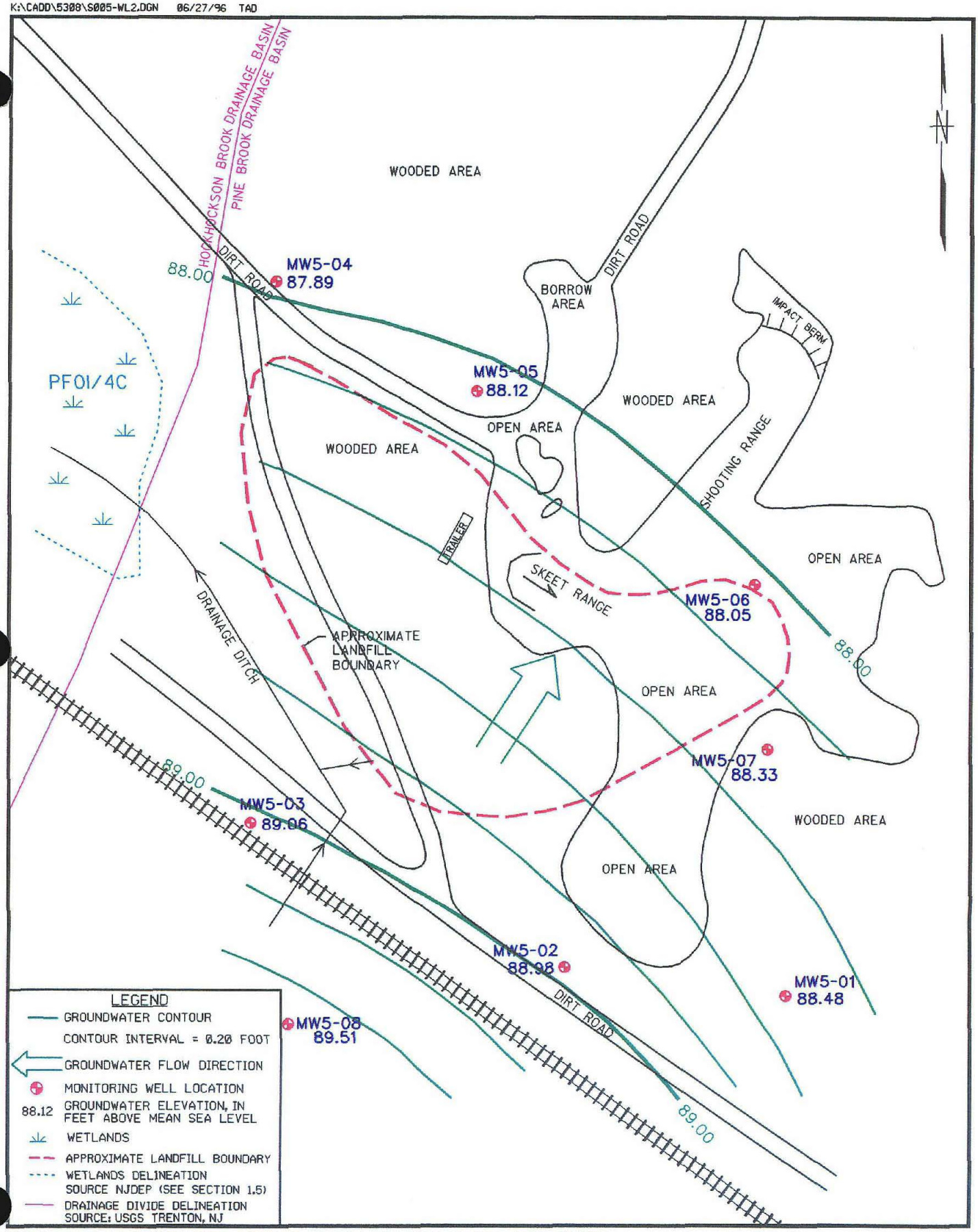
FIGURE 8-2

0 150 300

SCALE IN FEET

Brown & Root Environmental

K:\CADD\5308\S005-WL2.DGN 06/27/96 TAD



GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

FIGURE 8-3

0 150 300

SCALE IN FEET

Brown & Root Environmental

TABLE 8-4
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 5
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	REPRESENTATIVE CONCENTRATION	
ALUMINUM	11 / 11	287 - 7870	5097.82	8 / 8	468 - 42000	7829.38	YES	17212.11	10 x
ARSENIC	1 / 11	5.8 - 5.8	4.05	1 / 8	5.3	2.11	NO	2.94	
BARIUM	11 / 11	2.6 - 518	229.60	8 / 8	11 - 65.5	30.83	NO	55.31	
BERYLLIUM*	4 / 11	0.21 - 1.6	0.49	4 / 8	0.22 - 1.1	0.33	NO	0.60	
CADMIUM	5 / 11	0.6 - 1.9	1.21	7 / 8	0.51 - 7.5	2.46	YES	4.51	1.5
CALCIUM	11 / 11	506 - 17200	8306.55	8 / 8	855 - 10300	3893.13	NO	10300	
CHROMIUM	NOT DETECTED	-	-	8 / 8	4.7 - 33.4	11.34	YES	17.93	
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 8	3.8 - 29.6	7.84	YES	14.58	1
COPPER*	9 / 11	0.79 - 13.5	6.53	5 / 8	0.98 - 2	0.93	NO	1.79	
IRON	11 / 11	153 - 7690	4197.09	8 / 8	331 - 59200	10316.75	YES	23714.16	1
LEAD	3 / 11	2.1 - 3	2.44	3 / 8	1.6 - 2.1	1.17	NO	1.78	
MAGNESIUM	11 / 11	273 - 27400	8449.64	8 / 8	1170 - 6720	2792.50	NO	5497.59	
MANGANESE	11 / 11	3.3 - 65	46.18	8 / 8	12.7 - 302	100.51	YES	302	1.5
MERCURY*	11 / 11	0.005 - 0.12	0.12	8 / 8	0.012 - 0.13	0.07	NO	0.13	
NICKEL	10 / 11	0.81 - 25.5	11.98	7 / 8	2.6 - 102	25.68	YES	47.62	1
POTASSIUM	11 / 11	350 - 3245	2810.55	8 / 8	945 - 2850	1753.13	NO	2497.07	
SODIUM	11 / 11	1850 - 11650	8449.09	8 / 8	3920 - 33300	8970.00	YES	15693.76	
THALLIUM*	3 / 11	4 - 5.1	5.15	3 / 8	3.9 - 5.6	2.95	NO	4.75	
VANADIUM	10 / 11	0.69 - 42.25	16.48	7 / 8	1.2 - 10.8	4.54	NO	10.80	

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

TABLE 8-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 5
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
1,2-DICHLOROETHANE	NOT DETECTED	-	-	2 / 8	2 - 3	3
1,2-DICHLOROETHENE (TOTAL)	NOT DETECTED	-	-	2 / 8	2 - 9	7.34
BENZENE	NOT DETECTED	-	-	2 / 8	2 - 3	3
CHLOROFORM	NOT DETECTED	-	-	1 / 8	22	11.09
ETHYLBENZENE	NOT DETECTED	-	-	1 / 8	2	2
METHYLENE CHLORIDE	NOT DETECTED	-	-	1 / 8	2	2
TRICHLOROETHENE	NOT DETECTED	-	-	2 / 8	2 - 4	4
VINYL CHLORIDE	NOT DETECTED	-	-	1 / 8	2	2
XYLENE (TOTAL)	NOT DETECTED	-	-	1 / 8	4	4

TABLE 8-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	05GW01	05GW02	05GW03	05GW04	05GW05	05GW06	ARARS & TBCs		
LOCATION:	05GW01	05GW02	05GW03	05GW04	05GW05	05GW06	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	2150 E J	4310 E	7870 E J	468 E J	2740 E	2600 E	-	-	200
arsenic	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	50.0	-	8.00
barium	47.5	32.4	25.9	11.0	65.5	16.1	2000	2000 a	2000
beryllium	0.11 U	0.29	0.22	0.11 U	0.81	0.11 U	4.00	4000 e	20.0
cadmium	0.51	0.77	1.9	0.65	1.0	7.2 E	5.00	5.00 e	4.00
calcium	855	3530	1120	1350	10300	4130	-	-	-
chromium, total	16.8	5.6	12.0	5.2	6.9	6.1	100 *	100 a	100
cobalt	0.60 U	10.1	4.7	0.60 U	3.8	13.6	-	-	-
copper	1.1	0.77 U	1.0	2.0	0.77 U	0.77 U	1300	-	1000
iron	2670 E J	453 E	1450 E J	6980 E J	2310 E	59200 E	-	-	300
lead	1.5 U	1.5 U	2.1	1.6	1.5 U	1.9	15.0	-	10.0
magnesium	2090	1280	1170	1250	4860	3170	-	-	-
manganese	12.7	65.0 E	37.1 J	41.4 J	171 E	156 E	-	-	50.0
mercury	0.013	0.093	0.012	0.012	0.10	0.13	2.00	2.00 b	2.00
nickel	2.6	25.5	16.3	6.3	21.6	30.8	100	100 a	100
potassium	1820	2120	1760	970	2320	1240	-	-	-
sodium	6150	4320	4800	4370	4700	33300	-	-	50000
thallium	3.9 E J	5.1 E J	3.6 U	3.6 U	5.6 E J	3.6 UJ	2.00	0.400 a	10.0
vanadium	8.9	1.7	6.4	2.9	4.1	0.61 U	-	-	-
zinc	6.1 R	1.6 U	34.8 R	17.0 R	65.4 R	179 R	-	2000 a	5000
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,2-dichloroethane	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	3.0 E J	5.00	700 e	2.00
1,2-dichloroethene (total)	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	9.0 J	70.0 a	70.0 a	10.0
benzene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	2.0 E J	5.00	200 d	1.00
chloroform	22.0 E	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	100	100 e	6.00
ethylbenzene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	2.0 J	700	700 a	700
methylene chloride	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	2.0 J	5.00	2000 d	2.00
trichloroethene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	4.0 E J	5.00	-	1.00

TABLE 8-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	05GW01		05GW02		05GW03		05GW04		05GW05		05GW06		ARARS & TBCs		
LOCATION:	05GW01		05GW02		05GW03		05GW04		05GW05		05GW06		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
VOLATILES	**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**		**ug/L**	**ug/L**	**ug/L**
vinyl chloride	10.0	U	10.0	U	10.0	U	10.0	U	2.0	J	10.0	U	2.00	10.0 e	5.00
xylene (total)	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	4.0	J	10000	10000 a	40.0

TABLE 8-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	05GW07	05GW08	---	---	---	---	ARARS & TBCs		
LOCATION:	05GW07	05GW08	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
aluminum	42000 E	497 E					-	-	200
arsenic	5.3	3.3 U					50.0	-	8.00
barium	17.2	31.0					2000	2000 a	2000
beryllium	1.1	0.11 U					4.00	4000 e	20.0
cadmium	7.5 E	0.38 U					5.00	5.00 e	4.00
calcium	7370	2490					-	-	-
chromium, total	33.4	4.7					100 *	100 a	100
cobalt	29.6	0.60 U					-	-	-
copper	1.2	1.0					1300	-	1000
iron	9140 E	331 E					-	-	300
lead	1.5 U	1.5 UJ					15.0	-	10.0
magnesium	6720	1800					-	-	-
manganese	302 E	18.9					-	-	50.0
mercury	0.13	0.11 J					2.00	2.00 b	2.00
nickel	102 E J	0.75 U					100	100 a	100
potassium	2850	945					-	-	-
sodium	10200	3920					-	-	50000
thallium	3.6 UJ	3.6 U					2.00	0.400 a	10.0
vanadium	10.8	1.2					-	-	-
zinc	1170 R	1.6 U					-	2000 a	5000
VOLATILES	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
1,2-dichloroethane	2.0 J	10.0 U					5.00	700 e	2.00
1,2-dichloroethene (total)	2.0 J	10.0 U					70.0 a	70.0 a	10.0
benzene	3.0 E J	10.0 U					5.00	200 d	1.00
chloroform	10.0 U	10.0 U					100	100 e	6.00
ethylbenzene	10.0 U	10.0 U					700	700 a	700
methylene chloride	10.0 U	10.0 U					5.00	2000 d	2.00
trichloroethene	2.0 E J	10.0 U					5.00	-	1.00

TABLE 8-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	05GW07		05GW08		---	---	---	---	ARARS & TBCs		
LOCATION:	05GW07		05GW08		---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI								
VOLATILES	**ug/L**		**ug/L**						**ug/L**	**ug/L**	**ug/L**
vinyl chloride	10.0	U	10.0	U					2.00	10.0 e	5.00
xylene (total)	10.0	U	10.0	U					10000	10000 a	40.0

TABLE 8-4a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 5
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

• - Criteria are for total chromium.

•• - Action level 1300 ug/L for water treatment technology for public water supply systems.

••• - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 8-4b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		05GW01		05GW02		05GW03		05GW04		05GW05		ARARS & TBCs		
LOCATION:		05GW01		05GW02		05GW03		05GW04		05GW05		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
MISCELLANEOUS														
biochemical oxygen demand	mg/L	0.50	J	0.80	J	0.80	J	8.0		7.0		-	-	-
chemical oxygen demand	mg/L	7.0	U	3.0	J	2.0	J	15.0		9.0		-	-	-
chloride	mg/L	14.0		6.0		8.0		8.0		9.0		-	-	250
nitrate nitrogen	mg/L	0.50	U	0.50	U	0.26	J	0.50	U	0.50	U	10.0	10.0	-
sulfate	mg/L	11.0		43.0		53.0		13.0		61.0		500	-	250
total organic carbon	mg/L	1.0		1.0		1.0		3.0		2.0		-	-	-
total phosphorus as PO4	mg/L	0.20	U	0.10	J	0.20	U	0.20	U	0.20		-	-	-
turbidity	ntu	20.0		5.0		11.0		11.0		1.6		-	-	-

TABLE 8-4b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 5

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		05GW06		05GW07		05GW08		---	---	ARARS & TBCs		
LOCATION:		05GW06		05GW07		05GW08		---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI		1995 RI		1995 RI						
MISCELLANEOUS												
biochemical oxygen demand	mg/L	13.0		17.0		0.70	J			-	-	-
chemical oxygen demand	mg/L	31.0		23.0		4.0	J			-	-	-
chloride	mg/L	50.0		50.0		9.0				-	-	250
nitrate nitrogen	mg/L	0.50	U	0.50	U	0.50	U			10.0	10.0	-
sulfate	mg/L	130		280	E	11.0				500	-	250
total organic carbon	mg/L	8.0		9.0		0.80	J			-	-	-
total phosphorus as PO4	mg/L	0.20	U	0.20	U	0.10	J			-	-	-
turbidity	ntu	6.4		8.3		3.8				-	-	-

TABLE 8-4b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 5
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

. - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

. - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

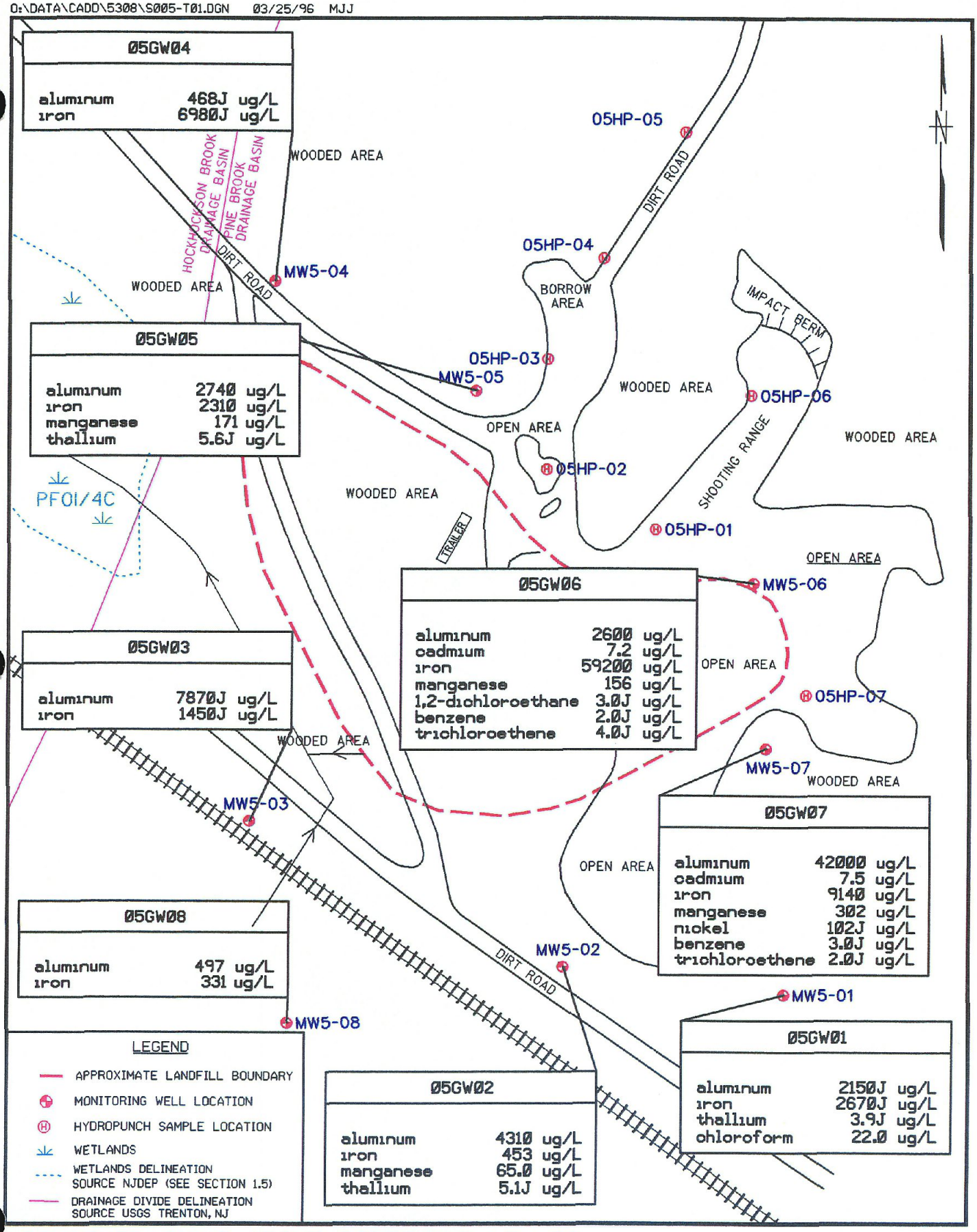
b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

O:\DATA\CADD\5308\S005-T01.DGN 03/25/96 MJJ



CONCENTRATIONS ABOVE SCREENING LEVLES

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

FIGURE 8-4

Brown & Root Environmental

8.5.2 Organics in Groundwater

1,2-DCA (2 ug/L to 3 ug/L), 1,2-DCE (2 ug/L to 9 ug/L), TCE (2 ug/L to 4 ug/L), and benzene (2 ug/L to 3 ug/L) were each detected in two groundwater samples collected at Site 5 (05 GW 06 and 06 GW 07). Sample 05 GW 06 also exhibited low levels of ethylbenzene (2 ug/L), xylenes (4 ug/L), methylene chloride (2 ug/L), and xylene (4 ug/L). Vinyl chloride (2 ug/L) was detected in 05 GW 05 and chloroform was detected at 22 ug/L in sample 05 GW 01. Low levels of volatile organics (xylene, ethybenzene, benzene, and 1,2-DCE) in the hydropunch samples generally confirm the presence of these VOCs, but data quality of these hydropunch results does not allow their use in human health risk assessment. Hydropunch samples were used only for screening purposes, to guide additional well placement.

8.5.2.3 Miscellaneous Parameters

The Site 5 groundwater analyses consisted of BOD, COD, chlorides, sulfates, TOC, phosphates, and turbidity. Results are presented in Appendix A. Sulfate was detected in MW5-06 (downgradient) and MW5-07 (crossgradient and adjacent to the landfill) at concentrations greater than those found in upgradient wells MW5-03 and MW5-06 and greater than background groundwater levels. MW5-07 slightly exceeded the SMCL for sulfate. These data confirm the presence of elevated sulfate levels also found during the previous 1993 sampling investigation. Other indicator parameters (BOD, COD, and TOC) were also present at slightly greater levels in downgradient versus upgradient wells; however, results are below the range associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972).

8.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 5 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 8.6.1. Persistence of detected chemicals in the environment is discussed in Section 8.6.2. Section 8.6.3 presents a discussion of contaminant trends.

8.6.1 Detected Chemicals and Transport Potential

VOCs and several inorganics were present in Site 5 groundwater samples. No soil samples were collected at the site. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

The chlorinated ethenes detected in groundwater have been associated with degradation of DCE and TCE (Cline and Viste, 1983).

Several chlorinated ethenes (1,2-DCA, 1,2-DCE, TCE, and vinyl chloride), benzene, and other volatile aromatics were detected at low levels in groundwater downgradient of the landfill. All detected volatile organic groundwater contaminants exhibit relatively high solubilities, vapor pressure, and air-water partition coefficients (Henry's law constant). These compounds are characteristically mobile in the environment (either through soil gas migration or groundwater transport). Inorganics detected in the groundwater at levels above background were aluminum, arsenic, beryllium, cadmium, cobalt, and thallium.

8.6.2 Contaminant Persistence

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

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

Vinyl chloride and 1,2-DCE are associated with degradation of PCE and TCE (Cline and Viste, 1983). Concentrations of the parent compounds (TCE and PCE) may diminish over time, depending upon the presence of source materials that could continue to leach product into groundwater. Benzene and related alkyl-substituted aromatics are also considered susceptible to biodegradation in the environment.

8.6.3 Observed Chemical Contaminant Trends

TCE and its degradation products (1,2-DCE and vinyl chloride) and benzene and related aromatics were detected at low levels in the groundwater. The locations and detected levels are consistent with historical data. This investigation and the 1993 sampling revealed that TCE and 1,2-DCE are present at the highest concentrations in MW5-06. This well is located to the northeast (hydrologically downgradient) and adjacent to the northeastern edge of the landfill. Both investigations indicate that benzene is present in this well and that TCE and 1,2-DCE are present at similar low levels in MW5-07. MW5-07 is located downgradient (east) of the landfill and south of MW5-06.

Several differences were noted between the VOC trends in the current investigation and the 1993 investigation. Vinyl chloride was the only VOC detected in monitoring well MW5-05 in the current investigation, whereas benzene was the only VOC detected in the 1993 investigation (and was detected in two out of three sampling rounds). The 1993 investigation also indicated that 1,2-DCE and benzene were present in monitoring well MW5-04 in two out of three sampling rounds, but neither compound was detected in the current investigation. The current investigation indicated the presence of chloroform, which was not detected in earlier samples, in monitoring well MW5-01. Since the levels of compounds other than chloroform were below quantitation limits, reproducibility between sampling rounds is not expected to be good; hence, evidence for specific trends with changes in groundwater quality over time is inconclusive.

Inorganic constituents detected at concentrations greater than background levels in groundwater include aluminum, arsenic, beryllium, cadmium, cobalt, and thallium. In wells where these contaminants were present at elevated levels, low turbidity readings and Ph measurements (generally between 4.0 and 4.7) suggest dissolved metals. The detected groundwater concentrations of these metals in 05 GW 07 (a downgradient well) and cadmium in 05 GW 06 (also downgradient) were greater than the levels observed in upgradient wells. The detected level of thallium in downgradient well 05 GW 05 was within a range similar to that observed in samples 05 GW 01 and 05 GW 02 (upgradient or cross-gradient wells).

8.6.4 Conclusions

Low-level releases of chlorinated ethenes and benzene derivatives from the landfill to the groundwater have occurred. Groundwater data from the current investigation are consistent with historical data and indicate that chlorinated ethenes and benzene compounds are present in two downgradient monitoring wells located along the eastern side of the landfill. VOCs were also detected at trace levels in 05 GW 05 (downgradient from the landfill) and 05 GW 01 (hydrologically cross-gradient), but these results did not correlate with results from an earlier investigation. The analytical results from the current investigation should be considered valid due to the application of acceptable QA/QC procedures as demonstrated through data validation.

Filtering of samples was not deemed necessary because relatively low turbidity readings were obtained.

8.7 BASELINE RISK ASSESSMENT

This section of the RI report presents the results of the baseline risk assessment for Site 5. The risk assessment was performed using the approach outlined in Section 2.4. Table 8-6 provides the selected COPCs and representative concentrations of inorganics and organics in site-related groundwater. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

TABLE 8-6
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 5 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	17212.11	NORMAL
ARSENIC	2.94	LOGNORMAL
BERYLLIUM	0.60	NORMAL
CADMIUM	4.51	NORMAL
COBALT	14.58	NORMAL
COPPER	1.79	NONPARAMETRIC
IRON	23714.16	NORMAL
LEAD	1.78	LOGNORMAL
MERCURY	0.13	LOGNORMAL
NICKEL	47.62	NORMAL
THALLIUM	4.75	LOGNORMAL
1,2-DICHLOROETHANE	3	LOGNORMAL
1,2-DICHLOROETHENE (TOTAL)	7.34	LOGNORMAL
BENZENE	3	LOGNORMAL
CHLOROFORM	11.09	LOGNORMAL
ETHYLBENZENE	2	LOGNORMAL
METHYLENE CHLORIDE	2	LOGNORMAL
TRICHLOROETHENE	4	LOGNORMAL
VINYL CHLORIDE	2	LOGNORMAL
XYLENE (TOTAL)	4	LOGNORMAL

The result of the conservative baseline risk assessment was greater than the guideline target acceptable cancer risk range and greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 8.7.1.4 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used in the risk management process, where clean-up goals and remediation alternatives are identified for a site.

8.7.1 Risk Characterization

The results of the risk assessment are presented below on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential and industrial receptors).

8.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 5 are within the mid-range of the 1E-04 to 1E-06 target acceptable risk range. (Ingestion exposures contributed the significant portion of risk.)

The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future industrial employee assuming exposure to COPCs in groundwater at Site 5. (Ingestion exposures contributed the significant portion of risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are discussed in Section 8.7.1.4 and presented in Tables 8-7 and 8-8, respectively.

8.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 5. In addition, this risk assessment yielded estimated noncarcinogenic His with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of groundwater risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. The amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 8.7.1.4 and presented for groundwater in Tables 8-9 and 8-10, respectively.

TABLE 8-7
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,2-DICHLOROETHANE	9.5E-07	4.8E-09
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A
BENZENE	3.0E-07	5.2E-09
CHLOROFORM	2.4E-07	2.3E-09
ETHYLBENZENE	N/A	N/A
METHYLENE CHLORIDE	5.2E-08	2.0E-10
TRICHLOROETHENE	1.5E-07	2.9E-09
VINYL CHLORIDE	1.3E-05	7.1E-08
XYLENE (TOTAL)	N/A	N/A
ALUMINUM	N/A	N/A
ARSENIC	1.5E-05	6.6E-09
CADMIUM	N/A	N/A
COBALT	N/A	N/A
IRON	N/A	N/A
NICKEL	N/A	N/A
TOTAL RISK	3.0E-05	9.3E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 8-8
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN								
SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	THYROID	GROUNDWATER DERMAL CONTACT
1,2-DICHLOROETHANE	N/A			N/A	N/A					N/A
1,2-DICHLOROETHENE (TOTAL)	8.0E-03	8.0E-03			8.0E-03					7.5E-05
BENZENE	N/A	N/A					N/A			N/A
CHLOROFORM	1.1E-02			1.1E-02	1.1E-02					1.1E-04
ETHYLBENZENE	2.0E-04			2.0E-04	2.0E-04			2.0E-04		1.8E-05
METHYLENE CHLORIDE	3.3E-04				3.3E-04					1.3E-06
TRICHLOROETHENE	6.5E-03	6.5E-03					6.5E-03			1.2E-04
VINYL CHLORIDE	N/A				N/A		N/A			N/A
XYLENE (TOTAL)	2.0E-05						2.0E-05			1.7E-06
ALUMINUM	1.7E-01									1.4E-03
ARSENIC	9.6E-02		9.6E-02							4.1E-05
CADMIUM	8.8E-02			8.8E-02						3.6E-04
COBALT	2.4E-03	2.4E-03							2.4E-03	1.9E-05
IRON	7.7E-01				7.7E-01	7.7E-01				6.3E-03
NICKEL	2.3E-02						2.3E-02			6.4E-05
	HI BY TARGET ORGAN	1.7E-02	9.6E-02	9.9E-02	7.9E-01	7.7E-01	3.0E-02	2.0E-04	2.4E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 8-9
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHANE	4.1E-06	1.5E-07	3.8E-06
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
BENZENE	1.3E-06	1.7E-07	1.5E-06
CHLOROFORM	1.0E-06	7.3E-08	1.3E-05
ETHYLBENZENE	N/A	N/A	N/A
METHYLENE CHLORIDE	2.2E-07	6.4E-09	5.3E-08
TRICHLOROETHENE	6.5E-07	9.3E-08	3.5E-07
VINYL CHLORIDE	5.7E-05	2.3E-06	1.2E-05
XYLENE (TOTAL)	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
ARSENIC	6.5E-05	1.6E-07	N/A
CADMIUM	N/A	N/A	N/A
COBALT	N/A	N/A	N/A
IRON	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
TOTAL RISK	1.3E-04	2.9E-06	3.0E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 8-10
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	THYROID	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHANE	N/A			N/A	N/A					N/A	4.2E-02
1,2-DICHLOROETHENE (TOTAL)	5.2E-02	5.2E-02			5.2E-02					2.9E-03	N/A
BENZENE	N/A	N/A					N/A			N/A	8.9E-02
CHLOROFORM	7.1E-02			7.1E-02	7.1E-02					4.1E-03	N/A
ETHYLBENZENE	1.3E-03			1.3E-03	1.3E-03			1.3E-03		6.9E-04	3.2E-04
METHYLENE CHLORIDE	2.1E-03				2.1E-03					4.8E-05	1.1E-04
TRICHLOROETHENE	4.3E-02	4.3E-02					4.3E-02			4.7E-03	N/A
VINYL CHLORIDE	N/A				N/A		N/A			N/A	N/A
XYLENE (TOTAL)	1.3E-04						1.3E-04			6.7E-05	2.1E-03
ALUMINUM	1.1E+00									4.3E-02	N/A
ARSENIC	6.3E-01		6.3E-01							1.3E-03	N/A
CADMIUM	5.8E-01			5.8E-01						1.1E-02	N/A
COBALT	1.6E-02	1.6E-02							1.6E-02	6.1E-04	N/A
IRON	5.1E+00				5.1E+00	5.1E+00				2.0E-01	N/A
NICKEL	1.5E-01						1.5E-01			2.0E-03	N/A
	HI BY TARGET ORGAN	1.1E-01	6.3E-01	6.5E-01	5.2E+00	5.1E+00	1.9E-01	1.3E-03	1.6E-02		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

8.7.1.3 Lead Results

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 from the test pits.

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 5 exposures are presented in Appendix I.

8.7.1.4 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 5 for future residential receptors and future industrial receptors assuming exposure to COPCs in groundwater.

Comparison to Background

Beryllium, copper, mercury, and thallium were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 8-4 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Consideration of Modified Dermal Absorption and Target Organ Grouping

As discussed in Section 2.4.6.2, groundwater cancer and non-cancer risks were recalculated using a modified gastrointestinal absorption factor for one chemical. After these steps, the final RME cancer risks are still above the 1E-04 to 1E-06 target acceptable range for the future residential receptor (1.3E-04, via groundwater ingestion). Vinyl chloride and arsenic are the principal COPCs contributing to the groundwater RME cancer risks.

The revised His are greater than 1.0 for exposure to groundwater by future residential and future industrial receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are less than 1.0 for each affected organ for the future industrial receptor but are greater than 1.0 in some cases for the residential child. For groundwater ingestion by the future residential child, the target organs, corresponding RME His, and associated principal COPCs are as follows: digestive system (5.1 - iron) and liver (5.2 - iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future industrial employees exposed to groundwater in Tables 8-7 and 8-8, respectively. Estimated RME carcinogenic risks and

noncarcinogenic HQsare presented for future residential receptors exposed to groundwater in Tables 8-9 and 8-10, respectively.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate cancer and non-cancer risks for exposure to COPCs in groundwater for future residential receptors. 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. Based on this evaluation, the estimated total central tendency cancer risks are within the mid-range of the target acceptable risk range; however, the noncarcinogenic HI was greater than 1.0 for some target organs. For groundwater ingestion by the future residential child, the target organs, corresponding central tendency HIs, and associated principal COPCs are as follows: digestive system (2.4 - iron) and liver (2.4 - iron). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks and noncarcinogenic HQsare presented for future residential receptors exposed to groundwater in Tables 8-9a and 8-10a, respectively.

8.7.2 Conclusions

Groundwater was sampled at Site 5. The potential receptors considered for this site were future industrial receptors and residential receptors. The RME cancer risk associated with the future residential (groundwater) exposure scenario is greater than 1E-04, the upper end of the target acceptable risk range. Vinyl chloride (via ingestion of groundwater and inhalation during showering) and arsenic (via ingestion of groundwater) are the principal COPCs that contribute to this cancer risk. However, the RME estimate for the future residential receptor is probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

Noncarcinogenic Hqs associated with the future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Iron is the COPC that exceeded 1.0 for this exposure scenario. In addition, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the liver and digestive systems as target organs.

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

The amended risk assessment procedure did not result in the elimination of all non-cancer risks above guideline limits. Iron by groundwater ingestion remained with HQs above one.

TABLE 8-9a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHANE	5.8E-07	2.4E-08	2.2E-07
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
BENZENE	1.9E-07	2.6E-08	8.7E-08
CHLOROFORM	1.4E-07	1.2E-08	7.4E-07
ETHYLBENZENE	N/A	N/A	N/A
METHYLENE CHLORIDE	3.2E-08	1.0E-09	3.0E-09
TRICHLOROETHENE	9.4E-08	1.5E-08	2.0E-08
VINYL CHLORIDE	8.1E-06	3.6E-07	6.7E-07
XYLENE (TOTAL)	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
ARSENIC	9.4E-06	2.1E-08	N/A
CADMIUM	N/A	N/A	N/A
COBALT	N/A	N/A	N/A
IRON	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
TOTAL RISK	1.9E-05	4.6E-07	1.7E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 8-10a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 5
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	THYROID	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,2-DICHLOROETHANE	N/A			N/A	N/A					N/A	8.3E-03
1,2-DICHLOROETHENE (TOTAL)	2.4E-02	2.4E-02			2.4E-02					1.9E-03	N/A
BENZENE	N/A	N/A					N/A			N/A	1.8E-02
CHLOROFORM	3.3E-02			3.3E-02	3.3E-02					2.7E-03	N/A
ETHYLBENZENE	6.0E-04			6.0E-04	6.0E-04			6.0E-04		4.6E-04	6.3E-05
METHYLENE CHLORIDE	1.0E-03				1.0E-03					3.2E-05	2.1E-05
TRICHLOROETHENE	2.0E-02	2.0E-02					2.0E-02			3.2E-03	N/A
VINYL CHLORIDE	N/A				N/A		N/A			N/A	N/A
XYLENE (TOTAL)	6.0E-05						6.0E-05			4.5E-05	4.2E-04
ALUMINUM	5.1E-01									2.9E-02	N/A
ARSENIC	2.9E-01		2.9E-01							8.6E-04	N/A
CADMIUM	2.7E-01			2.7E-01						7.5E-03	N/A
COBALT	7.3E-03	7.3E-03							7.3E-03	4.1E-04	N/A
IRON	2.4E+00				2.4E+00	2.4E+00				1.3E-01	N/A
NICKEL	7.1E-02						7.1E-02			1.3E-03	N/A
	HI BY TARGET ORGAN	5.2E-02	2.9E-01	3.0E-01	2.4E+00	2.4E+00	9.1E-02	6.0E-04	7.3E-03		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 5 in Table 8-11 for groundwater. Table 8-11a presents the relevant central tendency risk estimates associated with residential receptors for groundwater.

8.8 ECOLOGICAL RISK ASSESSMENT

8.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Some bare areas are present on the 13-acre inactive landfill, but the majority of the site is dominated by young pitch pines. Upland habitats surround most of the site and are dominated by mature white oak, chestnut oak, and mountain laurel. Soils in these areas are classified as Lakewood sand. A narrow forested wetland is located to the west, along the railroad tracks. Vegetation in the forested wetland is dominated by red maple and blackgum, and standing water in the wetland is rarely present. A small drainage ditch is located approximately 100 feet west of the dirt road that borders the western edge of the site, and water is present in the ditch only after periods of heavy rainfall. The closest surface water is a tributary of Hockhockson Brook, located approximately 1,000 feet east of Site 5. The site is located on the border of the Hockhockson Brook and Pine Brook watersheds. The topography of the site is flat, inhibiting off-site runoff, therefore, precipitation perches and infiltrates on the site. RI Site 2 is situated 1,000 feet to the northeast.

The landfill provides fair terrestrial habitat, and the adjacent uplands and wetlands provide excellent habitat, mainly for terrestrial ecological receptors. Most species of mammals and birds found in the Mainside area are expected to utilize these areas, and the border of the site provides an "edge effect" that may attract a wide variety of terrestrial receptors. No sensitive habitats, other than the wetland, and no threatened or endangered species are known to be present on or around the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major potential contaminant release pathway from the landfill is overland runoff. Precipitation runoff may carry constituents to nearby areas, but the flat nature of the site precludes significant overland migration to off-site areas, including the wetlands. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Groundwater to surface water contaminant migration is limited since no surface water is present near the site and groundwater flows away from the wetlands and drainage ditch.

TABLE 8-11
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 5
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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	3.0E-05^	1.3E-04^	N/A	N/A	7.9E-01@	5.2E+00@	N/A	N/A
	Dermal Contact	N/A	9.3E-08^	2.9E-06^	N/A	N/A	8.5E-03^	2.7E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.0E-05^	N/A	N/A	N/A	N/A	1.3E-01^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	3.0E-05	1.6E-04	-	-	8.0E-01	5.5E+00	1.3E-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.

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TABLE 8-11a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 5
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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	N/R	1.9E-05^	N/A	N/A	N/R	2.4E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	4.6E-07^	N/A	N/A	N/R	1.8E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	1.7E-06^	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	2.1E-05	-	-	-	2.6E+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
** = 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.

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Exposure Routes

Terrestrial receptors associated with Site 5 may be exposed to soil contaminants via incidental ingestion of soil or ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants in Site 5 surface water by using it as a source of drinking water, but this exposure route is considered to be insignificant. Terrestrial vegetation may also be exposed to contaminants in Site 5 soils. Aquatic, semi-aquatic, and terrestrial receptors inhabiting the wetlands are unlikely to come into contact with contaminants associated with Site 5 since off-site runoff is limited and groundwater does not flow in the direction of the wetlands.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

All contaminants detected in two subsurface soil samples taken from Site 5 test pits were considered preliminary COPCs. Contaminants detected in 1993 RI/FS and 1995 RI groundwater samples were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

8.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminated surface soils. Surface soil and terrestrial plant ET values are presented in Tables 2-30 and 2-31, respectively.

8.8.3 Preliminary Exposure Assessment

Contaminant concentrations in soil used for this initial screening were obtained from data generated during 1993 RI/FS activities. The maximum detected contaminant concentrations in the two soil samples (taken from test pit samples) combined were used as conservative representative exposure point concentrations. Data from 1993 RI/FS and 1995 RI groundwater samples are assessed qualitatively in Section 8.8.3. Background concentrations presented for comparative purposes were obtained from facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

8.8.4 Risk Characterization

In Site 5 soils, the inorganics aluminum (HQ = 6.55), chromium (HQ = 292.5), and vanadium (HQ = 5.15) exceeded ETs and were retained as final COPCs (Table 8-12). The PAHs fluoranthene (HQ = 2.3), phenanthrene (HQ = 2.2), and pyrene (HQ = 1.6), exceeded Ets and were retained as final COPCs. Beryllium was conservatively retained as a final COPC since no suitable ET was available. For terrestrial plants, aluminum (HQ = 78.6), chromium (HQ = 117), silver (HQ = 1.15), vanadium (HQ = 51.5), and zinc (HQ = 1.64) exceeded Ets and were retained as final COPCs (Table 8-13). Selenium was conservatively retained as a final COPC since no suitable terrestrial plant ET was available.

The toxicological properties of final COPCs in surface soil are summarized in Appendix M.

8.8.5 Summary and Conclusions

Site 5 and the surrounding area provide excellent terrestrial habitat. The forested wetland to the west provides excellent habitat, primarily for terrestrial receptors, and the drainage ditch to the west contains no aquatic habitat. The site is fairly flat, inhibiting off-site runoff. No surface water is present near the site, and groundwater flows away from the wetland. Therefore, potential risks to ecological receptors are mainly confined to the landfill area.

Some VOCs, SVOCs, and metals were detected in groundwater samples collected during 1993 RI/FS activities. Elevated levels of several metals and VOCs were detected in 1995 RI groundwater samples. Groundwater flows to the northeast, away from the wetland area. Data from two soil samples taken from 1993 RI/FS test pit samples were used for quantitative assessment. Hqs for inorganics and organics in soils were indicative of low potential risk, with the exception of chromium. This inorganic was not detected significantly above background, and the elevated HQ is most likely due to the only ET that was available for chromium; this ET is heavily conservative. Beryllium was conservatively retained as a final COPC since no suitable ET was available, but this inorganic was not detected significantly above background. Hqs for terrestrial plants from exposure to contaminant surface soils were indicative of low potential risk, except for aluminum, chromium, and vanadium. Nonetheless, aluminum was lower than background and chromium and vanadium were not detected significantly above background. Moreover, the only Ets available for these inorganics were heavily conservative. No ET was available for selenium, but selenium was only detected in one sample at a relatively low concentration. No terrestrial plant Ets were available for organics, but concentrations were low for all organics detected, and plants do not translocate most organics significantly.

In summary, off-site migration of contaminants to the surrounding wetland areas, upland areas, and Hockhockson Brook or Pine Brook watersheds via overland runoff of groundwater to surface water migration is limited. HQ values for some inorganics detected on the landfill were moderately high but are mitigated by several factors. In addition, some cover material has been placed on the landfill, limiting

potential exposure to surface soil contaminants. Extensive vegetation is present on the site and no signs of plant stress are evident. For these reasons, potential risks to ecological receptors at Site 5 are low, and further ecological study or remediation at Site 5 appears to be unwarranted.

8.9 EVALUATION AND RECOMMENDATIONS

8.9.1 Evaluation Summary

Metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included aluminum, cadmium, iron, manganese, nickel, and thallium.

Organic compounds found in groundwater at concentrations above regulatory guidelines include 1,2-dichloroethene, benzene, chloroform, and TCE. These compounds were also found in previous investigations. After significant investigation, over more than a decade, no concentrated source of VOCs has been found. It is unlikely that a concentrated source of VOC contamination exists in the former disposal material.

Hydropunch screening samples indicate that the lateral extent of organics contamination in groundwater is adequately delineated by the existing monitoring wells.

Results of human health risk assessment concluded that calculated non-cancer risks were above guideline limits for ingestion of groundwater.

Ecological risk assessment concluded that contaminants do not appear to be significantly migrating to surface water or sediment in the wetlands via overland runoff and/or groundwater to surface water discharge.

8.9.2 Recommendations

Considering the presence of contaminants in groundwater at levels above NJDEP guideline criteria, state regulations regarding "Classification Exception Areas" (CEAs) may require periodic groundwater monitoring or further plume delineation.

Due to the limited impact on human health and the environment, no further remedial activities appear needed at this site.

9.0 SITE 6: LANDFILL WEST OF NORMANDY ROAD

9.1 SITE BACKGROUND AND PHYSICAL SETTING

The landfill west of Normandy Road is a 4-acre site located in the Waterfront area. From 1943 to 1965, the site was used to dispose of refuse from the Waterfront area. The wastes consisted 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 landfill surface is 3 to 10 feet higher than the adjacent marsh wetlands 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. Figure 9-1 is a map of the site.

9.2 PREVIOUS INVESTIGATIONS

9.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site observations. The site was not recommended for a confirmation study.

During the 1993 SI, four soil borings were drilled and completed as monitoring wells. Two soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Low levels of VOCs and two pesticides were detected in soil samples from the locations of MW6-02 and MW6-03. 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. Landfill parameters were relatively low compared to active solid waste landfills.

9.2.2 Summary of Conclusions

Elevated levels of metals, pesticides, semivolatiles and PCBs were found in soil samples. Groundwater was found to be minimally impacted.

9.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

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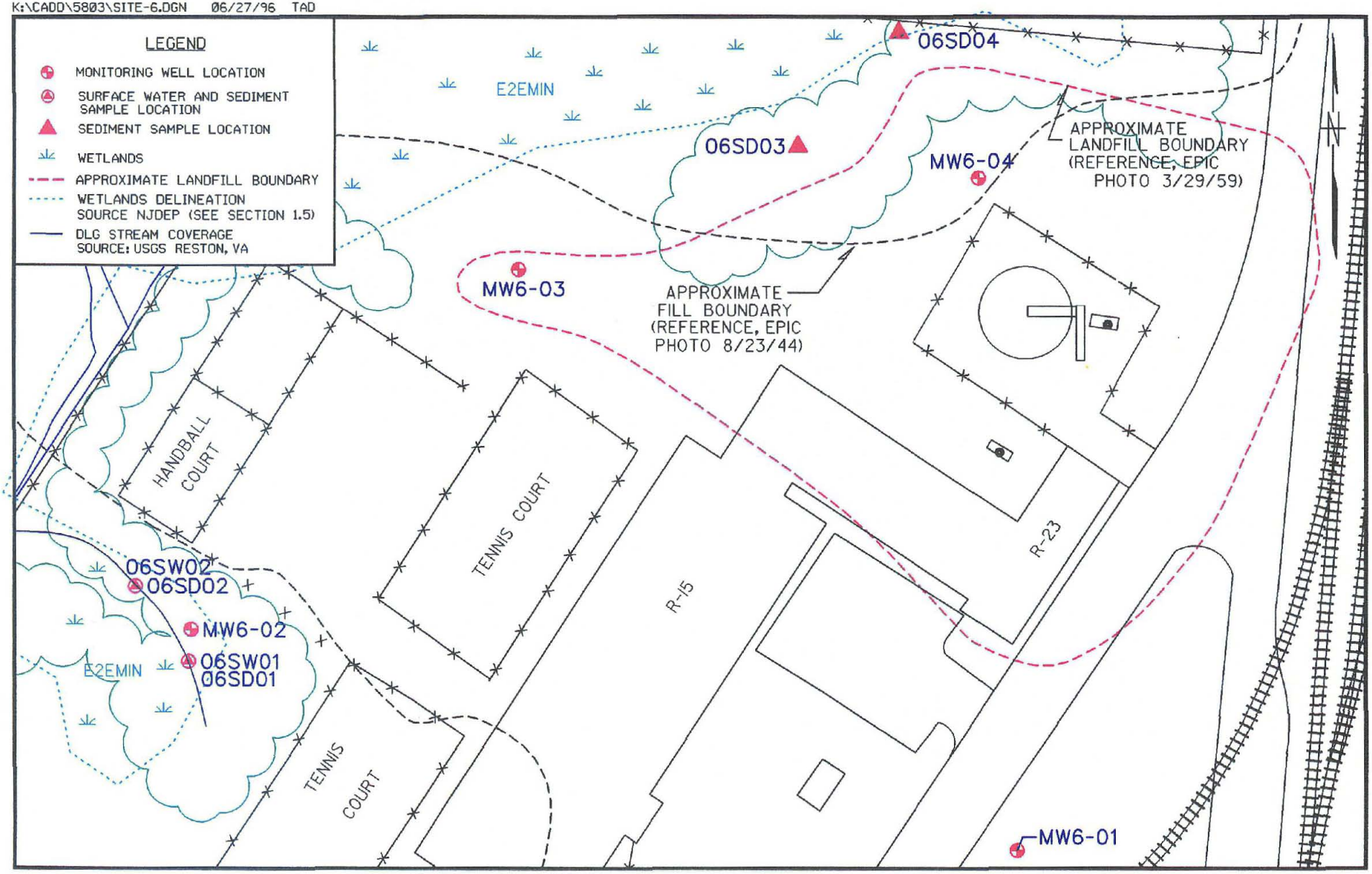

SAMPLE LOCATIONS

SITE 6 - LANDFILL WEST OF NORMANDY ROAD

0 60 120

SCALE IN FEET

FIGURE 9-1

Brown & Root Environmental

- Sample existing wells using low-flow technique to confirm previous results.

- Compare data to background levels and risk based criteria.

- Sample additional downgradient surface water and sediment to determine impact of landfill on adjacent wetlands.

9.3 RI FIELD INVESTIGATIONS

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

- Sampling and analysis of surface water (Section 9.3.1).

- Sampling and analysis of sediment (Section 9.3.2).

- Sampling and analysis of groundwater from the four existing monitoring wells (Section 9.3.3).

- Measurement of static-water levels in the four monitoring wells (Section 9.3.3).

A survey was conducted to establish the horizontal locations and vertical elevations of the sediment sample locations, the surface water sample locations, and selected existing monitoring wells. Surveying notes are provided in Appendix F.

9.3.1 Surface Water Sampling

B&R Environmental collected two surface water samples (06 SW 01 and 06 SW 02) in the wetlands in June 1995. Figure 9-1 shows sampling locations. The RI work plan stated that, if any flowing seeps or wet areas were found along the landfill edge, a surface water sample would be collected to determine if the landfill has had an impact on the adjacent wetlands. However, because of very dry conditions during the summer, no surface water seeps were found along the landfill edge. Sample 06 SW 01 was collected from the wetlands area located immediately west of the southernmost tennis court and Sample 06 SW 02 was collected in a wetlands area immediately west of the western fence line (Figure 9-1). Sample log sheets are presented in Appendix D.

The field team collected the surface water samples by dipping the sample bottle directly into the water. Field measurements collected during sampling included pH, specific conductance, temperature, turbidity, dissolved oxygen, and salinity.

The two surface water samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TAL metals, ammonia, phosphate, COD, TOC, nitrite/nitrate, turbidity, chloride, BOD, and hardness analyses.

9.3.2 Sediment Sampling

Two sediment samples (06 SED 01 and 06 SED 02) were collected in June 1995 in the wetlands area surrounding Site 6 to determine if the landfill has had an impact on the adjacent wetlands. 06 SED 01 was collected from the wetlands area located immediately west of the southernmost tennis court. 06 SED 02 was collected in a wetlands area immediately west of the western fence line. Two other sediment samples (06 SED 03 and 06 SED 04) were collected in June 1995 from two dry rills along the northeastern landfill edge (Figure 9-1). Sample log sheets are presented in Appendix D.

The four sediment samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TOC, pH, and moisture analyses.

9.3.3 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of water-level measurements was collected on August 7, 1995, the second on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 4.29 to 5.46 feet above MSL during the first round of measurements and from approximately 3.76 to 5.07 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 9-1. Monitoring well characteristics are summarized in Table 9-1a.

Groundwater Sampling

B&R Environmental collected groundwater samples from the four existing monitoring wells (MW6-01 through MW6-04) to determine groundwater quality and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. The four monitoring wells were sampled in late July and early August 1995. Field measurements collected during purging were pump rate (L/min), water-level measurements, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, B&R Environmental purged the wells, using the micro-purge protocol, to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure that little or no drawdown in water levels occurred throughout the purge and sample process.

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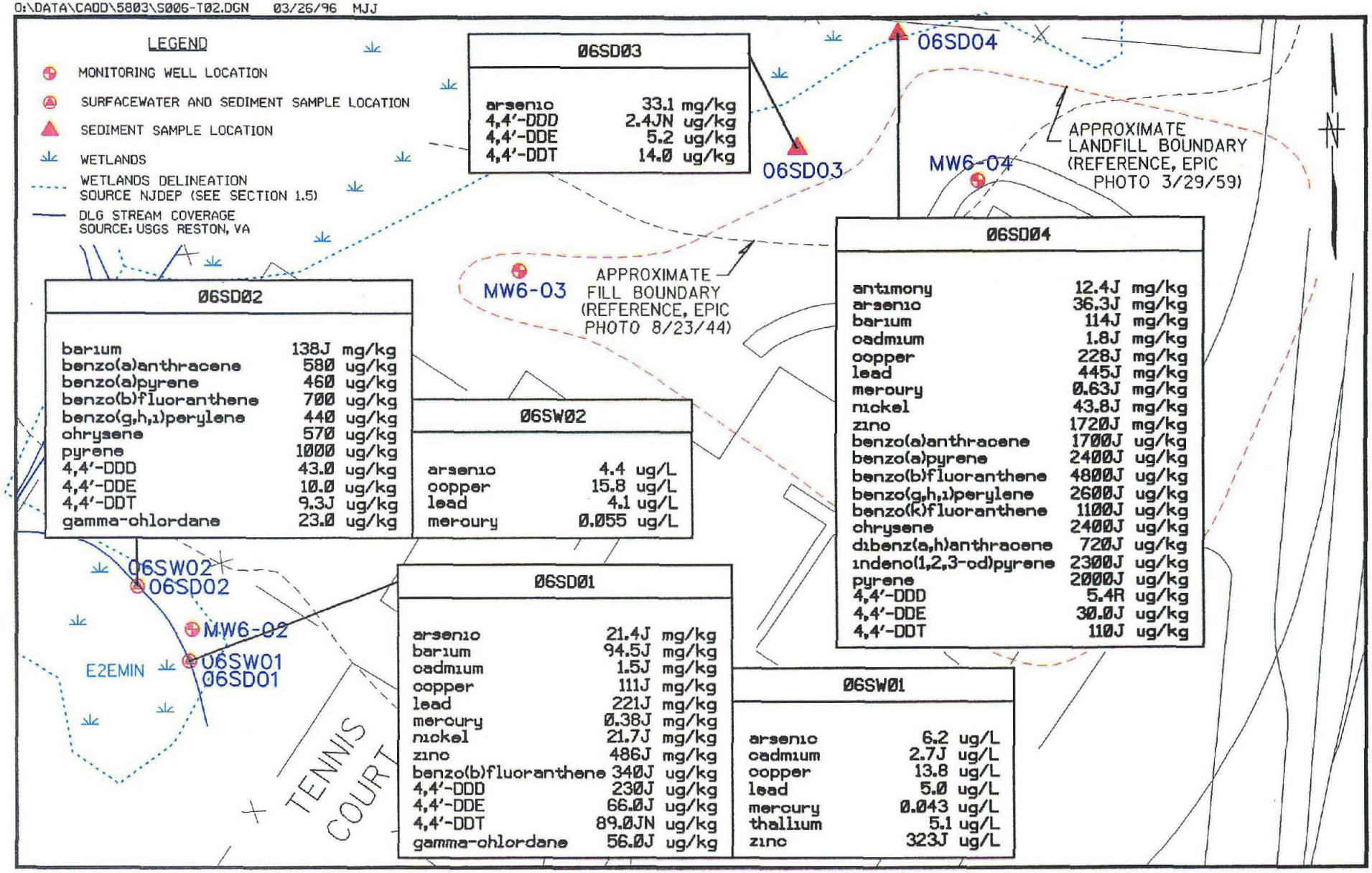

CONCENTRATIONS ABOVE SURFACE WATER AND SEDIMENT ARARS

SITE 6 - LANDFILL WEST OF NORMANDY ROAD

FIGURE 9-4

0 60 120

SCALE IN FEET

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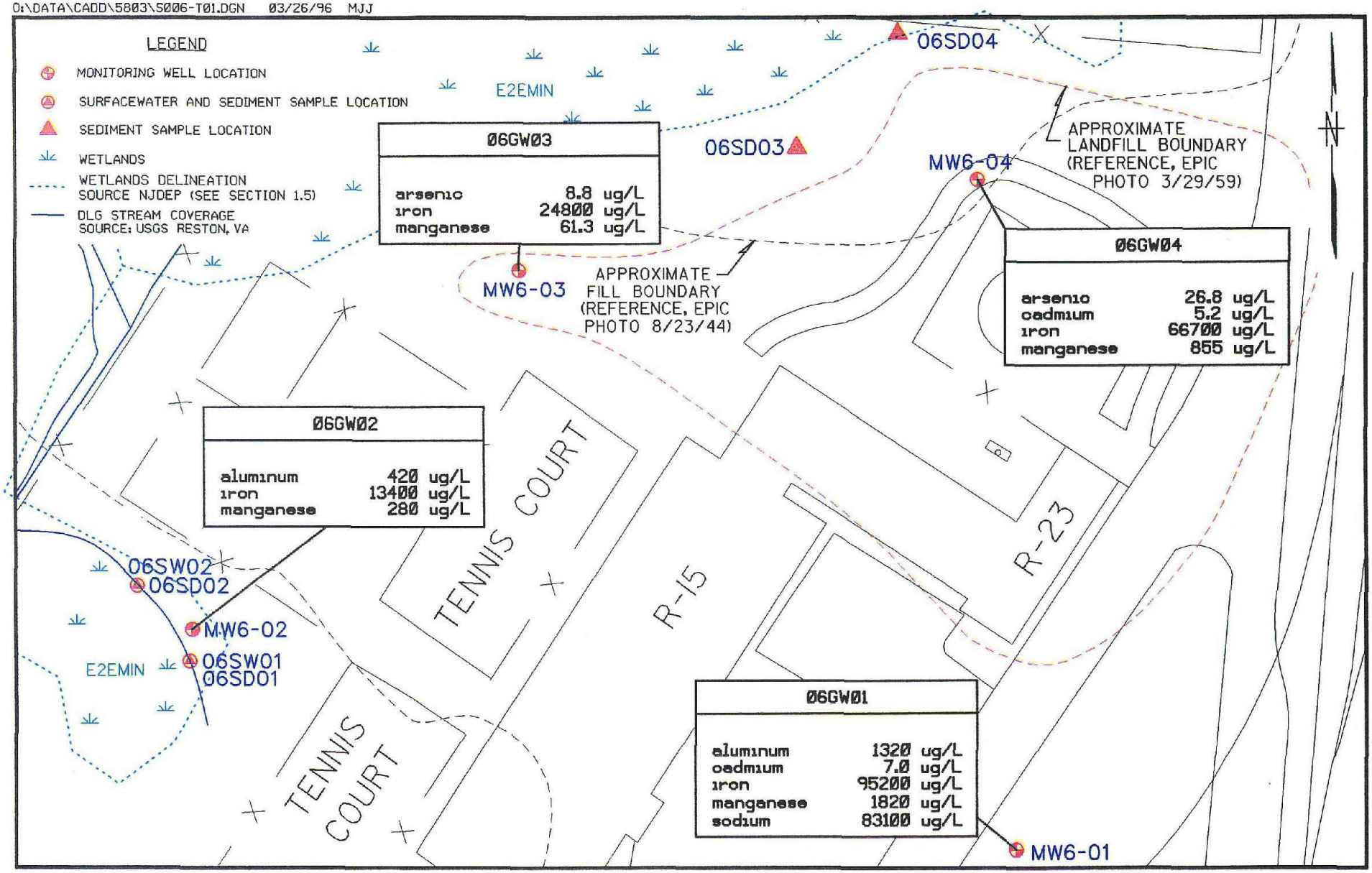

CONCENTRATIONS ABOVE GROUNDWATER ARARS
SITE 6 - LANDFILL WEST OF NORMANDY ROAD

0 60 120
SCALE IN FEET

FIGURE 9-5

Brown & Root Environmental

Table 9-1
Site 6 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table(1) (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
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 9-1a
Site 6 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW6-01	20	16.50	17.75	18.04	4	5 - 20	3.5 - 21	5/4/92
MW6-02	16	11.11	12.68	12.90	4	4 - 16	2 - 16.5	5/6/92
MW6-03	22	11.48	13.64	13.85	4	12 - 22	10 - 23	5/6/92
MW6-04	18	12.79	14.58	14.75	4	3 - 18	2 - 19	5/5/92

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.

The four groundwater samples (06 GW 01 through 06 GW 04) were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, explosives, TOC, COD, phosphate, ammonia, turbidity, chloride, sulfates, nitrite/nitrate, and BOD analyses.

Sample log sheets are presented in Appendix D.

9.4 SITE CHARACTERISTICS

9.4.1 Geology

Regional mapping places Site 6 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges between 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 penetrated fill material and the Englishtown Formation.

9.4.2 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 9-1. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 9-2 and 9-3, 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 upon the boring log descriptions, the wells are screened across the contact between the fill material and the Englishtown Formation.

9.5 NATURE AND EXTENT OF CONTAMINATION

9.5.1 Sediment

Four site-related sediment samples (06 SD 01 through 06 SD 06) were collected at Site 6 (Figure 9-1). Tables 9-2 and 9-3 present the occurrence and distribution of inorganic and organic chemicals detected in site-related sediment samples and compare them to background as presented in Section 31. Tables 9-2a and 9-2b present a comparison of detected compounds to ARARs and TBCs. Figure 9-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

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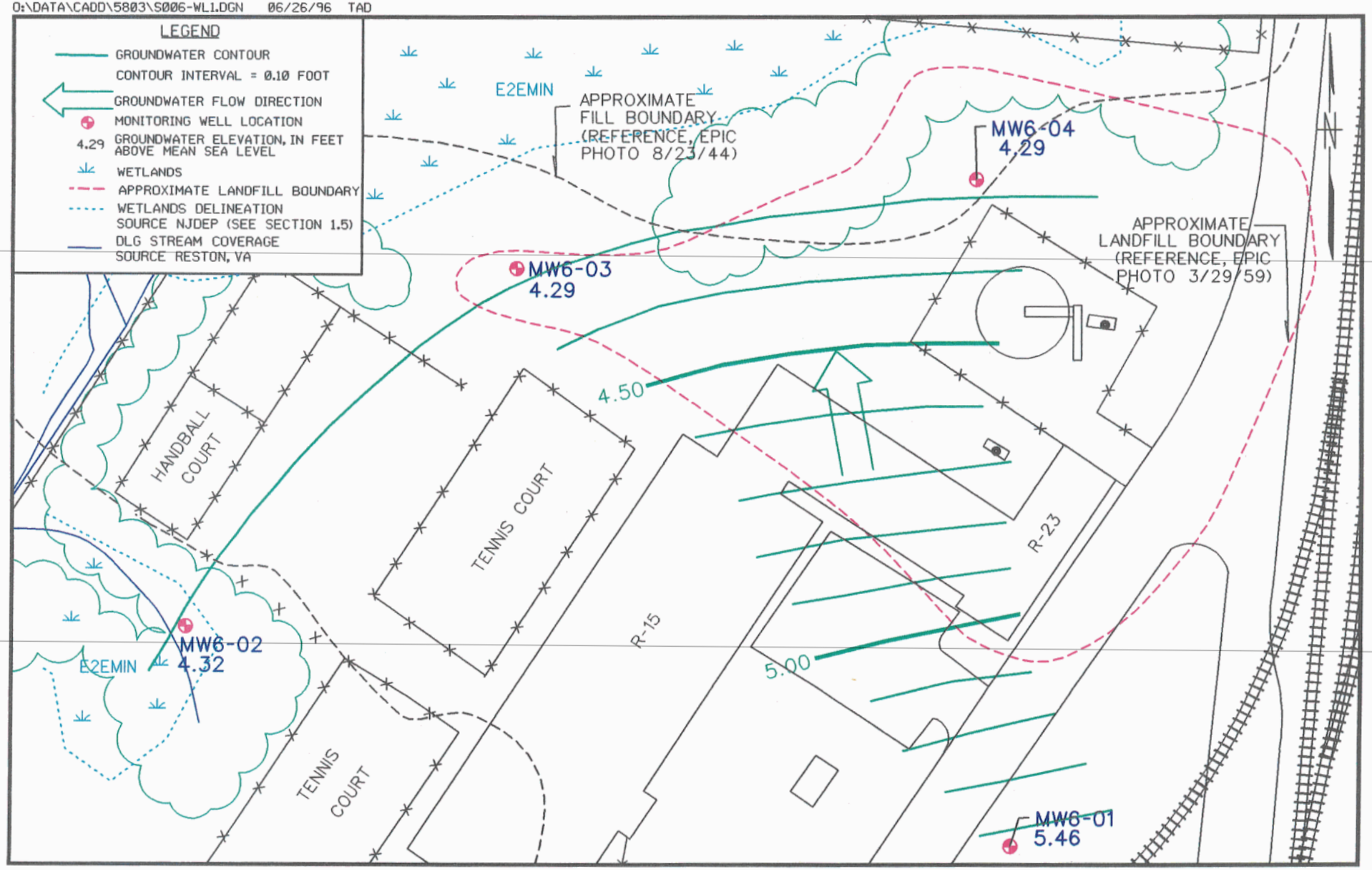

GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 6 - LANDFILL WEST OF NORMANDY ROAD

FIGURE 9-2

0 60 120

SCALE IN FEET

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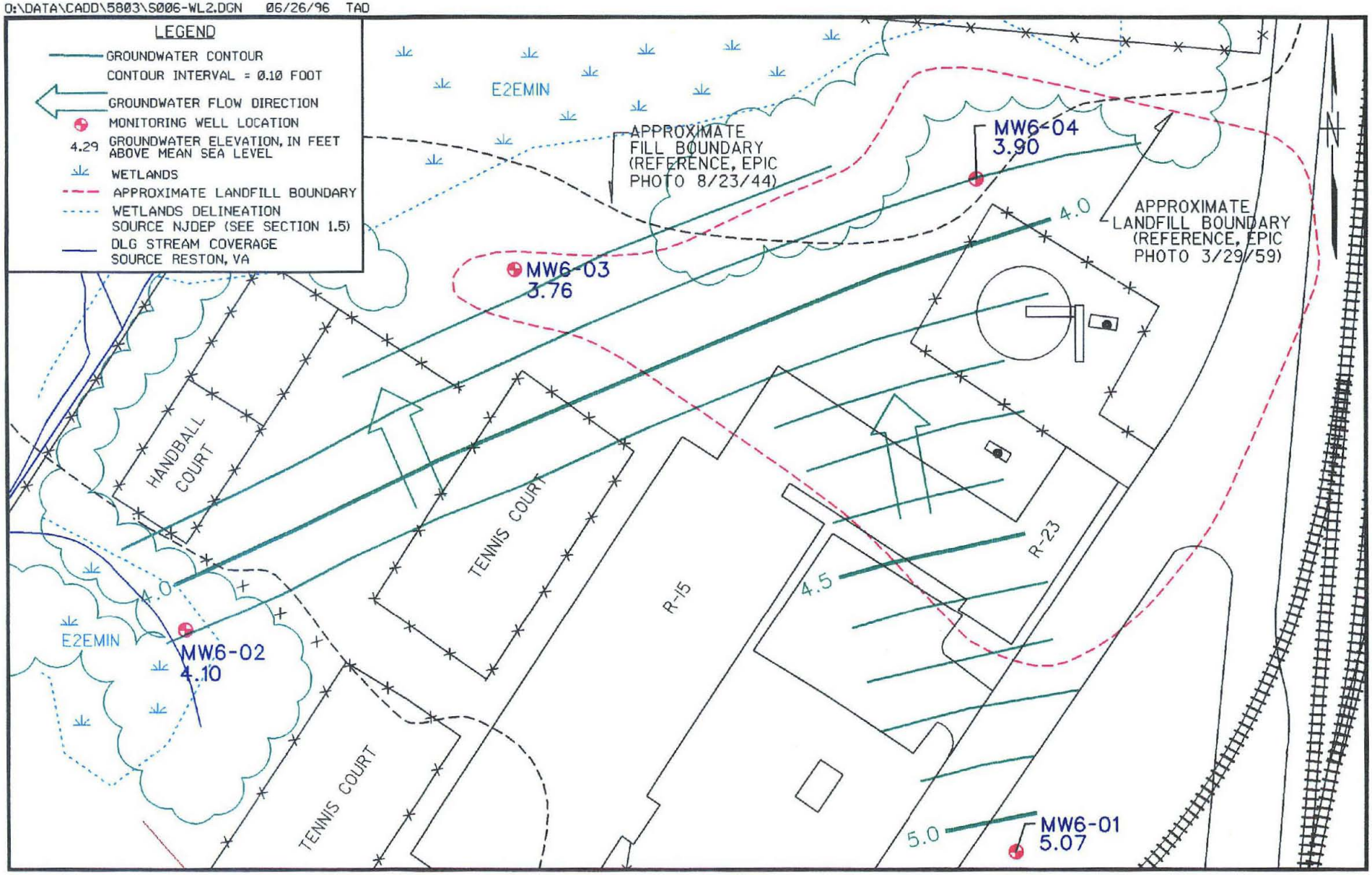

GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 6 - LANDFILL WEST OF NORMANDY ROAD

0 60 120

SCALE IN FEET

FIGURE 9-3

Brown & Root Environmental

TABLE 9-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 6
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	4 / 4	3660 - 7610	5405.00	NO	7610
ANTIMONY	NOT DETECTED	-	-	1 / 4	12.4	5.60	YES	12.4
ARSENIC	2 / 3	2.4 - 6.2	5.95	4 / 4	3 - 36.3	23.45	YES	36.3
BARIUM	3 / 3	3.9 - 10.6	14.07	4 / 4	13.7 - 138	90.05	YES	138
BERYLLIUM	1 / 3	0.57	0.67	3 / 4	0.21 - 0.99	0.48	NO	0.99
CADMIUM	NOT DETECTED	-	-	2 / 4	1.5 - 1.8	0.98	YES	1.8
CALCIUM	3 / 3	179 - 518	685.33	4 / 4	1080 - 8820	3987.50	YES	8820
CHROMIUM	3 / 3	4.3 - 56	43.13	4 / 4	18 - 77.2	40.55	NO	77.2
COBALT	1 / 3	2.1	3.30	3 / 4	4.3 - 8.2	5.20	YES	8.2
COPPER	3 / 3	1.5 - 13	12.47	4 / 4	13.1 - 228	93.25	YES	228
IRON	3 / 3	228 - 7650	6578.67	4 / 4	13800 - 52200	31825.00	YES	52200
LEAD	3 / 3	4.6 - 34.3	30.60	4 / 4	28.7 - 445	183.93	YES	445
MAGNESIUM	3 / 3	60.7 - 256	306.47	4 / 4	401 - 2460	1592.75	YES	2460
MANGANESE	3 / 3	4.6 - 9.2	13.80	4 / 4	27.1 - 451	161.10	YES	451
MERCURY	1 / 3	0.068	0.05	4 / 4	0.027 - 0.63	0.27	YES	0.63
NICKEL	2 / 3	2.1 - 6	7.93	4 / 4	2.3 - 43.8	18.98	YES	43.8
POTASSIUM	2 / 3	86.1 - 681	589.40	4 / 4	542 - 1770	1199.50	YES	1770
SELENIUM	NOT DETECTED	-	-	4 / 4	1.2 - 3.4	2.28	YES	3.4
SODIUM	3 / 3	26.6 - 116	115.27	4 / 4	28.6 - 420	243.65	YES	420
THALLIUM	NOT DETECTED	-	-	1 / 4	2.1	0.88	YES	1.85
VANADIUM	3 / 3	5.9 - 42.7	36.93	4 / 4	18.2 - 87.8	49.50	YES	87.8
ZINC	3 / 3	14.2 - 26.9	37.33	4 / 4	61.1 - 1720	588.63	YES	1720

Note: Selected COPCs are indicated in boldface type.

TABLE 9-3
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 06
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'-DDD	2 / 3	4.9 - 21	21	3 / 4	2.4 - 230	230
4,4'-DDE	1 / 3	1.7	1.7	4 / 4	5.2 - 66	66
4,4'-DDT	1 / 3	19	19	4 / 4	9.3 - 110	110
4-METHYL-2-PENTANONE	-	-	-	1 / 4	2	2
ACENAPHTHYLENE	-	-	-	1 / 4	160	160
ALPHA-CHLORDANE	-	-	-	2 / 4	22 - 48	48
ANTHRACENE	-	-	-	2 / 4	88 - 260	260
BENZO(A)ANTHRACENE	2 / 3	140 - 560	560	4 / 4	75 - 1700	1700
BENZO(A)PYRENE	2 / 3	160 - 590	590	4 / 4	110 - 2400	2064.33
BENZO(B)FLUORANTHENE	2 / 3	150 - 490	490	4 / 4	190 - 4800	4102.58
BENZO(G,H,I)PERYLENE	2 / 3	130 - 380	380	3 / 4	170 - 2600	2231.19
BENZO(K)FLUORANTHENE	2 / 3	150 - 470	470	4 / 4	66 - 1100	942.05
BIS(2-ETHYLHEXYL)PHTHALATE	-	-	-	1 / 4	880	880
CARBAZOLE	-	-	-	1 / 4	140	140
CHRYSENE	2 / 3	250 - 940	940	4 / 4	130 - 2400	2400
DIBENZ(A,H)ANTHRACENE	-	-	-	2 / 4	150 - 720	720
DIBENZOFURAN	-	-	-	1 / 4	78	78
DIELDRIN	-	-	-	2 / 4	0.31 - 1.6	1.6
ENDOSULFAN II	-	-	-	3 / 4	2.6 - 24	20.81
ENDRIN	-	-	-	1 / 4	1.6	1.6
ENDRIN KETONE	1 / 3	1.6	1.6	1 / 4	7.3	7.3
FLUORANTHENE	2 / 3	300 - 1800	1800	4 / 4	110 - 1600	1600
FLUORENE	1 / 3	190	190	1 / 4	83	83
GAMMA-CHLORDANE	1 / 3	0.095	0.095	3 / 4	0.34 - 56	56
HEPTACHLOR	-	-	-	2 / 4	0.16 - 0.35	0.35
HEPTACHLOR EPOXIDE	-	-	-	4 / 4	0.2 - 2.3	2.3
INDENO(1,2,3-CD)PYRENE	2 / 3	110 - 310	310	4 / 4	69 - 2300	1959.32
NAPHTHALENE	-	-	-	1 / 4	90	90
PHENANTHRENE	2 / 3	200 - 1900	1900	3 / 4	210 - 740	740
PYRENE	2 / 3	350 - 1900	1900	4 / 4	130 - 2000	2000
TOLUENE	1 / 3	480	480	1 / 4	31	31
XYLENE (TOTAL)	-	-	-	1 / 4	3	3

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TABLE 9-2a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	06SD01	06SD02	06SD03	06SD04	---	---	---	ARARS & TBCs
LOCATION:	06SD01	06SD02	06SD03	06SD04	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI				
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**				**mg/kg**
aluminum	7610 J	6370	3980	3660 J				-
antimony	9.3 UJ	5.2 U	5.5 U	12.4 E J				2.00 M
arsenic	21.4 E J	3.0	33.1 E	36.3 E J				8.20 L
barium	94.5 E J	138 E J	13.7	114 E J				40.0 B
beryllium	1.0 J	0.57	0.21	0.30 UJ				-
cadmium	1.5 E J	0.61 U	0.65 U	1.8 E J				1.20 L
calcium	4880 J	1170	1080	8820 J				-
chromium, total	44.5 J	18.0	22.5	77.2 J				81.0 L
cobalt	8.2 J	4.3	1.2 U	7.7 J				50.0 T
copper	111 E J	20.9	13.1	228 E J				34.0 L
iron	52200 J	13800	15300	46000 J				-
lead	221 E J	41.0 J	28.7 J	445 E J				47.0 L
magnesium	2460 J	1180	401	2330 J				-
manganese	134 J	27.1 J	32.3 J	451 J				460 O
mercury	0.38 E J	0.027	0.060	0.63 E J				0.150 L
nickel	21.7 E J	8.1	2.3	43.8 E J				21.0 L
potassium	956 J	1770	542	1530 J				-
selenium	3.2 J	1.3 J	1.2 J	3.4 J				-
sodium	335 J	191	28.6	420 J				-
thallium	2.1 J	0.73 U	0.78 U	1.3 UJ				-
vanadium	48.7 J	18.2	43.3	87.8 J				-
zinc	486 E J	87.4 J	61.1 J	1720 E J				150 L
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
acenaphthylene	740 UJ	410 U	430 U	160 E J				44.0 L
anthracene	740 UJ	88.0 J	430 U	260 J				330 F
benzo(a)anthracene	170 J	580 E	75.0 J	1700 E J				330 F
benzo(a)pyrene	160 J	460 E	110 J	2400 E J				430 L
benzo(b)fluoranthene	340 E J	700 E	190 J	4800 E J				330 F

TABLE 9-2a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	06SD01	06SD02	06SD03	06SD04	---	---	---	ARARS & TBCs
LOCATION:	06SD01	06SD02	06SD03	06SD04	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI				
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
benzo(g,h,i)perylene	170 J	440 E	430 U	2600 E J				330 F
benzo(k)fluoranthene	89.0 J	170 J	66.0 J	1100 E J				330 F
bis(2-ethylhexyl)phthalate	740 U	880	430 U	1700 U				890000000 S
carbazole	740 UJ	410 U	430 U	140 J				330 F
chrysene	240 J	570 E	130 J	2400 E J				330 F
dibenz(a,h)anthracene	740 UJ	150 J	430 U	720 E J				330 F
dibenzofuran	740 UJ	410 U	430 U	78.0 J				2000 P
fluoranthene	380 J	1200	110 J	1600 J				2900 Q
fluorene	740 UJ	83.0 J	430 U	690 UJ				540 P
indeno(1,2,3-cd)pyrene	130 J	290	69.0 J	2300 E J				330 F
naphthalene	740 UJ	410 U	430 U	90.0 J				480 P
phenanthrene	210 J	490	430 U	740 J				850 Q
pyrene	380 J	1000 E	130 J	2000 E J				660 L
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
4-methyl-2-pentanone	2.0 J	12.0 U	13.0 U	21.0 UJ				-
toluene	31.0 J	12.0 U	13.0 U	21.0 UJ				670 P
xylene (total)	3.0 J	12.0 U	13.0 U	21.0 UJ				25.0 P
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
4,4'-DDD	230 E J	43.0 E	2.4 E JN	5.4 E R				1.60 L
4,4'-DDE	66.0 E J	10.0 E	5.2 E	30.0 E J				2.20 L
4,4'-DDT	89.0 E JN	9.3 E J	14.0 E	110 E J				1.60 L
aldrin	38.0 UJ	0.077 R	2.2 U	0.35 R				-
alpha-chlordane	48.0 E J	22.0 E	0.39 R	3.5 UJ				7.00 O
dieldrin	7.3 UJ	4.0 U	0.31 J	1.6 J				52.0 Q
endosulfan II	24.0 E J	2.6 J	4.3 U	5.6 E JN				5.40 P
endrin	7.3 UJ	4.0 U	1.6 JN	6.9 UJ				20.0 Q
endrin ketone	73.0 UJ	4.0 U	4.3 U	7.3 J				20.0 Q
gamma-chlordane	56.0 E J	23.0 E	0.34 JN	3.5 UJ				7.00 O

TABLE 9-2a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	06SD01		06SD02		06SD03		06SD04		---	---	---	ARARS & TBCs
LOCATION:	06SD01		06SD02		06SD03		06SD04		---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI					
PESTICIDES	**ug/kg**		**ug/kg**		**ug/kg**		**ug/kg**					**ug/kg**
heptachlor	0.35	J	0.16	J	2.2	U	3.5	UJ				5.00 O
heptachlor epoxide	2.3	J	0.24	J	0.20	J	1.0	J				5.00 O

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

TABLE 9-2b

COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		06SD01		06SD02	06SD03	06SD04		---	---	---	ARARS & TBCs
LOCATION:		06SD01		06SD02	06SD03	06SD04		---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:		1995 RI		1995 RI	1995 RI	1995 RI					
MISCELLANEOUS											
moisture	%	54.8		18.3	23.1	52.3					-
pH		6.6	J	4.6	5.1	6.7	J				-
total organic carbon	mg/kg	33000	J	2000	8200	80000	J				-

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

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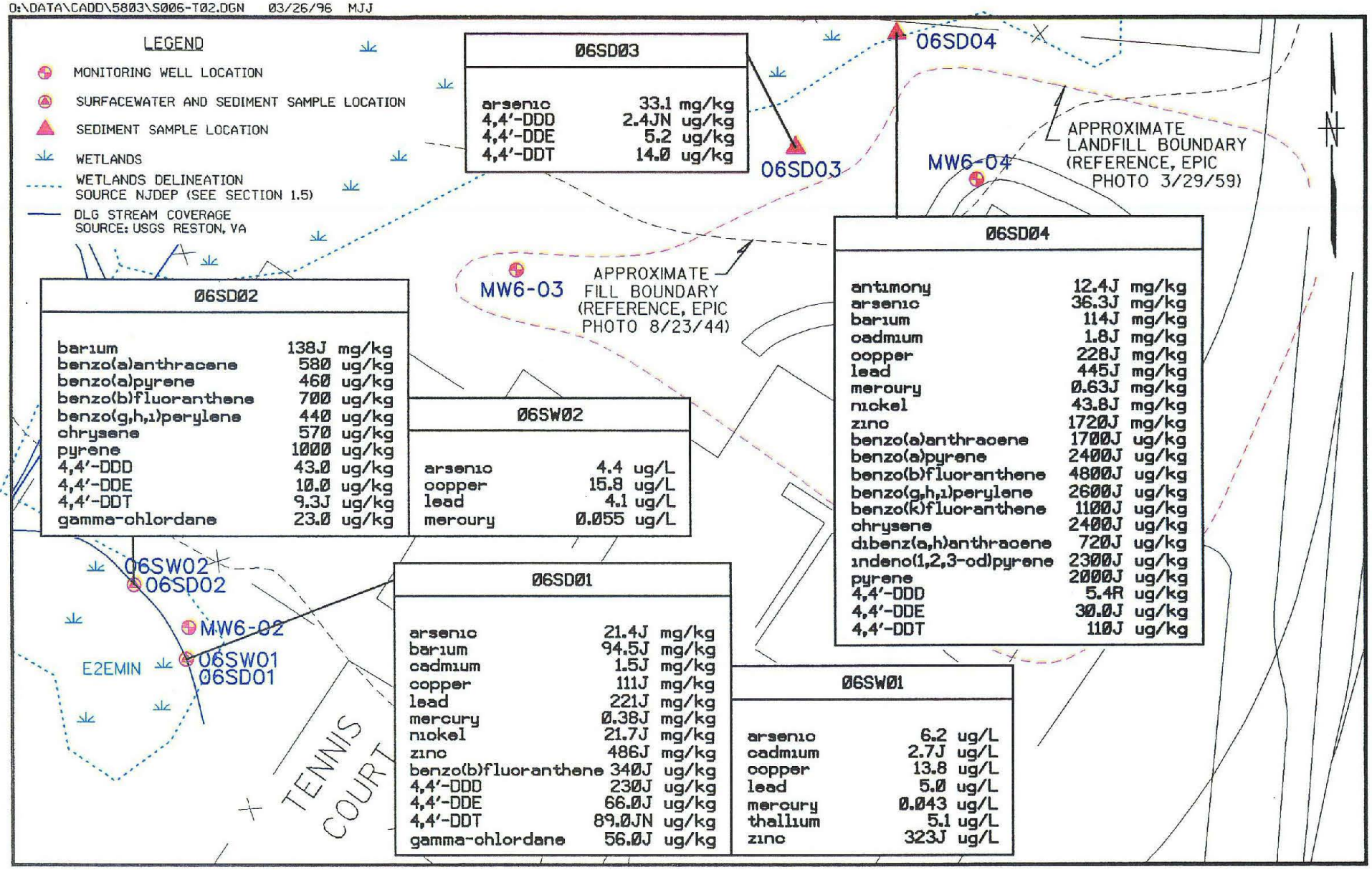

CONCENTRATIONS ABOVE SURFACE WATER AND SEDIMENT ARARS

SITE 6 - LANDFILL WEST OF NORMANDY ROAD

FIGURE 9-4

0 60 120

SCALE IN FEET

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9.5.1.1 Inorganics

Higher concentrations of metals were seen in site-related samples. Samples collected at 06 SD 01 and 06 SD 04 showed arsenic (up to 36.3 mg/kg), barium (up to 138 mg/kg), copper (up to 228 mg/kg), iron (up to 52,200 mg/kg), lead (up to 445 mg/kg), manganese (up to 451 mg/kg), nickel (up to 43.8 mg/kg), selenium (up to 3.4 mg/kg), and zinc (up to 1,720 mg/kg). Antimony and thallium were detected once at levels of 12.4 mg/kg and 2.1 mg/kg, respectively.

9.5.1.2 Organics

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 ug/kg to 1,900 ug/kg. The maximum concentrations of individual PAHs detected in the site-related sediments occurred in sample 06 SD 04 and ranged from one to 10 times higher than the concentrations in background sediment. Background samples revealed the pesticide DDT and its analogs at the following concentrations: 4,4'-DDT (19 ug/kg), 4,4'-DDE (1.7 ug/kg), and 4,4'-DDD (21 ug/kg). These pesticides were detected in the site-related sediment samples at Site 6, with 4,4'-DDT ranging from 9.3 ug/kg to 110 ug/kg, 4,4'-DDE ranging from 5.2 ug/kg to 66 ug/kg, and 4,4'-DDD ranging from 2.4 ug/kg to 230 ug/kg. Several additional pesticides were detected in site-related sediment samples that were not present in background sediments or present at much lower levels. Trace levels of xylene (3 ug/kg) and 4-methyl-2-pentanone (2 ug/kg) were each detected in one site-related sediment sample, 06 SD 01, but were not found in background sediments. Bis(2-ethylhexyl) phthlalate was present in one site-related sediment sample at a concentration of 880 ug/kg. Toluene was detected in one site-related sediment sample at a level (31 ug/kg) considerably lower than the concentration detected in a background sediment sample (480 ug/kg).

9.5.1.3 Miscellaneous Parameters

The Site 6 sediment analyses consisted of pH and TOC. TOC levels in sediment did not exceed background.

9.5.2 Groundwater

Four site-related groundwater samples (06 GW 01 through 06 GW 04) were collected at Site 6 (Figure 9-1). Tables 9-4 and 9-5 present the occurrence and distribution of inorganic and inorganic chemicals detected in background and site-related groundwater samples and compare them to background. Tables 9-4a and 9-4b present a comparison of detected compounds to ARARs and TBCs. Figure 9-5 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

TABLE 9-4
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	1320 - 2090	3386.67	4 / 4	145 - 1320	518.75	NO	1320
ARSENIC	1 / 3	5.1 - 5.1	5.60	3 / 4	5.1 - 26.8	10.5875	YES	26.8
BARIUM	3 / 3	30.4 - 78.1	105.47	4 / 4	30.4 - 64.9	47.125	NO	64.9
BERYLLIUM*	2 / 3	0.23 - 4.5	3.19	1 / 4	0.21	0.09375	NO	0.21
CADMIUM*	3 / 3	0.43 - 7	5.29	4 / 4	1.2 - 7	3.9	NO	7
CALCIUM	3 / 3	11000 - 24100	38066.67	4 / 4	5670 - 89800	31440	NO	89800
CHROMIUM	NOT DETECTED	-	-	1 / 4	1.2	0.66375	YES	1.2
COBALT	3 / 3	3.2 - 24.7	23.67	3 / 4	0.81 - 7.6	3.1775	NO	7.6
IRON*	3 / 3	1400 - 95200	66846.67	4 / 4	13400 - 95200	50025	NO	95200
MAGNESIUM	3 / 3	8610 - 17300	26940.00	4 / 4	3120 - 53000	19660	NO	53000
MANGANESE*	3 / 3	720 - 3040	3720.00	4 / 4	61.3 - 1820	754.075	NO	1820
NICKEL	3 / 3	3.7 - 43.2	38.33	4 / 4	0.76 - 5	2.6075	NO	5
POTASSIUM	3 / 3	3000 - 3620	6780.00	4 / 4	2250 - 9270	4395	NO	9270
SODIUM	3 / 3	15800 - 92500	127600.00	4 / 4	20800 - 83100	40925	NO	83100
ZINC	2 / 2	18.9 - 30.9	49.80	3 / 4	3.3 - 18.9	10.55	NO	18.9

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

TABLE 9-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 06
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

TABLE 9-4a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	06GW01	06GW02	06GW03	06GW04	---	---	ARARS & TBCs		
LOCATION:	06GW01	06GW02	06GW03	06GW04	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI					
INORGANICS	**ug/L**	**ug/L**	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**
aluminum	1320 E	420 E	190	145			-	-	200
arsenic	5.1	3.3 U	8.8 E	26.8 E			50.0	-	8.00
barium	30.4	64.9	48.2	45.0			2000	2000 a	2000
beryllium	0.11 U	0.21	0.11 U	0.11 U			4.00	4000 e	20.0
cadmium	7.0 E	1.2	2.2	5.2 E			5.00	5.00 e	4.00
calcium	22000	5670	8290	89800			-	-	-
chromium, total	1.0 U	1.0 U	1.0 U	1.2			100 *	100 a	100
cobalt	7.6	4.0	0.81	0.60 U			-	-	-
iron	95200 E	13400 E	24800 E	66700 E			-	-	300
magnesium	17300	5220	3120	53000			-	-	-
manganese	1820 E	280 E	61.3 E	855 E			-	-	50.0
nickel	3.7	5.0	0.76	1.0			100	100 a	100
potassium	3620	2250	2440	9270			-	-	-
sodium	83100 E	34800	25000	20800			-	-	50000
zinc	18.9	25.8 R	7.1	3.3			-	2000 a	5000
PESTICIDES	**ug/L**	**ug/L**	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**
endosulfan I	0.050 U	0.050 U	0.050 U	0.0021 J			-	-	0.400
gamma-BHC (Lindane)	0.0008 J	0.050 U	0.050 U	0.050 U			0.200	0.200 a	0.200

TABLE 9-4a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 9-4b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		06GW01	06GW02	06GW03	06GW04	---	ARARS & TBCs		
LOCATION:		06GW01	06GW02	06GW03	06GW04	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI				
MISCELLANEOUS									
ammonia nitrogen	**mg/L**	3.0 E	0.20 J	1.0 U	6.0 E		-	30.0	0.500
biochemical oxygen demand	**mg/L**	12.0	2.0	2.0	12.0		-	-	-
chemical oxygen demand	**mg/L**	48.0	10.0	12.0	64.0		-	-	-
chloride	**mg/L**	210	80.0	49.0	45.0		-	-	250
nitrate nitrogen	**mg/L**	0.50 U	0.12 J	0.50 U	0.50 U		10.0	10.0	-
sulfate	**mg/L**	21.0	25.0	39.0	3.0		500	-	250
total organic carbon	**mg/L**	13.0	3.0	3.0	21.0		-	-	-
total phosphorus as PO4	**mg/L**	0.20 J	0.20 U	0.20 U	0.20		-	-	-
turbidity	**ntu**	288	5.8	26.0	460		-	-	-

TABLE 9-4b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

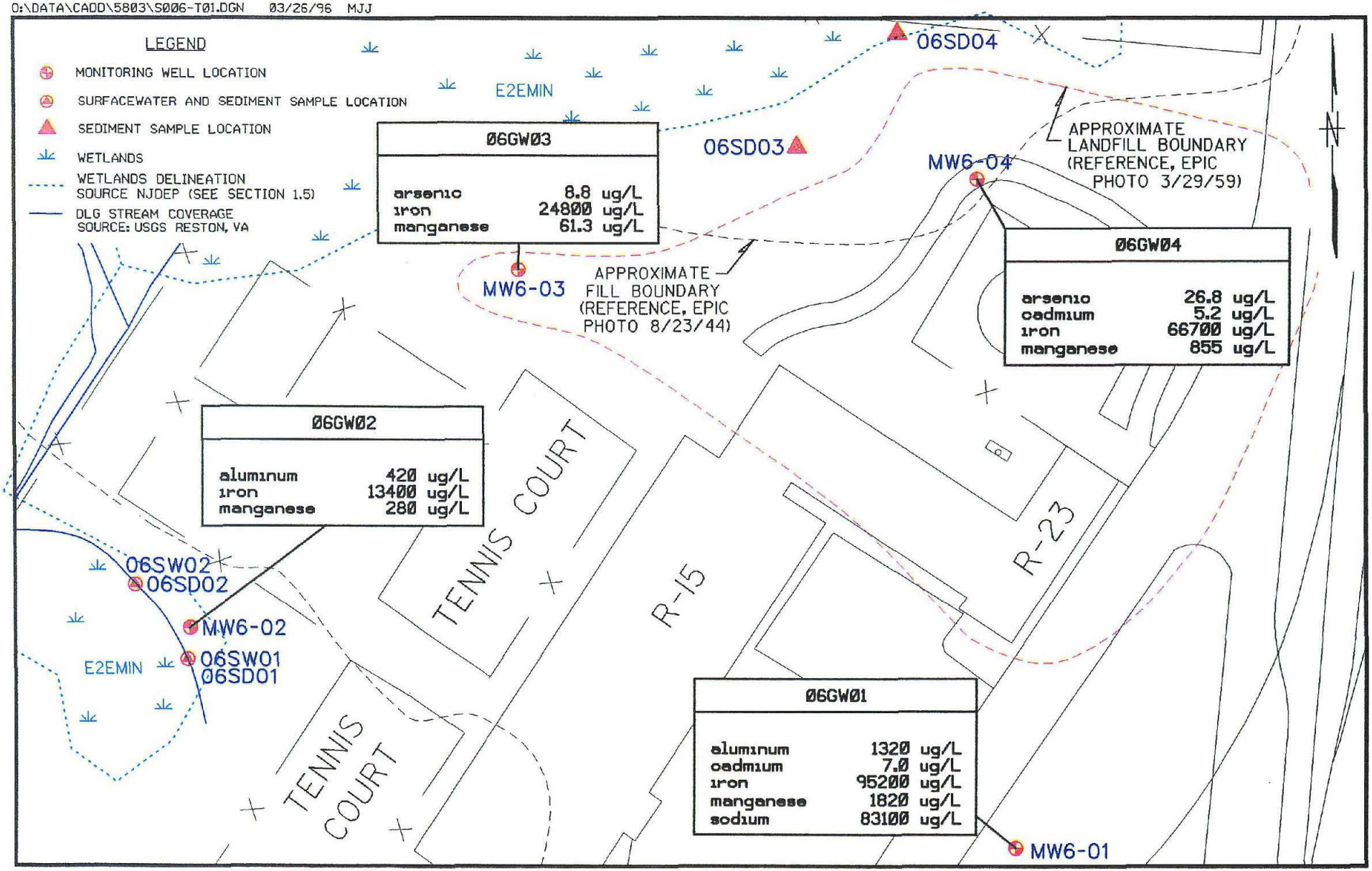
b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

O:\DATA\CADD\5803\S006-T01.DGN 03/26/96 MJJ



CONCENTRATIONS ABOVE GROUNDWATER ARARS
SITE 6 - LANDFILL WEST OF NORMANDY ROAD

FIGURE 9-5

0 60 120
SCALE IN FEET

Brown & Root Environmental

9.5.2.1 Inorganics

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 ug/L to 7.0 ug/L) and iron (13,400 ug/L to 95,200 ug/L) in samples 06 GW 01, 06 GW 02, 06 GW 03, and 06 GW 04 and manganese (1820/ug/L) in sample 06 GW 01.

9.5.2.2 Organics

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

9.5.2.3 Miscellaneous Parameters

Miscellaneous parameter analyses of four groundwater samples at Site 6 consisted of ammonia, BOD, COD, chlorides, nitrates, sulfates, TOC, phosphates, and turbidity. Most indicator parameters revealed lower concentrations in all downgradient wells than in upgradient well MW6-01. Downgradient concentrations were slightly greater than upgradient levels and greater than background ranges for ammonia and TOC in MW6-04 and for sulfate in MW6-03. Upgradient well MW6-01 revealed ammonia, chloride, BOD, COD, and TOC at concentrations greater than background. The wells containing maximum detected concentrations 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).

9.5.3 Surface Water

Two surface water samples were collected in Site 6: 06 SW 01 and 06 SW 02 (Figure 9-1). Table 9-6 presents the occurrence and distribution of inorganic and organic chemicals in site-related surface water samples and compares them to background. No organic chemicals were detected in Site 6 surface water samples. Tables 9-6a and 9-6b present a comparison of detected compounds to ARARs and TBCs. Figure 9-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

TABLE 9-6
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 6
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	305 - 500	402.50	NO	500
ARSENIC	NOT DETECTED	-	-	2 / 2	4.4 - 6.2	5.30	YES	6.2
BARIUM	3 / 3	16.3 - 34	53.73	2 / 2	45.1 - 468	256.55	YES	468
BERYLLIUM	2 / 3	0.22 - 0.33	0.41	1 / 2	0.14	0.11	NO	0.14
CADMIUM	1 / 3	0.18	0.23	1 / 2	2.7	1.39	YES	2.7
CALCIUM	3 / 3	462 - 10100	9128.00	2 / 2	20000 - 20300	20150.00	YES	20300
CHROMIUM	3 / 3	0.72 - 2.6	2.71	1 / 2	1.1	2.68	NO	1.1
COBALT	3 / 3	0.81 - 1.9	2.54	1 / 2	1.8	1.58	NO	1.8
COPPER	2 / 3	1.1 - 9.8	7.40	2 / 2	13.8 - 15.8	14.80	YES	15.8
IRON	3 / 3	160 - 702	1040.00	2 / 2	11400 - 13600	12500.00	YES	13600
LEAD	1 / 3	4.4	3.43	2 / 2	4.1 - 5	4.55	YES	5
MAGNESIUM	3 / 3	369 - 2770	2525.33	2 / 2	5360 - 5390	5375.00	YES	5390
MANGANESE	3 / 3	14 - 55.5	59.93	2 / 2	337 - 338	337.50	YES	338
MERCURY	2 / 3	0.023 - 0.028	0.04	2 / 2	0.043 - 0.055	0.05	YES	0.055
NICKEL	3 / 3	2.1 - 7.1	8.60	1 / 2	4.3	3.78	NO	4.3
POTASSIUM	2 / 3	251 - 1850	1482.33	2 / 2	3250 - 3610	3430.00	YES	3610
SELENIUM	1 / 3	3.5	4.00	2 / 2	3.9 - 4.4	4.15	YES	4.4
SODIUM	NOT DETECTED	-	-	2 / 2	53900 - 54700	54300.00	YES	54700
THALLIUM	2 / 3	3.5 - 5.5	7.00	1 / 2	5.1	3.30	NO	5.1
VANADIUM	2 / 3	0.89 - 0.9	1.32	1 / 2	1.2	1.83	YES	1.2
ZINC	3 / 3	7.6 - 29.4	32.67	2 / 2	55.4 - 323	189.20	YES	323

Note: Selected COPCs are indicated in boldface type.

TABLE 9-6a

COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	06SW01	06SW02	---	---	ARARS & TBCs				
LOCATION:	06SW01	06SW02	---	---	AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Criteria Freshwater Chronic Aquatic Life	NJDEP Surface Water Criteria for Protection of Human Health
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
aluminum	500	305 J			-	-	-	-	-
arsenic	6.2 E	4.4 E			189	0.0180	0.140	-	0.0170
barium	468 J	45.1			-	-	-	-	2000
beryllium	0.14 U	0.14			-	-	-	-	-
cadmium	2.7 E J	0.17 U			1.10 +	-	-	-	-
calcium	20000	20300			-	-	-	-	-
chromium, total	8.5 U	1.1			209 +	-	-	-	160
cobalt	2.7 U	1.8			-	-	-	-	-
copper	13.8 E	15.8 E			11.0 +	-	-	-	-
iron	13600	11400			-	-	-	-	-
lead	5.0 E	4.1 E			3.20 +	-	-	-	5.00
magnesium	5390	5360			-	-	-	-	-
manganese	338	337			-	-	-	-	-
mercury	0.043 E	0.055 E			0.0120	0.140	0.150	-	-
nickel	6.5 U	4.3			160 +	610	4600	-	516
potassium	3610	3250			-	-	-	-	-
selenium	3.9 J	4.4 J			5.00	-	-	-	10.0
sodium	53900	54700			-	-	-	-	-
thallium	5.1 E	3.0 U			-	1.70	6.30	-	1.70
vanadium	4.9 U	1.2			-	-	-	-	-
zinc	323 E J	55.4 J			101 +	-	-	-	-

TABLE 9-6a
COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L.

TABLE 9-6b

COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 6

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		06SW01	06SW02	---	ARARS & TBCs				
LOCATION:		06SW01	06SW02	---					
DATA SOURCE:		1995 RI	1995 RI		AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Freshwater Chronic Aquatic Life	NJDEP Surface Water Protection of Human Health
MISCELLANEOUS									
ammonia nitrogen	mg/L	0.40 E J	0.40 E J		-	-	-	0.0200 &	-
biochemical oxygen demand	mg/L	4.0	4.0		-	-	-	-	-
chemical oxygen demand	mg/L	23.0	19.0		-	-	-	-	-
chloride	mg/L	100	101		-	-	-	230	230
nitrate nitrogen	mg/L	1.1	0.50		-	10.0	-	-	10.0
total hardness	mg/L	65.0	65.0		-	-	-	-	-
total organic carbon	mg/L	6.0	6.0		-	-	-	-	-
total phosphorus as PO4	mg/L	0.80	0.70 R		-	-	-	-	-
turbidity	ntu	57.0	48.0		-	-	-	-	-

TABLE 9-6b
COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L

& - Value represents the more stringent of criteria for freshwaters classified as FW2-NT, FW2-TP, and FW2-TM

9.5.3.1 Inorganics

The site-related samples showed the presence of all the metals listed above in addition to arsenic. Concentrations of the following metals were greater than background in both samples: arsenic, iron, manganese, and selenium. Sample 06 SW 01 also revealed barium at a level greater than background.

9.5.3.2 Miscellaneous Parameters

Miscellaneous parameter analyses of the two 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 (op. cit.).

9.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 6 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 9.6.1. Persistence of detected chemicals in the environment is discussed in Section 9.6.2. Section 9.6.3 presents a brief discussion of contaminant trends.

9.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 6 indicate 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. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

Low levels of two pesticides were detected in groundwater samples. Endosulfan I (downgradient) and gamma-BHC (upgradient) are considered somewhat mobile in groundwater, since their solubilities and 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 06 GW 02, 06 GW 03, and 06 GW 04 revealed elevated concentrations of cadmium, iron, and manganese. However, these data do not suggest migration of inorganic contaminants from the site because upgradient sample 06 GW 01 exhibited the same metals at higher concentrations.

No organics were detected in surface water. Higher concentration of organics detected in the sediments may be attributable to the organic carbon present in the sediments that tends to bind the heavier organics such as PCBs and PAHs.

9.6.2 Contaminant Persistence

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

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

9.6.3 Observed Chemical Contaminant Trends

Surface water samples at Site 6 do not demonstrate continuous chemical migration impact from the landfill. The detected sediment contamination could be the result of runoff and erosional dispersion. Organic compounds in sediment fall into three classes: PAHs (which are considered relatively immobile), pesticides (which have varying degrees of mobility), and volatiles (which are 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.

9.6.4 Conclusions

Runoff and erosional dispersion may allow limited migration of contaminated sediments although the compounds found in the sediments may not originate at Site 6. An attempt to obtain surface water samples/sediments from landfill seeps was not possible due to an extended period of dry weather. Detected chemicals in the groundwater indicate the possibility of limited groundwater impacts for certain metals and Endosulfan I at a very low level.

9.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 6. The risk assessment was performed using the approach outlined in Section 2.4. Tables 9-7 through 9-9 provide the selected COPCs and representative concentrations of inorganics and organics in site-related sediment, groundwater, and surface water (inorganics only), respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than the guideline target acceptable cancer risk range and greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 9.7.1.5 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

9.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential, recreational, and industrial receptors).

9.7.1.1 Future Industrial Employee

The conservative preliminary baseline risk assessment yielded estimated total cancer risks of approximately 1E-04 for the future industrial employee assuming exposure to COPCs in groundwater at Site 6. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of these risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 9.7.1.4 and presented for groundwater in Tables 9-10 and 9-11, respectively.

TABLE 9-7
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 6
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	7610	NONPARAMETRIC
ANTIMONY	12.4	NONPARAMETRIC
ARSENIC	36.3	NONPARAMETRIC
BARIUM	138	NONPARAMETRIC
BERYLLIUM	0.99	NONPARAMETRIC
CADMIUM	1.8	NONPARAMETRIC
CHROMIUM	77.2	NONPARAMETRIC
COBALT	8.2	NONPARAMETRIC
COPPER	228	NONPARAMETRIC
IRON	52200	NONPARAMETRIC
LEAD	445	NONPARAMETRIC
MANGANESE	451	NONPARAMETRIC
MERCURY	0.63	NONPARAMETRIC
NICKEL	43.8	NONPARAMETRIC
SELENIUM	3.4	NONPARAMETRIC
THALLIUM	1.85	NORMAL
VANADIUM	87.8	NONPARAMETRIC
ZINC	1720	NONPARAMETRIC
4,4'-DDD*	230	NONPARAMETRIC
4,4'-DDE*	66	NONPARAMETRIC
4,4'-DDT*	110	NONPARAMETRIC
4-METHYL-2-PENTANONE*	2	NONPARAMETRIC
ACENAPHTHYLENE*	160	NONPARAMETRIC
ALPHA-CHLORDANE*	48	NONPARAMETRIC
ANTHRACENE*	260	NONPARAMETRIC
BENZO(A)ANTHRACENE*	1700	NONPARAMETRIC
BENZO(A)PYRENE*	2064.33	NORMAL
BENZO(B)FLUORANTHENE*	4102.58	NORMAL
BENZO(G,H,I)PERYLENE*	2231.19	NORMAL
BENZO(K)FLUORANTHENE*	942.05	NORMAL
BIS(2-ETHYLHEXYL)PHTHALATE*	880	NONPARAMETRIC
CARBAZOLE*	140	NONPARAMETRIC
CHRYSENE*	2400	NONPARAMETRIC
DIBENZ(A,H)ANTHRACENE*	720	NONPARAMETRIC
DIBENZOFURAN*	78	NONPARAMETRIC
DIELDRIN*	1.6	NONPARAMETRIC
ENDOSULFAN II*	20.81	NORMAL
ENDRIN*	1.6	NONPARAMETRIC
ENDRIN KETONE*	7.3	NORMAL
FLUORANTHENE*	1600	NONPARAMETRIC
FLUORENE*	83	NONPARAMETRIC
GAMMA-CHLORDANE*	56	NONPARAMETRIC
HEPTACHLOR*	0.35	NONPARAMETRIC
HEPTACHLOR EPOXIDE*	2.3	NONPARAMETRIC
INDENO(1,2,3-CD)PYRENE*	1959.32	NORMAL
NAPHTHALENE*	90	NONPARAMETRIC
PHENANTHRENE*	740	NONPARAMETRIC
PYRENE*	2000	NONPARAMETRIC
TOLUENE*	31	NONPARAMETRIC
XYLENE (TOTAL)*	3	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

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TABLE 9-8
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 6 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ARSENIC	26.8	NONPARAMETRIC
BERYLLIUM	0.21	LOGNORMAL
CADMIUM	7	NONPARAMETRIC
IRON	95200	NONPARAMETRIC
MANGANESE	1820	NONPARAMETRIC
ENDOSULFAN I	0.0021	LOGNORMAL
GAMMA-BHC (LINDANE)	0.0008	LOGNORMAL

TABLE 9-9
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE WATER - SITE 6 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	500	NONPARAMETRIC
ARSENIC	6.2	NONPARAMETRIC
BARIUM	468	NONPARAMETRIC
BERYLLIUM	0.14	NONPARAMETRIC
CADMIUM	2.7	NONPARAMETRIC
COBALT	1.8	NONPARAMETRIC
COPPER	15.8	NONPARAMETRIC
IRON	13600	NONPARAMETRIC
LEAD	5	NONPARAMETRIC
MANGANESE	338	NONPARAMETRIC
MERCURY	0.055	NONPARAMETRIC
SELENIUM	4.4	NONPARAMETRIC
VANADIUM	1.2	NONPARAMETRIC
ZINC	323	NONPARAMETRIC

9.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 6. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of cancer risks; ingestion and dermal contact contributed to non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 9.7.1.4 and presented for groundwater in Tables 9-12 and 9-13, respectively.

9.7.1.3 Future Recreational Receptor

The estimated total cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 6 are 9.3E-07 (ingestion) and 2.1E-07 (dermal contact). The cancer risks for exposure to COPCs in surface water during wading at Site 6 are 1.9E-07 (ingestion) and 3.6E-08 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range.

The estimated individual noncarcinogenic HQs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 6 are less than 1.0 for ingestion and dermal contact exposure pathways. The estimated individual noncarcinogenic HQs for exposure to COPCs in surface water during wading at Site 6 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic health effects are not anticipated when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to sediment at Site 6 in Tables 9-14 and 9-15, respectively. Estimated carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to surface water at Site 6 in Tables 9-16 and 9-17, respectively.

TABLE 9-10
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
ENDOSULFAN I	N/A	N/A
GAMMA-BHC (LINDANE)	3.6E-09	2.3E-10
ARSENIC	1.4E-04	6.1E-08
TOTAL RISK	1.4E-04	6.1E-08

NA = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-10a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
ENDOSULFAN I	N/A	N/A
GAMMA-BHC (LINDANE)	4.0E-10	3.7E-11
ARSENIC	6.1E-06	3.8E-09
TOTAL RISK	6.1E-06	3.8E-09

NA = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-11
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
ENDOSULFAN I	3.4E-06	2.9E-07
GAMMA-BHC (LINDANE)	2.6E-05	1.7E-06
ARSENIC	8.7E-01	3.8E-04

NA = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-12
RME CARCINOGENIC RISK TO FUTURE RESIDENTIÀL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
ENDOSULFAN I	N/A	N/A	N/A
GAMMA-BHC (LINDANE)	1.5E-08	7.4E-09	3.9E-08
ARSENIC	6.0E-04	1.4E-06	N/A
TOTAL RISK	6.0E-04	1.4E-06	3.9E-08

NA = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-12a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
ENDOSULFAN I	N/A	N/A	N/A
GAMMA-BHC (LINDANE)	2.2E-09	1.2E-09	2.2E-09
ARSENIC	3.4E-05	7.5E-08	N/A
TOTAL RISK	3.4E-05	7.6E-08	2.2E-09

NA = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-13
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GW BY TARGET ORGAN					
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
ENDOSULFAN I	2.2E-05	2.2E-05		2.2E-05		1.1E-05	N/A
GAMMA-BHC (LINDANE)	1.7E-04			1.7E-04	1.7E-04	6.4E-05	N/A
ARSENIC	5.7E+00		5.7E+00			1.2E-02	N/A
	HI BY TARGET ORGAN	2.2E-05	5.7E+00	1.9E-04	1.7E-04		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-13a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 6
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GW INGESTION BY TARGET ORGAN					
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
ENDOSULFAN I	1.0E-05	1.0E-05		1.0E-05		7.5E-06	N/A
GAMMA-BHC (LINDANE)	8.0E-05			8.0E-05	8.0E-05	4.3E-05	N/A
ARSENIC	1.1E+00		1.1E+00			3.1E-03	N/A
	HI BY TARGET ORGAN	1.0E-05	1.1E+00	9.0E-05	8.0E-05		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-14
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 6
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDD	6.0E-10	1.5E-10
4,4'-DDE	2.5E-10	6.1E-11
4,4'-DDT	4.1E-10	1.0E-10
4-METHYL-2-PENTANONE	N/A	N/A
ACENAPHTHYLENE	N/A	N/A
ALPHA-CHLORDANE	6.8E-10	1.7E-10
ANTHRACENE	N/A	N/A
BENZO(A)ANTHRACENE	1.4E-08	5.4E-09
BENZO(A)PYRENE	1.7E-07	2.2E-07
BENZO(B)FLUORANTHENE	3.3E-08	1.3E-08
BENZO(G,H,I)PERYLENE	N/A	N/A
BENZO(K)FLUORANTHENE	7.5E-10	3.0E-10
BIS(2-ETHYLHEXYL)PHTHALATE	1.4E-10	5.3E-11
CARBAZOLE	3.1E-11	6.1E-12
CHRYSENE	1.9E-10	7.6E-11
DIBENZ(A,H)ANTHRACENE	5.8E-08	1.1E-07
DIBENZOFURAN	N/A	N/A
DIELDRIN	2.8E-10	1.1E-10
ENDOSULFAN II	N/A	N/A
ENDRIN	N/A	N/A
ENDRIN KETONE	N/A	N/A
FLUORANTHENE	N/A	N/A
FLUORENE	N/A	N/A
GAMMA-CHLORDANE	8.0E-10	2.0E-10
HEPTACHLOR	1.7E-11	8.5E-12
HEPTACHLOR EPOXIDE	2.3E-10	1.1E-10
INDENO(1,2,3-CD)PYRENE	1.6E-08	6.2E-09
NAPHTHALENE	N/A	N/A
PHENANTHRENE	N/A	N/A
PYRENE	N/A	N/A
TOLUENE	N/A	N/A
XYLENE (TOTAL)	N/A	N/A
ALUMINUM	N/A	N/A
ANTIMONY	N/A	N/A
ARSENIC	6.0E-07	2.5E-08
BARIUM	N/A	N/A
BERYLLIUM	4.7E-08	1.8E-07
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COBALT	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
NICKEL	N/A	N/A
SELENIUM	N/A	N/A
THALLIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	9.3E-07	5.7E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

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TABLE 9-15
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 6
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDD	NA	NA
4,4'-DDE	NA	NA
4,4'-DDT	2.8E-05	7.0E-06
4-METHYL-2-PENTANONE	3.2E-09	6.3E-10
ACENAPHTHYLENE	NA	NA
ALPHA-CHLORDANE	1.0E-04	2.5E-05
ANTHRACENE	1.1E-07	3.4E-08
BENZO(A)ANTHRACENE	NA	NA
BENZO(A)PYRENE	NA	NA
BENZO(B)FLUORANTHENE	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA
BENZO(K)FLUORANTHENE	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	5.6E-06	2.2E-06
CARBAZOLE	NA	NA
CHRYSENE	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA
DIBENZOFURAN	2.5E-06	4.9E-07
DIELDRIN	4.1E-06	1.6E-06
ENDOSULFAN II	4.4E-07	1.5E-07
ENDRIN	6.8E-07	2.1E-07
ENDRIN KETONE	NA	NA
FLUORANTHENE	5.1E-06	2.0E-06
FLUORENE	2.7E-07	1.1E-07
GAMMA-CHLORDANE	1.2E-04	3.0E-05
HEPTACHLOR	8.9E-08	4.4E-08
HEPTACHLOR EPOXIDE	2.3E-05	1.1E-05
INDENO(1,2,3-CD)PYRENE	NA	NA
NAPHTHALENE	2.9E-07	1.1E-07
PHENANTHRENE	NA	NA
PYRENE	8.5E-06	2.6E-06
TOLUENE	2.0E-08	7.8E-09
XYLENE (TOTAL)	1.9E-10	8.4E-11
ALUMINUM	9.7E-04	7.7E-04
ANTIMONY	4.0E-03	3.1E-03
ARSENIC	1.5E-02	6.4E-04
BARIUM	2.5E-04	2.5E-04
BERYLLIUM	2.5E-05	1.0E-04
CADMIUM	4.6E-04	3.6E-04
CHROMIUM	2.0E-03	3.9E-03
COBALT	1.7E-05	1.4E-05
COPPER	7.3E-04	NA
IRON	2.2E-02	NA
LEAD	NA	NA
MANGANESE	1.2E-02	NA
MERCURY	2.7E-04	NA
NICKEL	2.8E-04	NA
SELENIUM	8.7E-05	NA
THALLIUM	3.0E-03	NA
VANADIUM	1.6E-03	NA
ZINC	7.3E-04	NA

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-16
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 6
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALUMINUM	N/A	N/A
ARSENIC	1.0E-07	5.0E-09
BARIUM	N/A	N/A
BERYLLIUM	6.6E-09	3.1E-08
CADMIUM	N/A	N/A
COBALT	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
SELENIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	1.1E-07	3.6E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 9-17
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 6
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALUMINUM	6.4E-05	6.0E-05
ARSENIC	2.6E-03	1.3E-04
BARIUM	8.5E-04	9.9E-04
BERYLLIUM	3.6E-06	1.7E-05
CADMIUM	6.9E-04	6.4E-04
COBALT	3.8E-06	3.6E-06
COPPER	5.1E-05	3.9E-06
IRON	5.8E-03	5.4E-03
LEAD	N/A	N/A
MANGANESE	8.6E-03	1.3E-02
MERCURY	2.3E-05	3.6E-05
SELENIUM	1.1E-04	6.5E-06
VANADIUM	2.2E-05	1.0E-04
ZINC	1.4E-04	2.6E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

9.7.1.4 Lead Results

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 from previous investigations.

The IEUBK Lead Model was not applied at this site since lead was not detected in groundwater samples and because of the absence of surface soil and subsurface soil sampling at this site.

9.7.1.5 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 6 for future residential and future industrial receptors assuming exposure to COPCs in groundwater.

Comparison to Background

Beryllium, cadmium, iron, and manganese were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 9-4 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

As discussed in Section 2.4.6.2, groundwater cancer risks were recalculated for future residential and future industrial receptors. After these steps, the final RME cancer risks are still greater than the 1E-04 to 1E-06 target acceptable range for the future residential receptor (6.0E-04, via groundwater ingestion) and for the future industrial receptor (1.4E-04, via groundwater ingestion). Arsenic is the principal COPC contributing to groundwater RME cancer risks. Estimated RME carcinogenic risks are presented for future industrial receptors exposed to groundwater at Site 6 in Table 9-10 and for future residential receptors exposed to groundwater at Site 6 in Table 9-12.

Consideration of Target Organ Grouping

The revised RME HIs are less than 1.0 for the future industrial receptor but are greater than 1.0 for the residential child. Therefore, groundwater noncarcinogenic risks for the future residential child were grouped according to target organ. The resulting final RME HIs are greater than 1.0 for arsenic (HI of 5.7; target organ - skin). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. RME noncarcinogenic HIs are presented for future industrial receptors exposed to groundwater at Site 6 in Table 9-11 and for future residential receptors exposed to groundwater at Site 6 in Table 9-13.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate cancer and non-cancer risks for exposure to COPCs in groundwater for future residential receptors and cancer risks for the future industrial employee. Estimated total central tendency cancer risks for exposure to groundwater (future residential and future industrial receptors) are within the mid-range of the target acceptable risk range. 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. However, for groundwater ingestion by the future residential child, a central tendency HI of 1.1 was calculated for the skin (attributable to arsenic). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks are presented for exposure to groundwater for future industrial receptors in Table 9-10a and for future residential receptors in Table 9-12a. Estimated central tendency noncarcinogenic risks are presented for exposure to groundwater for the future residential child in Table 9-13a.

9.7.2 Conclusions

Sediment, groundwater, and surface water were sampled at Site 6. The potential receptors considered for this site were future industrial, residential, and recreational receptors. The RME cancer risks associated with future industrial (groundwater) and future residential (groundwater) exposure scenarios exceeded 1E-04, the upper end of the target risk range. Arsenic (via ingestion of groundwater) was the major COPC that contributed to the cancer risks for these exposure scenarios. However, these RME estimates are probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

Noncarcinogenic HQs associated with the future residential (groundwater) exposure scenario exceeded 1.0; the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Arsenic is the COPC that exceeded 1.0 for this exposure scenario. In addition, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the skin as the target organ.

The amended risk assessment procedure did not result in the elimination of all non-cancer risks above guideline limits. Arsenic by groundwater ingestion remained with HQ above 1.0.

Surface and subsurface soil were sampled in the SI. Low levels of inorganics, organics, PCBs, and pesticides were detected, all at levels below regulatory guideline limits. Low levels of metals were also found which were generally below regulatory guideline limits. These limited soil results were not used in calculating the human health risk assessment.

Currently the majority of the landfill is covered by buildings or pavement, limiting the surface/subsurface contaminant transport and exposure pathway.

Risk characterization results (total RME cancer risks and total RME noncarcinogenic HIs) are presented for all potential receptors at Site 6 in Table 9-18 for sediment, groundwater, and surface water. Table 9-18a presents the relevant central tendency risk estimates associated with future industrial and future residential receptors for groundwater.

9.8 ECOLOGICAL RISK ASSESSMENT

9.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 6, formerly a landfill, constitutes approximately 4 acres. Building R-15, two tennis courts, and a handball court have been built on the landfill. The areas immediately surrounding the buildings and courts are comprised of mowed grass. Some black locust and box elder trees are located adjacent to the landfill. An extensive *Phragmites* tidal marsh is located north and west of the landfill, and portions of the landfill extend into the marsh. The landfill is 3 to 10 feet higher than the marsh area, and runoff from the landfill flows into the marsh. Some small drainageways are present near the edge of the marsh that lead to a tributary of Ware Creek approximately 1000 feet northwest of Site 6. Ware Creek eventually drains to Sandy Hook Bay. Soils in the wetland areas next to the landfill are Sulfaquents, black muck soils that are saturated to the surface.

RI site 12 is located approximately 150 feet south of Site 6, Site 17 is located approximately 500 feet to the southwest, and Site 15 is located approximately 1,500 feet to the south. All four sites are located within the Ware Creek watershed. Site 6 contains no ecological habitat, but the adjacent marsh provides excellent, extensive habitat for salt marsh-related ecological receptors. Most semi-aquatic mammals and wading birds found in the Waterfront area are expected to use the marsh. No sensitive habitats, other than the marsh, and no threatened or endangered species are known to exist on or near Site 6.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major contaminant release pathways from the landfill are overland runoff and infiltration of contaminants. Overland runoff from precipitation may carry constituents to nearby surface waters, sediments, and soils, particularly to surface water and sediments in the marsh. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Groundwater from the site may

TABLE 9-18
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	9.3E-07	N/A	N/A	N/A	N/A	6.4E-02
	Dermal Contact	N/A	N/A	N/A	5.7E-07	N/A	N/A	N/A	N/A	9.3E-03
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	6.1E-08^	1.4E-06^	N/A	N/A	3.8E-04^	1.2E-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	1.1E-07	N/A	N/A	N/A	N/A	1.9E-02
	Dermal Contact	N/A	N/A	N/A	3.6E-08	N/A	N/A	N/A	N/A	2.1E-02
TOTAL		-	1.4E-04	6.0E-04	1.6E-06	-	8.7E-01	5.7E+00	-	1.1E-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
^ - Value from amended risk assessment.
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

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TABLE 9-18a
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	6.1E-06^	3.4E-05^	N/A	N/A	N/R	1.1E+00@	N/A	N/A
	Dermal Contact	N/A	3.8E-09^	7.6E-08^	N/A	N/A	N/R	3.2E-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		-	6.1E-06	3.4E-05	-	-	-	1.1E+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
^ - Value from amended risk assessment.
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

eventually discharge to surface water in the marsh; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms. Nonetheless, extensive developed areas on the landfill inhibit significant infiltration.

Exposure Routes

Terrestrial receptors at Site 6 may be exposed to soil contaminants via incidental ingestion of soil or by ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants in Site 6 surface water by using it for drinking, although this pathway is generally insignificant, since the saltwater influence makes the water unsuitable for drinking. Terrestrial vegetation may also be exposed to contaminants in soils at Site 6. However, since the marsh provides substantially more habitat than the landfill, and since terrestrial habitat on the landfill is limited and relatively poor, related exposure routes of main concern pertain to the marsh. Therefore, evaluation of risks to terrestrial plants and terrestrial receptors at Site 6 from surface soil exposure was not applicable. Aquatic organisms and semi-aquatic terrestrial organisms that use the nearby wetlands may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water although the absence of significant infiltration limits this pathway.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1995 RI activities for this site. In particular, contaminants detected in Site 6 surface water and sediments were considered preliminary COPCs. Contaminants detected in 1993 SI subsurface soil, sediment, and groundwater samples, along with 1995 RI groundwater samples, were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

9.8.1.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminated surface water and sediments. Despite the tidal marsh adjacent to some Waterfront sites and potential saltwater influence, salinity measurements from 1995 RI surface water samples at the edge of the marsh for Site

6 were quite low. Hence, freshwater-based ETs were utilized. Surface water and sediment ET values are presented in Tables 2-28 and 2-29, respectively.

9.8.3 Preliminary Exposure Assessment

Contaminant concentrations in environmental media used for this initial screening were obtained from data generated during 1995 RI activities. Data collected during the summer and fall of 1995 for surface water and sediment were evaluated. The maximum detected contaminant concentrations in surface water and sediment were used as conservative representative exposure point concentrations. In addition, 1993 SI subsurface soil, sediment, and groundwater samples, and 1995 RI groundwater samples, are discussed qualitatively in Section 9.8.3. Background concentrations presented for comparative purposes were obtained from facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

9.8.4 Risk Characterization

In Site 6 surface water, aluminum (HQ = 5.74), barium (HQ = 120.0), cadmium (HQ = 2.70), copper (HQ = 1.44), lead (HQ = 2.0), manganese (HQ = 4.23), thallium (HQ = 1.28), and zinc (HQ = 3.23) exceeded ET values and were retained as final COPCs (Table 9-19). No organic contaminants were detected in Site 6 surface waters.

In Site 6 sediments, the inorganics antimony (HQ = 6.20) and barium (HQ = 3.45) exceeded the only ET values available and were retained as final COPCs (Table 9-20). Lead and zinc exceeded both most and less conservative ET values, while several other inorganic contaminants exceeded most conservative but did not exceed less conservative ET values. These inorganics include arsenic, cadmium, copper, mercury, and nickel. As a result, all of these inorganics were retained as final COPCs. For the organics detected in sediments, alpha-chlordane (HQ = 28.2), endosulfan II (HQ = 3.85), and gamma-chlordane (HQ = 32.9) exceeded the only ET values available. The organics acenapthylene, benzo(k)fluoranthene, dibenzo(a,h,)anthrecene, chrysene, and pyrene exceeded most conservative values but did not exceed less conservative values. A number of organics exceeded both most and less conservative ET values. These include the organochlorine pesticides 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, and the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene. Aluminum, beryllium, thallium, and vanadium were conservatively retained as final COPCs in sediments since no suitable ET values were available.

The toxicological properties of final COPCs in surface water and sediment are summarized in Appendix M.

9.8.5 Summary and Conclusions

Although habitat on the landfill is limited, the marsh that surrounds the landfill provides excellent habitat for wetland ecological receptors. Most wetland organisms found in the Waterfront area are expected to utilize the salt marsh. Runoff and erosion of contaminants from the landfill toe to the marsh is possible. Groundwater-to-surface water discharge is also possible, but the absence of extensive infiltration at the site limits this contaminant migration pathway.

Subsurface soil samples were taken at the northern edge of the landfill as part of 1993 SI activities. Low levels of some VOCs and PAHs were detected, along with low levels of 4,4'-DDT, 4,4'-DDE, and the PCB compound Aroclor 1254. Relatively low concentrations of metals were also detected, including arsenic, chromium, lead, and zinc. Four sediment samples were also taken from the drainage areas at the base of the landfill during the SI. Some low levels of a few VOCs, low levels of several PAHs, and low levels of some pesticides were detected. Elevated levels of benzo(a)pyrene and some metals were also detected. Low levels of a few organics were present in SI groundwater samples, as were elevated levels of some metals, including lead and zinc. RI groundwater samples indicated that most metals concentrations were comparable to background, with the exception of slightly elevated levels of cadmium and manganese.

Surface water and sediment samples were taken in the marsh as part of 1995 RI activities to further investigate potential impacts on the wetlands, and were used for quantitative assessment. HQ values for inorganics in surface water were indicative of low potential risk, with the exception of barium, and no organics were detected. The high HQ for barium may be more a function of the only ET value available, which is heavily conservative, rather than the concentrations of barium detected. HQ values for inorganics in sediments were indicative of low potential risk, including barium, although some of the inorganics for which no suitable sediment ETs were available slightly exceeded background. Some pesticides and several PAHs were detected in sediments adjacent to the landfill. HQ values for the pesticides detected, 4,4'-DDT and its analogs, were indicative of moderate potential risk. These compounds may not originate from the landfill since they most likely were used base-wide for pest control in the past. HQ values for most PAHs detected were indicative of low potential risk, but some PAHs also slightly exceeded less conservative ET values, indicating moderate potential risk. In addition, the concentrations of most PAHs were generally higher in 1995 RI sediment samples than in 1993 SI sediment samples, suggesting active migration. Groundwater at the site flows toward the marsh, but contaminant concentrations were low in groundwater, suggesting that overland runoff and erosion from the landfill toe appear to be the main contaminant release and migration pathway.

Although concentrations of metals, pesticides, and PAHs in sediments were generally not high compared to background values, a large number of contaminants were detected and a cumulative toxic effect may be possible. It appears that landfill-related contaminants have impacted the marsh adjacent to the landfill, but the area of impact is not fully defined. For these reasons, additional surface soil samples from the

landfill toe and sediment samples further from the site appear to be needed to investigate potential erosion of contaminants and fully characterize the area of impact in the marsh from landfill-related contaminants, mainly organics. These samples may also indicate whether nearby RI sites, such as Sites 12 and 17, are also contributing contaminants to the watershed.

9.9 EVALUATION AND RECOMMENDATIONS

9.9.1 Evaluation Summary

Low metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included arsenic, aluminum, cadmium, iron, manganese and sodium.

No organic compounds were found in groundwater at concentrations above regulatory guideline.

Results of human health risk assessment concluded that calculated non cancer risks were above guideline limits for ingestion of groundwater.

Ecological risk assessment concluded that additional surface soil samples from the landfill toe and sediment samples further from the site appear to be needed to investigate potential erosion of contaminants and fully characterize the area of impact in the marsh.

9.9.2 Recommendations

Obtain additional marsh area samples to determine the extent of impacts and possible contribution from other nearby sites.

10.0 SITE 7: LANDFILL SOUTH OF "P" BARRICADES

10.1 SITE BACKGROUND AND PHYSICAL SETTING

The landfill south of "P" Barricades is a 5-acre site that, from 1965 to 1977, was used for the disposal of municipal-type solid waste and waste from Waterfront industrial operations. Disposed of materials consisted of munitions shipping wastes (dunnage, packing), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood, and small quantities of waste paint, thinners, and solvents), and domestic refuse. The site is now covered with loose sand quarried from the surrounding area. Figure 10-1 is a map of the site.

The site is characterized as an open area surrounded by woodlands and wetlands. The landfill is primarily covered with a sandy soil and is not closed with an impermeable cap. The site is vegetated with white pines and high grasses. A few bare areas are evidently due to the absence of topsoil in those areas. An unpaved road borders the site to the north, west, and south. The ground surface slopes downward to the north from approximately 160 feet MSL near MW7-03 to approximately 125 feet MSL near MW7-02. Groundwater generally flows toward the north, based on measured groundwater levels. Small marginal wetlands have formed in some areas on top of the landfill. Section 10.9.1 presents a more complete description of habitat and receptors.

10.2 PREVIOUS INVESTIGATIONS

10.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site observations. The site was not recommended for confirmation study.

During the SI in 1986 three monitoring wells were installed around the site perimeter. Groundwater samples were found to contain acetone and phthalate which were believed to be laboratory contaminants.

During the 1993 RI/FS, seven test pits were excavated and five monitoring wells were installed. A layer of trash, ranging in thickness from 2.5 to 6 feet, was encountered in five of the seven test pits. The encountered waste consisted of glass, paper, plastic, cans, and other types of household or shipboard-generated waste. Metal scrap, lumber, concrete, bricks, and other construction debris were also encountered. The cover material was thin to nonexistent. No sustained organic vapor readings were detected in any of the test pits. Two soil samples were collected from soil test pits for full TCL/TAL and TPH analysis.

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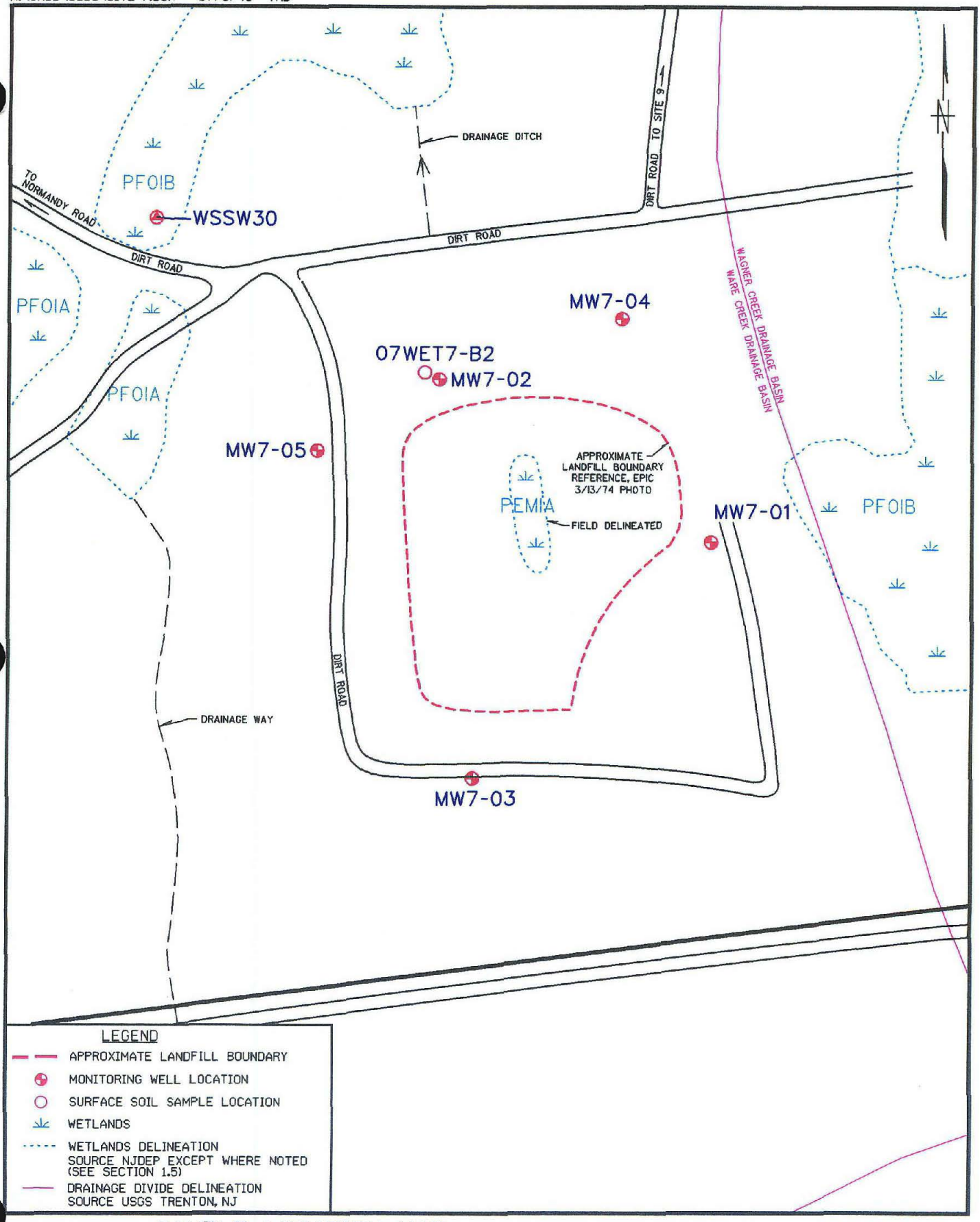

SAMPLE LOCATION MAP

FIGURE 10-1

SITE 7 - LANDFILL SOUTH OF "P" BARRICADES

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SCALE IN FEET

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Groundwater samples were submitted for full TCL/TAL, VOCs, drinking water metals analysis, and landfill indicator parameters. Volatiles were detected in wells MW7-02 and MW7-05. Chemicals often associated with laboratory contamination (methylene chloride and acetone) were detected in MW7-01. Elevated levels of metals including chromium, arsenic, and lead were detected in wells at the site. Results of the landfill parameters indicated elevated levels of COD, chlorides, and sulfates in the downgradient wells relative to the upgradient well, MW7-03. Low levels of two semivolatiles were detected in both samples taken at test pits 01 and 07.

10.2.2 Summary of Conclusions

Groundwater samples showed low levels of metals and volatile organic compounds. Ethylhexylphthalate was found in soil samples. RI test pits found mostly trash and construction debris and that the cover was thin, ranging in thickness from 0 to 0.5 feet.

10.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Sample existing wells using low-flow technique to confirm previous results.
- Compare data to background levels and risk based criteria.
- Sample downgradient surface soil to determine impact of landfill on adjacent wetland.

10.3 RI FIELD INVESTIGATIONS

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

- Sampling and analysis of groundwater from the five existing monitoring wells (Section 10.3.1).
- Measurement of static-water levels in the wells (Section 10.3.1).
- Sampling and analysis of one sediment sample (Section 10.3.2).

A survey was conducted to establish the horizontal locations and vertical elevations of the sediments surface soil sample and selected existing monitoring wells. Surveying notes are proved in Appendix F.

10.3.1 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of water-level measurements was collected on August 7, 1995, the second on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 115.00 to 139.70 feet above MSL during the first round of measurements and from approximately 112.03 to 137.44 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 10-1. Monitoring well construction data is presented in Table 10-1a.

Groundwater Sampling

Groundwater samples were obtained in July 1995 from the five existing monitoring wells (MW7-01 through MW7-05) to determine the groundwater quality at the site and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. Figure 10-1 shows sample locations. Field measurements collected during purging were pump rate (L/min), water-level measurements, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, B&R Environmental purged the wells, using the micro-purge protocol to reduce turbidity, until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purge and sample process.

The five groundwater samples (07 GW 01 through 07 GW 05) were submitted to Lancaster Laboratories for TCL VOC, TAL metals, BOD, nitrite/nitrate, turbidity, sulfates, chloride, ammonia, COD, TOC, and phosphate analyses. Sample log sheets are presented in Appendix D.

10.3.2 Sediment Soil Sample

One sediment soil sample (07 WET 07-B2) was collected north of the landfill edge to determine potential impacts to downgradient surface soils. The sample was taken in the broad drainageway of runoff from Site 7. Therefore, the sample is considered a "sediment" sample rather than a "surface soil" sample. The sample was submitted to Lancaster Laboratories for TCL VOC, TAL metals, ammonia, COD, chloride, moisture, nitrite, nitrate, sulfate, TOC, and phosphates analyses. The sample log sheet is presented in Appendix D.

Table 10-1
Site 7 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] feet	Top of PVC Riser[2]	Elevation of Water Table[2]
MW7-01	18.75	148.61	129.86	21.31	148.61	127.30
MW7-02	9.88	126.94	117.06	11.81	126.94	115.13
MW7-03	23.31	163.01	139.70	25.57	163.01	137.44
MW7-04	17.77	132.77	115.00	20.74	132.77	112.03
MW7-05	14.81	136.10	121.29	16.93	136.10	119.17

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

Table 10-1a
Site 7 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW7-01	39	147.52	148.61	NS	4	24 - 39	22 - 39	3/4/86
MW7-02	19	125.86	126.94	127.92	4	4 - 19	2.5 - 19	3/5/86
MW7-03	35	161.61	163.01	NS	4	20 - 35	18 - 35	1/24/86
MW7-04	23.50	130.96	132.77	NS	4	9 - 23.5	7 - 24[3]	2/28/91
MW7-05	24.8	134.01	136.10	NS	4	10 - 24.8	7 - 25.5[3]	2/27/91

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.
NS Not surveyed

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

NJDEP Geographic Information System data originally indicated the presence of wetlands to the east and northeast of site, but on-site inspection revealed that no wetlands were present in these areas. Surface drainage on the former landfill appears to be toward the north, therefore no sediment samples were taken east of the site.

10.3.3 Surface Water Sample

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

10.4 SITE CHARACTERISTICS

10.4.1 Geology

Regional mapping places Site 7 within the outcrop area of the Red Bank Sand. The Red Bank Sand and Tinton Sand, combined, range between 35 and 135 feet in thickness, and the soil borings are no more than 35 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Red Bank Sand and Navesink Formation. Assuming a portion of the Red Bank Sand was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Navesink Formation. In general, the borings encountered a white, yellowish-brown, and gray, micaceous, silty sand and fine- to medium-grained sand (probably representative of the Red Bank Sand), and black silt (possibly representative of the Navesink Formation).

Based upon the boring log descriptions, well MW7-03 penetrated only the Red Bank Sand, and wells MW7-01, MW7-02, MW7-04, and MW7-05 penetrated the Red Bank Sand and Navesink Formation.

10.4.2 Hydrogeology

Groundwater in the Red Bank Sand and Navesink aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 10-1. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 10-2 and 10-3, 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. There does not appear to be a significant seasonal variation in groundwater flow direction.

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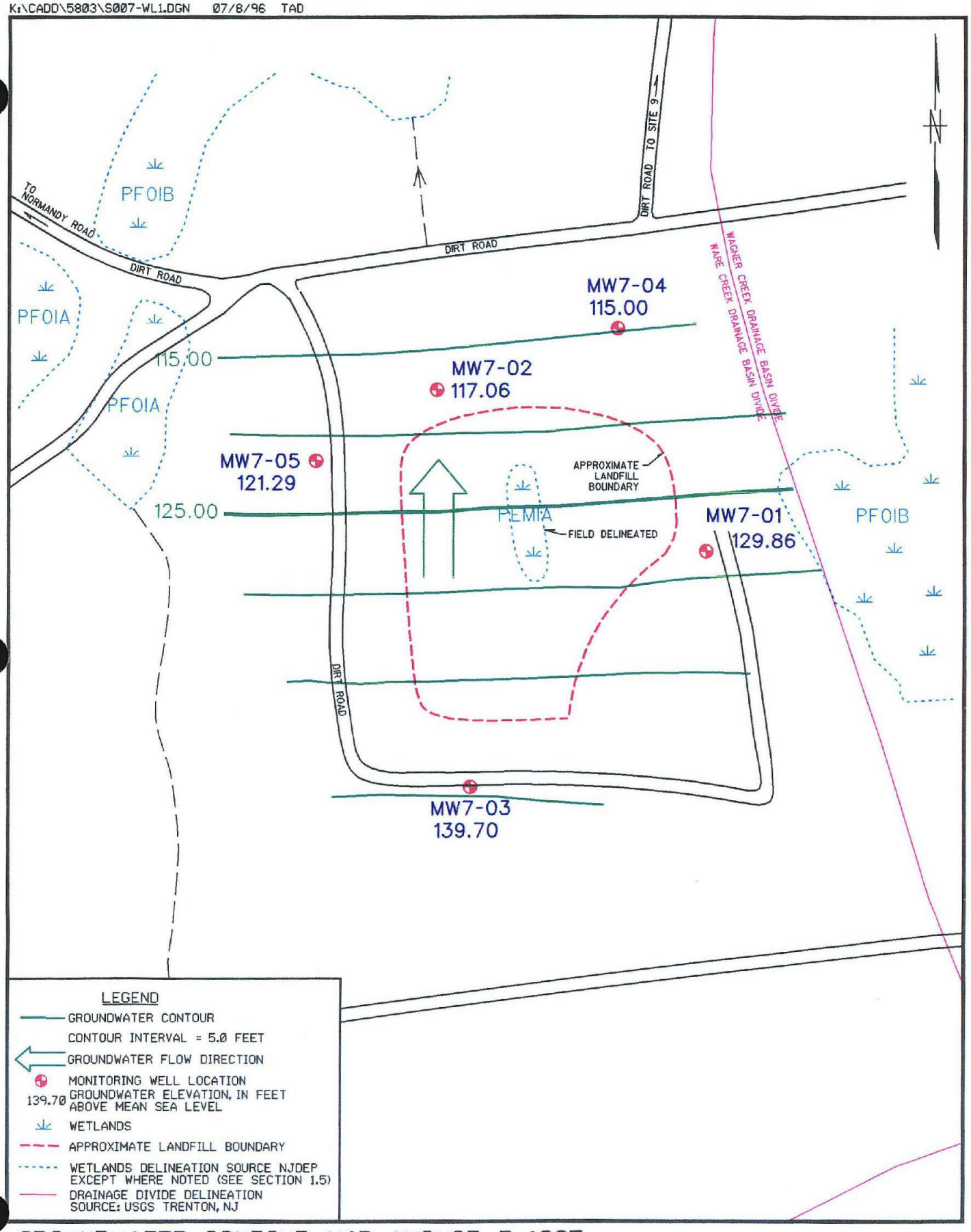

GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 7 - LANDFILL SOUTH OF "P" BARRICADES

FIGURE 10-2

0 200 400

SCALE IN FEET

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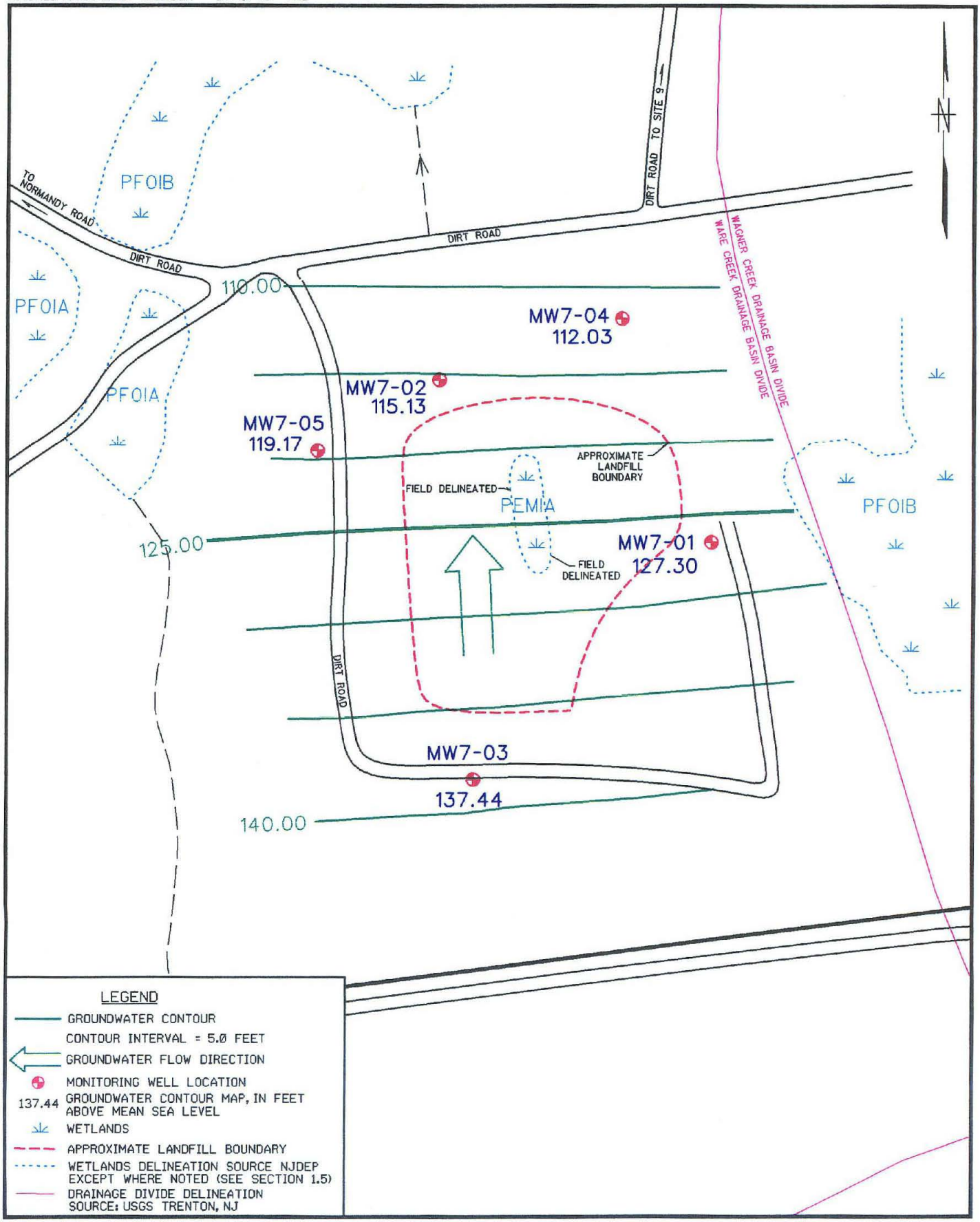


GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 7 - LANDFILL SOUTH OF "P" BARRICADES

FIGURE 10-3

0 200 400

SCALE IN FEET

Brown & Root Environmental

Based upon the boring log descriptions, well MW7-03 is screened in the Red Bank Sand, and wells MW7-01, MW7-02, MW7-04, and MW7-05 are screened across the contact between the Red Bank Sand and Navesink Formation. The hydraulic conductivities calculated for MW7-02 (Red Bank Sand and Navesink Formation) and MW7-03 (Red Bank Sand) are 9.74×10^{-4} cm/sec (2.76 ft/day) and 2.65×10^{-4} cm/sec (0.75 ft/day), respectively.

10.5 NATURE AND EXTENT OF CONTAMINATION

10.5.1 Sediment

One site-related sediment sample (07 SD WET7-B2) was collected at Site 7 (Figure 10-1). Table 10-2 presents the occurrence and distribution of inorganic chemicals detected in site-related sediment samples and compares them to background as presented in Section 31. No organic chemicals were detected in site-related sediment samples collected at Site 7. Tables 10-2a and 10-2b present a comparison of detected compounds to ARARs and TBCs. Figure 10-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

10.5.1.1 Inorganics

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

10.5.1.2 Miscellaneous Parameters

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

10.5.2 Groundwater

Five site-related groundwater samples (07 GW 01 through 07 GW 05) were collected at Site 7 (Figure 10-1). Tables 10-3 and 10-4 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples and compares them to background. Tables 10-3a and 10-3b present a comparison of detected compounds to ARARs and TBCs. Figure 10-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

TABLE 10-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 7
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	1 / 1	2770	2770.00	NO	2770
ARSENIC	2 / 3	2.4 - 6.2	5.95	1 / 1	11.7	11.70	YES	11.7
BARIUM	3 / 3	3.9 - 10.6	14.07	1 / 1	8.6	8.60	NO	8.6
CALCIUM	3 / 3	179 - 518	685.33	1 / 1	568	568.00	NO	568
CHROMIUM	3 / 3	4.3 - 56	43.13	1 / 1	13.2	13.20	NO	13.2
COPPER	3 / 3	1.5 - 13	12.47	1 / 1	3.6	3.60	NO	3.6
IRON	3 / 3	228 - 7650	6578.67	1 / 1	9950	9950.00	YES	9950
LEAD	3 / 3	4.6 - 34.3	30.60	1 / 1	19.6	19.60	NO	19.6
MAGNESIUM	3 / 3	60.7 - 256	306.47	1 / 1	243	243.00	NO	243
MANGANESE	3 / 3	4.6 - 9.2	13.80	1 / 1	38.1	38.10	YES	38.1
POTASSIUM	2 / 3	86.1 - 681	589.40	1 / 1	332	332.00	NO	332
SODIUM	3 / 3	26.6 - 116	115.27	1 / 1	28.7	28.70	NO	28.7
VANADIUM	3 / 3	5.9 - 42.7	36.93	1 / 1	19.3	19.30	NO	19.3
ZINC	3 / 3	14.2 - 26.9	37.33	1 / 1	33.7	33.70	NO	33.7

Note: Selected COPCs are indicated in boldface type.

TABLE 10-2a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 7

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	07SDWET7-B2	---	---	---	---	---	---	ARARS & TBCs
LOCATION:	07SDWET7-B2	---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI							
INORGANICS	**mg/kg**							**mg/kg**
aluminum	2770							-
arsenic	11.7 E							8.20 L
barium	8.6							40.0 B
calcium	568							-
chromium, total	13.2							81.0 L
copper	3.6							34.0 L
iron	10000							-
lead	19.6							47.0 L
magnesium	243							-
manganese	38.1							460 O
potassium	332							-
sodium	28.7							-
vanadium	19.3							-
zinc	33.7							150 L

TABLE 10-2a
COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCS - SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

TABLE 10-2b

COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 7

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		07SDWET7-B2		---	---	---	---	---	---	ARARS & TBCs
LOCATION:		07SDWET7-B2		---	---	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:		1995 RI								
MISCELLANEOUS										
chemical oxygen demand	mg/kg	15000								-
chloride	mg/kg	1.6	J							-
moisture	%	17.3								-
nitrate nitrogen	mg/kg	2.0								-
sulfate	mg/kg	7.0								-
total organic carbon	mg/kg	2600								-
total phosphorus as PO4	mg/kg	500								-

TABLE 10-2b
COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

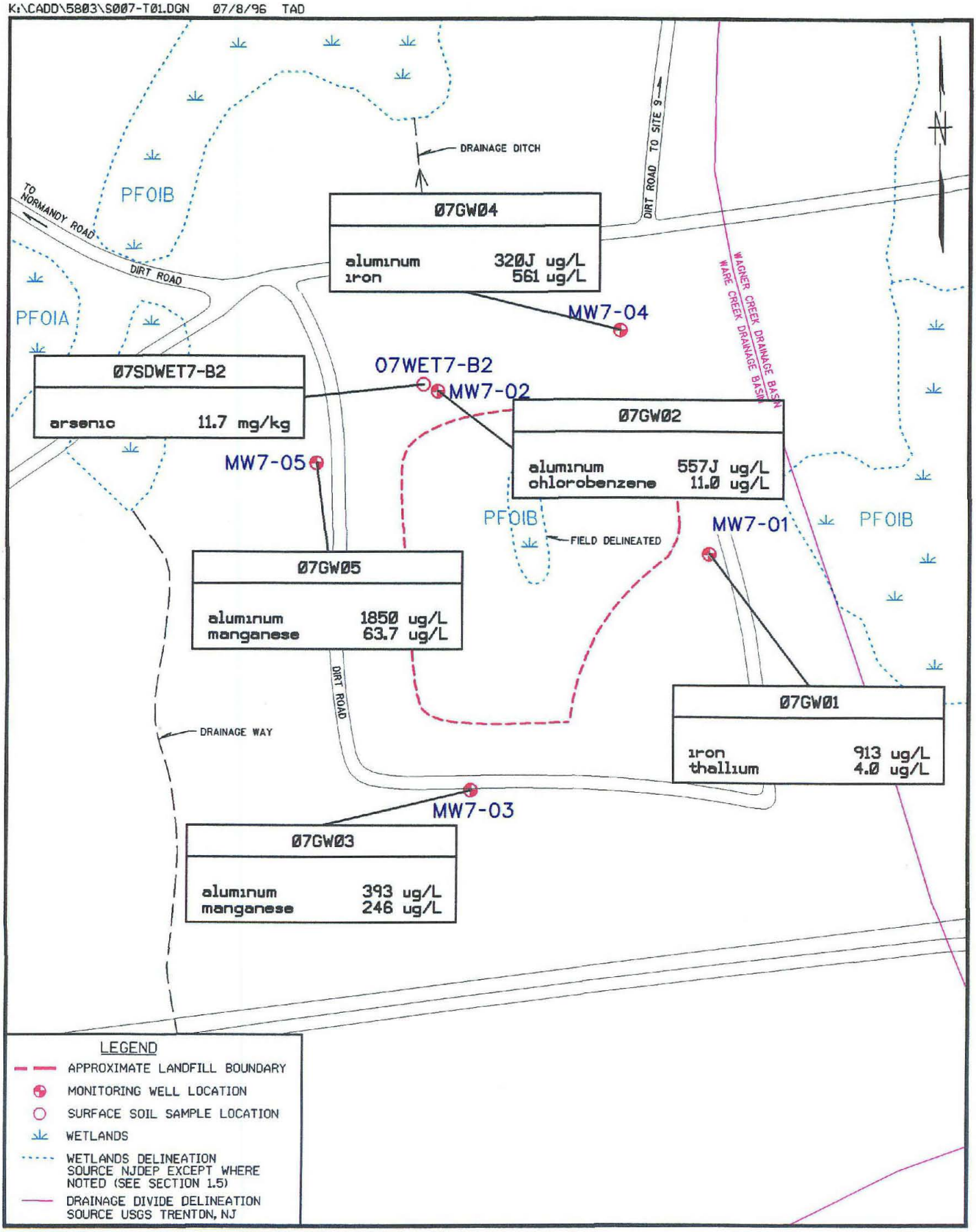
Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

K:\CADD\5803\S007-T01.DGN 07/8/96 TAD



CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 7 - LANDFILL SOUTH OF "P" BARRICADES

FIGURE 10-4

0 200 400

SCALE IN FEET

Brown & Root Environmental

TABLE 10-3
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	2 / 2	242 - 393	635.00	5 / 5	174 - 1850	658.80	YES	1307.14
BARIUM*	2 / 2	42.2 - 50.2	92.40	5 / 5	11.9 - 112	43.42	NO	112
BERYLLIUM*	1 / 2	0.4 - 0.4	0.46	2 / 5	0.4 - 0.66	0.245	NO	0.66
CALCIUM	2 / 2	1460 - 5870	7330.00	5 / 5	916 - 1480	1247.2	NO	1480
CHROMIUM	NOT DETECTED	-	-	1 / 5	1.9	0.768	YES	1.90
COBALT*	2 / 2	8.4 - 28.2	36.60	5 / 5	0.85 - 28.2	7.71	NO	18.89
COPPER	NOT DETECTED	-	-	2 / 5	1.7 - 1.8	0.931	YES	1.80
IRON	2 / 2	298 - 706	1004.00	5 / 5	63.7 - 913	396.14	NO	913
LEAD	NOT DETECTED	-	-	1 / 5	2.3	1.06	YES	2.23
MAGNESIUM	2 / 2	1800 - 2120	3920.00	5 / 5	594 - 6920	2469.4	NO	6920
MANGANESE	2 / 2	192 - 246	438.00	5 / 5	15.2 - 246	78.56	NO	169.88
MERCURY	1 / 2	0.047 - 0.047	0.05	4 / 5	0.005 - 0.34	0.0794	YES	0.22
NICKEL	2 / 2	3.4 - 11.3	14.70	5 / 5	1.2 - 4.8	3.34	NO	4.80
POTASSIUM	2 / 2	714 - 2110	2824.00	5 / 5	714 - 1950	1229	NO	1950
SODIUM	2 / 2	4710 - 7760	12470.00	5 / 5	4240 - 20600	10878	NO	20600
THALLIUM	NOT DETECTED	-	-	1 / 5	4	2.24	YES	3.54
VANADIUM	1 / 2	1.4 - 1.4	1.71	2 / 5	0.71 - 0.83	0.491	NO	0.83
ZINC	2 / 2	5 - 8.8	13.80	2 / 5	8.8 - 13.4	4.92	NO	13.40

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

TABLE 10-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 7
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
1,1,2-TRICHLOROETHANE	NOT DETECTED	-	-	1 / 5	1	1
1,2-DICHLOROETHENE (TOTAL)	NOT DETECTED	-	-	1 / 5	4	4
BENZENE	NOT DETECTED	-	-	1 / 5	1	1
CHLOROBENZENE	NOT DETECTED	-	-	1 / 5	11	9.73
CHLOROFORM	NOT DETECTED	-	-	1 / 5	2	2

TABLE 10-3a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 7

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	07GW01	07GW02	07GW03	07GW04	07GW05	---	ARARS & TBCs		
LOCATION:	07GW01	07GW02	07GW03	07GW04	07GW05	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI				
INORGANICS	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**		**ug/L**	**ug/L**	**ug/L**
aluminum	174	557 E J	393 E	320 E J	1850 E		-	-	200
barium	11.9	24.2	42.2	26.8	112		2000	2000 a	2000
beryllium	0.11 U	0.11 U	0.40	0.11 U	0.66		4.00	4000 e	20.0
calcium	916	1480	1460	1050	1330		-	-	-
chromium, total	1.0 U	1.0 U	1.0 U	1.9	1.0 U		100 *	100 a	100
cobalt	1.6	0.85	28.2	1.0	6.9		-	-	-
copper	0.77 U	1.8	0.77 U	1.7	0.77 U		1300	-	1000
iron	913 E	145	298	561 E	63.7		-	-	300
lead	2.3	1.5 U	1.5 UJ	1.5 U	1.5 UJ		15.0	-	10.0
magnesium	723	594	2120	1990	6920		-	-	-
manganese	19.0	48.9	246 E	15.2	63.7 E		-	-	50.0
mercury	0.0050	0.033	0.0040 UJ	0.017	0.34 J		2.00	2.00 b	2.00
nickel	4.2	1.2	3.4	3.1	4.8		100	100 a	100
potassium	941	1400	714	1140	1950		-	-	-
sodium	4240	20600	4710	7040	17800		-	-	50000
thallium	4.0 E	3.6 U	3.6 U	3.6 U	3.6 U		2.00	0.400 a	10.0
vanadium	0.83	0.61 U	0.61 U	0.71	0.61 U		-	-	-
zinc	1.6 U	1.6 U	8.8	1.6 U	13.4		-	2000 a	5000
VOLATILES	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**		**ug/L**	**ug/L**	**ug/L**
1,1,2-trichloroethane	10.0 U	10.0 U	10.0 U	10.0 U	1.0 J		3.00	3.00 a	3.00
1,2-dichloroethene (total)	10.0 U	10.0 U	10.0 U	10.0 U	4.0 J		70.0 a	70.0 a	10.0
benzene	10.0 U	1.0 J	10.0 U	10.0 U	10.0 U		5.00	200 d	1.00
chlorobenzene	10.0 U	11.0 E	10.0 U	10.0 U	10.0 U		-	-	4.00
chloroform	10.0 U	10.0 U	10.0 U	2.0 J	10.0 U		100	100 e	6.00

TABLE 10-3a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

. - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

. - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 10-3b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 7

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		07GW01		07GW02		07GW03		07GW04		07GW05		ARARS & TBCs		
LOCATION:		07GW01		07GW02		07GW03		07GW04		07GW05		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
MISCELLANEOUS														
ammonia nitrogen	mg/L	1.0	U	0.90	E J	1.0	U	1.0	U	1.0	U	-	30.0	0.500
biochemical oxygen demand	mg/L	1.3	J	2.0		0.80	J	0.70	J	0.90	J	-	-	-
chemical oxygen demand	mg/L	2.0	J	28.0		5.0	J	11.0		4.0	J	-	-	-
chloride	mg/L	9.0		27.0		8.0		13.0		25.0		-	-	250
nitrate nitrogen	mg/L	0.50	U	0.15	J	1.3		0.50	U	0.50	U	10.0	10.0	-
sulfate	mg/L	7.0		25.0		10.0		13.0		44.0		500	-	250
total organic carbon	mg/L	1.0	U	9.0		0.80	J	0.90	J	2.0		-	-	-
turbidity	ntu	3.0		0.90		4.2		5.7		0.50		-	-	-

TABLE 10-3b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

10.5.2.1 Inorganics

Concentrations of most metals in Site 7 groundwater were within the range of background results except for cadmium which was not found. Site-related samples also showed the presence of all the metals listed above, with the exception of cadmium. Thallium was detected at a low concentration in one groundwater sample, 07 GW 01 at 3.54 ug/L, but was not detected in background samples.

10.5.2.2 Organics

1,1,2-TCA (1 ug/L), 1,2-DCE (4 ug/L), benzene (1 ug/L), chlorobenzene (11 ug/L), and chloroform (2 ug/L) were each detected in one groundwater sample collected at Site 7. None of these compounds were detected in background groundwater samples.

10.5.2.3 Miscellaneous Parameters

Miscellaneous parameter analyses of five groundwater samples at Site 7 consisted of ammonia, BOD, COD, chlorides, nitrates, sulfates, TOC, phosphates, and turbidity. Results are presented in Appendix A. Most indicator parameters revealed lower concentrations in upgradient well MW7-03 than in all downgradient wells. Downgradient concentrations were greater than upgradient levels and greater than background ranges for ammonia, COD, and TOC in MW7-02, for COD in MW7-04, and for sulfate and TOC in MW7-05. Upgradient well MW7-03, as well as, MW7-01 did not reveal any concentrations greater than background. None of the indicator parameters in upgradient or downgradient wells were high enough to be within a range typically associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972). The wells containing maximum detected concentrations were generally consistent with the results of the 1993 remedial investigation.

10.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 7 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 10.6.1. Persistence of detected chemicals in the environment is discussed in Section 10.6.2. Section 10.6.3 presents a brief discussion of contaminant trends.

10.6.1 Detected Chemicals and Transport Potential

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

for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

Chlorinated aliphatics (1,1,2-TCA and 1,2-DCE), benzene, chlorobenzene, and chloroform were detected at low levels in groundwater downgradient of the landfill. All detected volatile organic groundwater contaminants exhibit relatively high solubilities, vapor pressure, and air-water partition coefficients (Henry's law constant). These compounds are characteristically mobile in the environment (either through soil gas migration or groundwater transport).

10.6.2 Contaminant Persistence

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

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

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

10.6.3 Observed Chemical Contaminant Trends

1,1,2-Trichloroethane, 1,2-DCE, benzene, and chlorobenzene detection levels are consistent with historical data. This investigation and the 1993 sampling revealed that 1,1,2-trichloroethane and 1,2-DCE are present at low levels in MW7-05. This well is located northwest (hydrologically downgradient) and adjacent

to the northwestern edge of the landfill. Both investigations indicate that chlorobenzene is present in monitoring well MW7-02, which is located downgradient (north) of the landfill and also northeast of MW7-05.

Several differences were noted between the VOC trends in the current investigation and the 1993 investigation. Benzene was detected at a trace level, below the limit of quantitation, in monitoring well MW7-02 in the current investigation but was not detected in the 1993 investigation (out of three sampling rounds). Chloroform was also detected in downgradient well MW7-04 at a trace level in the current investigation but was not detected in the previous investigation. With VOC compounds that are present at concentrations below quantitation limits, reproducibility between sampling rounds is not expected to be good.

The 1993 investigation showed that 1,1,2,2-tetrachloroethane was present in one out of three sampling rounds of monitoring well MW7-05, although this compound was not found in the current investigation. It is possible that 1,1,2,2-tetrachloroethane could be the source of the detected 1,1,2-trichloroethane, the latter of which was confirmed in this well over multiple sampling rounds. Over time, degradation by microorganisms may lead to source depletion that can alter the distribution of detected degradation products and parent compounds in groundwater.

Thallium was detected at a low level, near the instrument detection limit, in one site-related groundwater sample but was not detected in background groundwater samples. Results near the limit of detection in a single sample do not demonstrate the presence of elevated levels in groundwater. In addition, this element was not reported at elevated concentrations in other sampled media. The well containing thallium (MW7-01) is adjacent to the eastern border of the landfill and is hydrologically cross-gradient rather than downgradient from the landfill.

The source of a slightly elevated manganese level in sediment is unknown. Manganese is a common mineral and is not clearly related to landfill contamination.

10.6.4 Conclusions

Low-level release of chlorinated aliphatics and benzene derivatives from the landfill to the groundwater has occurred. Detected chemicals in the groundwater are expected to be transported downgradient. Groundwater data from the current investigation are consistent with historical data and indicate that these compounds are present in two monitoring wells located along the northwestern and northern sides of the landfill. Both wells are located downgradient of the landfill.

Chloroform was also detected at trace levels in 07 GW 04 (downgradient from the landfill), and thallium was detected at levels near the detection limit in 07 GW 01 (hydrologically cross-gradient). The significance of a single detection at levels below quantitation limits is limited. Based upon limited

detections compared to the total number of samples taken over time, it is safe to conclude that there is not widespread groundwater contamination with chloroform or thallium at this site.

10.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 7. The risk assessment was performed using the approach outlined in Section 2.4. Tables 10-5 and 10-6 provide the selected COPCs and representative concentrations of inorganics and organics in site-related sediment (inorganics only) and groundwater, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 10.7.1.5 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

10.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential, recreational, and industrial receptors).

10.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 7 are 1.0E-05 (ingestion) and 4.2E-07 (dermal contact). The total groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or formulate ARARs. The principal COPC contributing to the groundwater cancer risk is beryllium (ingestion, 96 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future industrial employee assuming exposure to COPCs in groundwater at Site 7 are less than 1.0 for the ingestion and dermal contact exposure pathways. Adverse noncarcinogenic effects are not expected when the HQs are below 1.0.

TABLE 10-5
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 7 (mg/kg)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ARSENIC	11.7	NONPARAMETRIC
MANGANESE	38.1	NONPARAMETRIC
ZINC	33.7	NONPARAMETRIC

TABLE 10-6
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 7 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
BARIUM	112	NONPARAMETRIC
BERYLLIUM	0.66	LOGNORMAL
COBALT	18.89	NORMAL
COPPER	1.8	LOGNORMAL
LEAD	2.23	LOGNORMAL
MERCURY	0.22	NORMAL
THALLIUM	3.54	LOGNORMAL
1,1,2-TRICHLOROETHANE	1	LOGNORMAL
1,2-DICHLOROETHENE (TOTAL)	4	LOGNORMAL
BENZENE	1	LOGNORMAL
CHLOROBENZENE	9.73	LOGNORMAL
CHLOROFORM	2	LOGNORMAL

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Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial receptors exposed to groundwater at Site 7 in Tables 10-7 and 10-8, respectively.

10.7.1.2 Future Residential Receptor

The estimated total cancer risks for the future residential receptor for exposure to COPCs in groundwater at Site 7 are within the 1E-04 to 1E-06 target acceptable risk range. (Ingestion exposures contributed the major portion of these risks.)

The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future residential child receptor assuming exposure to COPCs in groundwater at Site 7. (Ingestion exposures contributed the significant portion of risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 10.7.1.4 and presented in Tables 10-9 and 10-10, respectively.

10.7.1.3 Future Recreational Receptor

The estimated total cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 7 are 1.9E-07 (ingestion) and 8.0E-09 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range.

The estimated individual HQs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 7 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic effects are not expected when the HQs are below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to sediment at Site 7 in Tables 10-11 and 10-12, respectively.

TABLE 10-7
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 7
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,1,2-TRICHLOROETHANE	2.0E-07	8.2E-09
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A
BENZENE	1.0E-07	1.7E-09
CHLOROBENZENE	N/A	N/A
CHLOROFORM	4.3E-08	4.2E-10
BARIUM	N/A	N/A
BERYLLIUM	9.9E-06	4.1E-07
COBALT	N/A	N/A
COPPER	N/A	N/A
LEAD	N/A	N/A
MERCURY	N/A	N/A
THALLIUM	N/A	N/A
TOTAL RISK	1.0E-05	4.2E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-8
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 7
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,1,2-TRICHLOROETHANE	2.4E-03	1.0E-04
1,2-DICHLOROETHENE (TOTAL)	4.3E-03	4.1E-05
BENZENE	N/A	N/A
CHLOROBENZENE	4.8E-03	6.8E-04
CHLOROFORM	2.0E-03	1.9E-05
BARIUM	1.6E-02	1.6E-04
BERYLLIUM	1.3E-03	5.3E-05
COBALT	3.1E-03	2.5E-05
COPPER	4.4E-04	3.0E-07
LEAD	N/A	N/A
MERCURY	7.1E-03	4.2E-05
THALLIUM	4.3E-01	3.6E-03

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-9
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 7
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,1,2-TRICHLOROETHANE	8.5E-07	2.6E-07	6.6E-07
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
BENZENE	4.3E-07	5.5E-08	5.1E-07
CHLOROBENZENE	N/A	N/A	N/A
CHLOROFORM	1.8E-07	1.3E-08	2.3E-06
COPPER	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
THALLIUM	N/A	N/A	N/A
TOTAL RISK	1.5E-06	3.3E-07	3.5E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-10
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 7
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN								
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,1,2-TRICHLOROETHANE	1.6E-02								3.8E-03	N/A
1,2-DICHLOROETHENE (TOTAL)	2.8E-02	2.8E-02				2.8E-02			1.6E-03	N/A
BENZENE	N/A	N/A					N/A		N/A	3.0E-02
CHLOROBENZENE	3.1E-02			3.1E-02	3.1E-02	3.1E-02			2.6E-02	7.5E-02
CHLOROFORM	1.3E-02			1.3E-02		1.3E-02			7.3E-04	N/A
COPPER	2.9E-03	2.9E-03		2.9E-03		2.9E-03			9.4E-06	N/A
LEAD	N/A	N/A					N/A		N/A	N/A
MERCURY	1.4E-01			1.4E-01			1.4E-01	1.4E-01	3.9E-03	N/A
THALLIUM	2.8E+00		2.8E+00	2.8E+00		2.8E+00	2.8E+00		1.1E-01	N/A
	HI BY TARGET ORGAN	3.1E-02	2.8E+00	3.0E+00	3.1E-02	2.9E+00	3.0E+00	1.4E-01		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-10a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 7
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN								
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
1,1,2-TRICHLOROETHANE	7.5E-03								2.6E-03	N/A
1,2-DICHLOROETHENE (TOTAL)	1.3E-02	1.3E-02				1.3E-02			1.0E-03	N/A
BENZENE	N/A	N/A					N/A		N/A	5.8E-03
CHLOROBENZENE	1.5E-02			1.5E-02	1.5E-02	1.5E-02			1.7E-02	1.5E-02
CHLOROFORM	6.0E-03			6.0E-03		6.0E-03			4.9E-04	N/A
COPPER	7.0E-04	7.0E-04		7.0E-04		7.0E-04			3.2E-06	N/A
LEAD	N/A	N/A					N/A		N/A	N/A
MERCURY	6.5E-02			6.5E-02			6.5E-02	6.5E-02	2.6E-03	N/A
THALLIUM	1.3E+00		1.3E+00	1.3E+00		1.3E+00	1.3E+00		7.4E-02	N/A
	HI BY TARGET ORGAN	1.4E-02	1.3E+00	1.4E+00	1.5E-02	1.4E+00	1.4E+00	6.5E-02		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-11
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 7
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
ARSENIC	1.9E-07	8.0E-09
LEAD	N/A	N/A
MANGANESE	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	1.9E-07	8.0E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 10-12
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 7
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
ARSENIC	5.0E-03	2.1E-04
LEAD	NA	NA
MANGANESE	9.7E-04	1.3E-03
ZINC	1.4E-05	2.3E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

10.7.1.4 Lead Results

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 from previous investigations or in the 1995 RI sediment sample.

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 7 exposures are presented in Appendix I.

10.7.1.5 Amended Risk Assessment

Because the conservative preliminary baseline risk assessment yielded a noncarcinogenic HI greater than 1.0 for the future residential child assuming exposure to COPCs in groundwater at Site 7, risks have been recalculated for future residential exposure to groundwater.

Comparison to Background

Barium, beryllium, and cobalt were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 10-3 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

After elimination of COPCs similar to background, the final RME cancer risks for the future lifetime resident assuming exposure to COPCs in groundwater at Site 7 are 1.5E-06 (ingestion), 3.3E-07 (dermal contact), and 3.5E-06 (inhalation of volatiles). The groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range. The principal COPCs contributing to the groundwater cancer risk are 1,1,2-trichloroethane and benzene (ingestion, 88 percent of the cancer risk for this pathway); and chloroform (inhalation of volatiles, 67 percent of the cancer risk for this pathway). Estimated RME carcinogenic risks are presented for future residential receptors exposed to groundwater at Site 7 in Table 10-9.

Consideration of Target Organ Grouping

The revised HIs are greater than 1.0 for exposure to groundwater by future residential child receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are greater than 1.0 for some target organs. Thallium was the principal COPC responsible for HIs in the range of 2.8 to 3.0 for the target organs skin, kidney, liver, and central nervous system. Adverse noncarcinogenic

effects cannot be ruled out when the HI is greater than 1.0. RME noncarcinogenic risks are presented for future residential receptors exposed to groundwater at Site 7 in Table 10-10.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate non-cancer risks for exposure to COPCs in groundwater for the future residential child receptor. 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. However, for groundwater ingestion by the future residential child, central tendency HIs were in the range of 1.3 to 1.4 for the skin, kidney, liver, and central nervous system (all attributable to thallium). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency noncarcinogenic risks are presented for exposure to groundwater for the future residential child in Table 10-10a.

10.7.2 Conclusions

Sediment and groundwater were sampled at Site 7. The potential receptors considered for this site were future industrial, residential, and recreational receptors. The cancer risk associated with the future residential (groundwater) exposure scenario was approximately 5E-06, within the target acceptable risk range. 1,1,2-Trichloroethane and benzene (both via groundwater ingestion) and chloroform (inhalation of volatiles during showering) were the major COPCs that contributed to the cancer risk for this exposure scenario.

Noncarcinogenic HQs associated with the future residential (groundwater) exposure scenario exceeded 1.0; the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Thallium is the COPC that exceeded 1.0 for this exposure scenario. In addition, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the skin, kidney, liver, and central nervous system as the target organs.

Lead concentrations at the site were below EPA guideline limits and are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

The amended risk assessment procedure did not result in the elimination of all non-cancer risks above guideline limits. Thallium by groundwater ingestion (various target organs) remained with HQs above one.

Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 7 in Table 10-13 for sediment and groundwater. Table 10-13a presents the relevant central tendency risk estimates associated with future residential receptors for groundwater.

TABLE 10-13
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 7
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	1.9E-07	N/A	N/A	N/A	N/A	6.0E-03
	Dermal Contact	N/A	N/A	N/A	8.0E-09	N/A	N/A	N/A	N/A	1.5E-03
Groundwater	Ingestion	N/A	1.0E-05	1.5E-06^	N/A	N/A	4.7E-01	3.0E+00@	N/A	N/A
	Dermal Contact	N/A	4.2E-07	3.3E-07^	N/A	N/A	4.7E-03	1.5E-01^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.5E-06^	N/A	N/A	N/A	N/A	1.0E-01^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	1.1E-05	5.3E-06	2.0E-07	-	4.7E-01	3.1E+00	1.0E-01	7.5E-03

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.

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TABLE 10-13a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 7
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	N/R	N/R	N/A	N/A	N/R	1.4E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	N/R	N/A	N/A	N/R	9.8E-02^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	-	-	-	-	1.5E+00	-	-

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.

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10.8 ECOLOGICAL RISK ASSESSMENT

10.8.1. Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 7, approximately 5 acres in size, is located at the top of a small hill. The site has been covered with loose sand and is dominated by dense perennial grasses and blackberry. A small, narrow pocket wetland is present in the center of the landfill. Most of this wetland area, particularly the middle portion, is dominated by *Phragmites*, *Juncus* sp., and fescue grass. Some small pines are also present near the wetland. Soils in the wetland area are generally saturated at six inches. NJDEP Geographic Information System data originally indicated the presence of wetlands to the east and northeast of site, but ground-truthing revealed that no wetlands were present in these areas; no hydric soils, wetland hydrology, or aquatic plants were identified. A few small bare areas with limited vegetation are present on the landfill, mainly due to the absence of topsoil in those areas. Site 7 is bordered to the north, east, and south by wooded upland areas composed of black cherry, red maple, black locust, yellow poplar, and spicebush, on Tinton loamy soils. A dirt access road borders the site to the west.

The area slopes down to the north, and runoff from extreme storm events exits the site to the north near the northwest portion of the landfill. No drainageways are present on or near the landfill, though the Site 7 is located on the border of the Ware Creek and Wagner Creek watersheds. The closest surface water is a tributary of Compton Creek, located approximately 2,000 feet west, and a small tributary of Wagner Creek, located approximately 1,500 feet to the northeast. The entire Site 7 area provides excellent habitat, primarily for terrestrial receptors. Most species of mammals and game birds found on the installation probably utilize the dense brush and small trees on the site and the adjacent upland areas. Water in the small wetland area is ephemeral, and as a result, no significant aquatic community is present. No sensitive habitats, other than the small wetland, and no threatened or endangered species are known to occur in the area.

Contaminant Sources, Release Mechanisms, and Migration Pathways

A possible contaminant release pathway from the landfill is overland runoff. Overland runoff from the landfill may carry contaminants to downslope surface soils to the north, although the landfill has been covered with sand, greatly inhibiting surface soil contaminant migration. Some bare areas are present, but constitute an extremely small percentage of the landfill surface. Most drainage on the landfill occurs via rapid infiltration, but groundwater to surface water contaminant migration is unlikely since groundwater flows to the north, and no significant surface water is present north of the site. The closest surface water is one-third mile away.

Exposure Routes

Terrestrial receptors at Site 7 may be exposed to surface soil contaminants via incidental ingestion of soil or by ingestion of contaminated food items. However, sand has been placed on the landfill, limiting this exposure pathway. Terrestrial receptors may also come into contact with contaminants in Site 7 surface water by using it for drinking, although this pathway is generally insignificant. Terrestrial vegetation may also be exposed to contaminants in soils at Site 7, but again, a layer of sand has been placed on landfill surface soils. Terrestrial or semi-aquatic organisms utilizing the wetland area on the landfill may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Nonetheless, the wetland area is quite small, precluding extensive receptor use and significant contaminant exposure. Wetland organisms may also be exposed to constituents from contaminated groundwater that flows into surface water, although the scarcity of surface water on the site precludes exposure via this pathway. The pocket wetland is small and shallow, and is oriented in a north/south direction. Therefore, significant groundwater to surface water discharge to the wetlands from north-flowing groundwater is not probable.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1995 RI activities for this site. In particular, contaminants detected in a "sediment soil" sample collected immediately north of the site were considered preliminary COPCs and used for quantitative assessment. The sample was taken in an area with moist soils, rather than aquatic sediments. Nonetheless it was conservatively assessed as a sediment sample. Also, 1993 RI/FS test pit soil samples and groundwater samples, along with 1995 RI groundwater samples, were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

10.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminated sediments (moist soils) north of the site. Since the sediment sample was collected from an area of moist

soils, rather than aquatic sediments, sediment ET values were used. Sediment ET values utilized in the assessment are presented in Table 2-29.

10.8.3 Preliminary Exposure Assessment

Contaminant concentrations in the moist soil sample collected north of the site were used for this screening. Again, the sample was a moist soil sample, most likely due to a strong storm event; therefore, it was conservatively assessed as a sediment sample. The maximum detected contaminant concentrations in that sample were used as representative exposure point concentrations. The sample was collected in the area north of the site where potential surface water runoff would exit the site. Background concentrations presented for comparative purposes were obtained from facility-wide background samples. Section 2.4.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

10.8.4 Risk Characterization

Arsenic (HQ = 1.43) was the only inorganic that exceeded its ET value in sediments north of the site, though this inorganic did not exceed a less conservative value (Table 10-14). No organics were detected. Aluminum and vanadium were conservatively retained as final COPCs since no suitable ET values were available. The toxicological properties of all final COPCs are summarized in Appendix M.

10.8.5 Summary and Conclusions

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

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

TABLE 10-14

SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 7

NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Inorganics						
Aluminum	1/1	3940	2770	NA		Retained-No suitable threshold available
Arsenic	1/1	6.2	11.7	8.2/70	1.43/0.17	Retained-HQ > 1
Barium	1/1	10.6	8.6	40	0.22	Eliminated-Does not exceed threshold
Chromium	1/1	56	13.2	81	0.16	Eliminated-Does not exceed threshold
Copper	1/1	13	3.6	34	0.11	Eliminated-Does not exceed threshold
Lead	1/1	34.3	19.6	47	0.42	Eliminated-Does not exceed threshold
Manganese	1/1	9.2	38.1	460	0.08	Eliminated-Does not exceed threshold
Vanadium	1/1	42.7	19.3	NA		Retained-No suitable threshold available
Zinc	1/1	26.9	33.7	150	0.22	Eliminated-Does not exceed threshold

NA = No suitable threshold was available

1 When two values are presented, the left value is the most conservative available and the right value is a less conservative value, if available. In these instances, two HQ values are presented.

2 Contaminants were retained as final COPCs if the most conservative ET value available was exceeded.

chlorinated aliphatics and benzene derivatives in groundwater. Chloroform and thallium were also detected in elevated levels in groundwater, but in only one sample.

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

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

Extensive remedial action at the site, such as excavation or capping, could disrupt succession on the landfill and the ecology of the small wetland area. Some additional soils should, however, be placed on the small bare areas that contain limited soils. However, further ecological study or extensive remedial activity at Site 7 based on ecological concerns does not appear to be warranted.

10.9 EVALUATION AND RECOMMENDATION

10.9.1 Evaluation Summary

Low metals concentrations in groundwater generally confirmed previous results. Metals in groundwater at levels above regulatory guidelines included arsenic, aluminum, iron, manganese and thallium.

Chlorobenzene was found in one groundwater sample at a concentration above the NJDEP GWQS. Previous sampling events also showed low levels of chlorinated solvents. NJDEP regulations may require a CEA for the site.

Results of human health risk assessment concluded that calculated non cancer-risks were above guideline limits for ingestion of groundwater.

Ecological risk assessment concluded that extensive remedial action at the site, such as excavation or capping, could disrupt succession on the landfill and the ecology of the small wetland area. Further ecological study or extensive remedial activity at Site 7 based on ecological concerns does not appear to be warranted.

10.9.2 Recommendations

Some additional soils should be placed on the small bare areas that contain limited top soil.

11.0 SITE 9: LANDFILL SOUTHEAST OF "P" BARRICADES

11.1 SITE BACKGROUND AND PHYSICAL SETTING

The landfill Southeast of "P" barricades is an isolated 3-acre site located in the Waterfront area. From 1967 to 1972, the site was used for the disposal of dunnage lumber and construction debris. Lumber was stacked, burned (using a petroleum ignition source), and then covered. An estimated 4,500 to 7,500 cubic yards of lumber were disposed (IAS,1983).

Pine species reforestation was completed several years ago in the area. Mature hardwood stands surround the area on all sides. There are some scarred areas where vegetation is sparse. The landfill cover is thin and waste is exposed in some areas. An impermeable cap was not used for closure. The landfill surface slopes gently toward the south. A small, discontinuous stream is present approximately 300 feet south of the site. The stream has been found to be intermittent due to low stream flow volume during periods of dry weather. Figure 11-1 shows the site layout.

11.2 PREVIOUS INVESTIGATIONS

11.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and concluded minimal impact because records indicated only waste lumber was disposed at site. The site was not recommended for confirmation study.

During the SI in 1993 six test pits were dug to determine the composition of fill. Construction type debris, wood, some trash and metal debris was encountered.

During the SI (Weston, 1993), six test pits were excavated at the site to define the general limits of the landfill and to determine if material in the landfill had adversely affected subsurface soils. Test pit locations are illustrated in Figure 11-1. Fill material, which consisted primarily of construction debris and some household trash, was encountered in some of the test pits. Six soil samples, one from each test pit, were collected and analyzed for VOCs, SVOCs, metals, cyanide, and TPH. Subsurface soil analysis in the test pit samples indicated low levels of TPH, VOCs, pesticides, metals, and cyanide.

11.2.2 Summary of Conclusions

RI test pits found mostly construction debris and some household trash. Groundwater was not encountered in any test pit.

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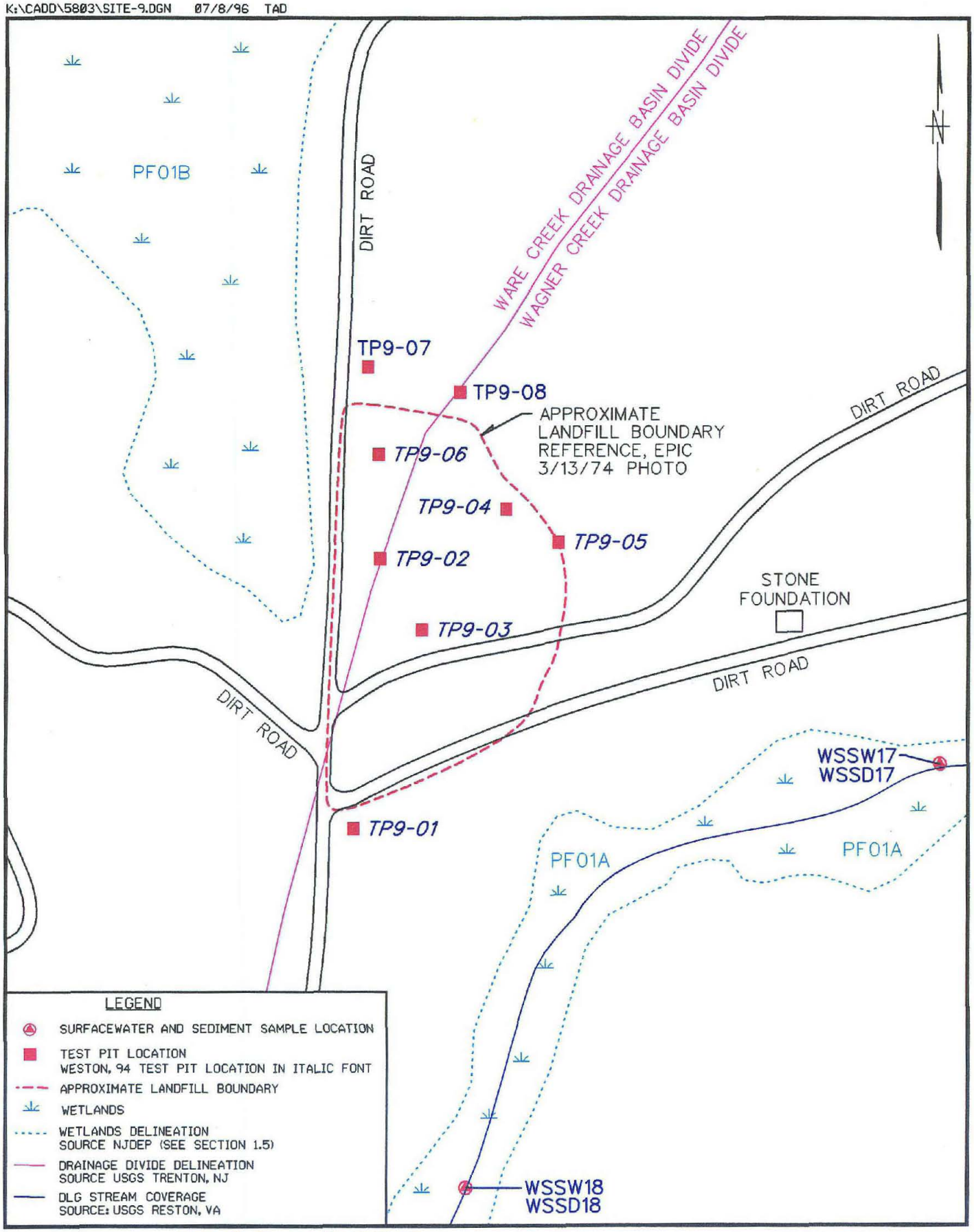

SAMPLE LOCATIONS

FIGURE 11-1

SITE 9 - LANDFILL SOUTHEAST OF "P" BARRICADES

0 200 400

SCALE IN FEET

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11.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Excavate two more test pits to confirm the northern extent of filled area.
- Sample nearby spring and streams to determine if groundwater is impacting surface water.

11.3 REMEDIAL INVESTIGATION SAMPLING ACTIVITIES

Between June and December 1995, B&R Environmental conducted the following field investigation activities at Site 9:

- Excavation of 2 test pits (Section 11.3.1)
- Sampling and analysis of surface water and sediment (Section 30.1.2)

B&R Environmental surveyed the horizontal locations and vertical elevations of the test pit locations and surface water and sediment sample locations. Surveying notes are provided in Appendix F.

11.3.1 Test Pits

Two test pits (09 TP 07 and 09 TP 08) were excavated in December 1995 in an attempt to better define the edge of the landfill at the site. The test pits were placed along the northern edge of the landfill, in the vicinity of the pine tree reforestation area. The test pits were excavated with a backhoe 7 feet and 8 feet, respectively, into the pine trees at the pine tree/hardwood forest boundary. Both test pits extended into the hardwood forest approximately 12 feet. A 20 feet long by 3 feet wide by 8.5 feet deep area was excavated for test pits 09 TP 07 and 09 TP 08. No municipal waste fill, dunnage lumber, or construction debris was encountered in either test pit. The material encountered during excavation of both pits generally consisted of olive-brown or orange-brown sandy silt and clay with a small amount of weathered sandstone/siltstone fragments.

The excavated material in the backhoe bucket was screened with an HNu and a description was logged. No HNu readings were recorded above background in either test pit. No samples were collected for chemical analysis. The test pits were backfilled with the material that was removed. Test pit log forms are included in Appendix E.

11.3.2 Surface Water and Sediment Sampling

Surface Water Sampling

Four surface water samples were proposed in the work plan; however, only three surface water samples were collected in June 1995, due to dry summer conditions. One stream/spring sample (WS SW 18) and two surface water samples (WS SW 17 and WS SW 19) were collected from a drainage ditch south of the site, as part of the watershed sampling program, to determine if groundwater flow and/or surface runoff have affected surface water and sediment. A duplicate (DUP-02) was also collected. A surface water sample was not collected upstream of the site because of the dry conditions. Samples were analyzed for TCL volatiles and semivolatiles, TAL metals/cyanide, hardness, and landfill parameters (ammonia, BOD, COD, chloride, nitrite, nitrate, TOC, phosphate, and turbidity).

Sample locations and analytical parameters are provided in a list in Section 30.1.2 Waterfront, Wagner Creek Watershed and are shown on Figure 30-2. See Table 30-1 for a summary of surface water samples. Sample log sheets are provided in Appendix D.

Sediment Sampling

B&R Environmental collected three sediment samples, including one field duplicate (WS SD 17, WS SD 18, and WS SD 19), in June 1995, as part of the watershed sampling program, along the drainage ditch and near the spring/stream, south of the site. An upstream surface water pathway could not be defined because of dry conditions; therefore, a sediment sample was not collected upstream of the site. Samples were analyzed for TCL volatiles and semivolatiles, TAL metals/cyanide, moisture, and landfill parameters (ammonia, BOD, COD, chloride, nitrite, nitrate, TOC, phosphate, and turbidity).

Sample locations and analytical parameters are provided in a list in Section 30.1.2 Waterfront, Wagner Creek Watershed and are shown on Figure 30-2. See Table 30-1 for a summary of sediment samples.

Sample log sheets are provided in Appendix D.

11.4 SITE CHARACTERISTICS

11.4.1 Geology

Regional mapping places Site 9 within the combined outcrop area of the Wenonah Formation and Mount Laurel Sand. The Wenonah Formation consists of gray and brown, silty, slightly glauconitic, very fine- to

fine-grained sand; the Mount Laurel Sand consists of brown and gray, silty, slightly glauconitic, fine- to coarse-grained quartz sand. The presence of the Wenonah Formation or Mount Laurel Sand beneath the site cannot be confirmed because no soil borings were drilled at the site. No inferences can be made about the sediments beneath the site because none of the other sites being investigated as part of this project are located in the same outcrop area.

11.4.2 Hydrogeology

Groundwater conditions at the site cannot be confirmed because no wells were installed at the site. Based upon the topographic setting of the site, shallow groundwater is assumed to flow northward toward Sandy Hook Bay.

11.5 NATURE AND EXTENT OF CONTAMINATION

11.5.1 Sediment

Three sediment samples (WS SD 17, WS SD 18, and WS SD 19) were collected at Site 9 (Figure 30-2). Section 30.2.1 presents the nature and extent of contamination in watershed sediment samples. Tables 30-2 and 30-3 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background values as presented in Section 30.5. Table 30-2a (see Section 30) presents a comparison of detected compounds to ARARs. Figure 30-3 shows sample locations and concentrations of compounds which exceed ARARs.

Low levels, in the range of potential concern for ecological receptors, of metals (arsenic, barium, and lead) were found in sediments.

11.5.2 Surface Water

Three surface water samples (WS SW 17, WS SW 18, and WS SW 19) were collected at Site 9 (Figure 30-2). Section 30.2.2 presents the nature and extent of contamination watershed surface water samples. Tables 30-4 and 30-5 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background values as presented in Section 30.5. Table 30-4a (see Section 30) presents a comparison of detected compounds to ARARs. Figure 30-3 shows sample locations and concentrations of compounds which exceed ARARs.

Low levels of metals (arsenic, chromium, copper, lead, and thallium) were found in surface water in the range of potential concern for ecological receptors.

11.6 QUALITATIVE RISK ASSESSMENT

Site 9 resides on the edge of the Wagner Creek watershed in the eastern section of the waterfront area. Both upland and wetland habitats are present in this watershed. Several inorganics were found at levels which exceeded ET values in surface water and sediments. Most of the HQ values were indicative of low potential risk, although aluminum, barium, lead, and silver were indicative of moderate potential risks. Barium was the only final COPC in sediments that exceeded its ET value, and its HQ value was indicative of low potential risk. However, aluminum, selenium, thallium, and vanadium were present above background and no suitable ET values were available for these inorganics.

On the whole, potential risks to aquatic receptors in the Wagner Creek Watershed are low to moderate. Yet, the exact source(s) of contamination in surface water and sediments is unclear.

11.7 EVALUATION AND RECOMMENDATIONS

11.7.1 Evaluation Summary

No risk to human health is apparent from the site.

The presence of metals in Wagner Creek sediments and surface water at concentrations above background levels indicates a possible impact to the receiving water body. The source of the metals is not defined, and is not necessarily Site 9.

11.7.2 Recommendations

Further investigation of metals in surface water and sediments of Wagner Creek may be indicated.

12.0 SITE 10: SCRAP METAL LANDFILL

12.1 SITE BACKGROUND AND PHYSICAL SETTING

The scrap metal landfill is a 2-acre site used from 1953 to 1965 for the disposal of demilitarized munitions and spent munitions cases. An estimated 65,000 cubic yards, which includes cover material, were disposed at the site. The disposed material consisted primarily of aluminum and steel containers. Spent grit and paint chips from the ammunition re-work operations were also buried. Since site closure, the cover material has eroded and 40-mm shell cases have been uncovered. Figure 12-1 is a map of the site.

The scrap metal landfill is characterized as an open area surrounded by wetlands. The site is accessible via a dirt road from the south and is bordered by railroad tracks to the southeast, a wetland to the north, and a drainage ditch to the east. The landfill is primarily covered with a sandy soil and is not closed with an impermeable cap. The site is vegetated with grasses and scrub pines, except for the access road and an open disturbed area (vehicle turn-around area) in the middle where no vegetation exists. The ground surface is relatively flat, and the average elevation is approximately 110 feet above MSL. The groundwater flow direction is to the northwest, north, and northeast based on measured groundwater levels.

12.2 PREVIOUS INVESTIGATIONS

12.2.1 Summary of Activities and Results

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

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

During the 1993 RI/FS, four test pits were excavated and four monitoring wells were installed. One sample from Test Pit 1 [located near the western edge of the "open area" within the "approximate landfill boundary" (see Figure 12-1)] was analyzed for TCL/TAL analytes and TPH. Waste was encountered in two of the four test pits. A layer of decomposed natural organic material (i.e., leaf, root, and organic silty matter) was encountered in all four test pits at a level between 3.5 and 5.5 feet. The waste consisted of metallic debris such as rusted shell casings at a level of 0 to 2 feet thick below the landfill surface. The

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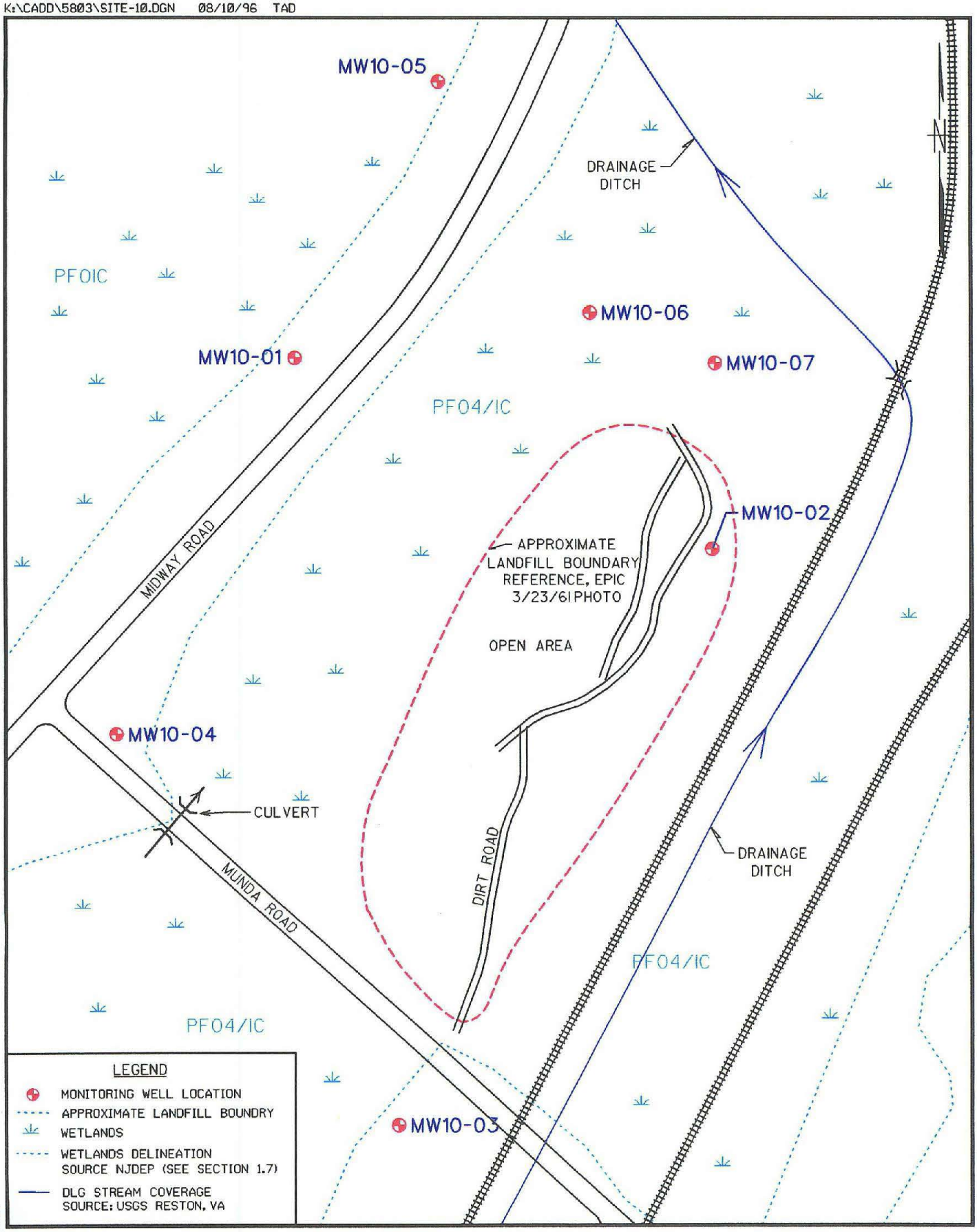

SAMPLE LOCATIONS

SITE 10 - SCRAP METAL LANDFILL

0 100 200

SCALE IN FEET

FIGURE 12-1

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cover material was thin to nonexistent. No sustained organic vapor readings were detected in any of the test pits. Two organics (possibly laboratory contaminants) and a low level of TPH were detected. Figure 12-1 shows the estimated extent of the landfill. Groundwater samples were collected from all seven wells and analyzed for TCL/TAL analytes, VOCs, drinking water metals, and landfill parameters. Elevated levels of metals were detected in several wells. Results of landfill parameters showed no distinction between downgradient wells and the upgradient wells. VOCs were detected, although these compounds are consistent with common laboratory artifacts. Additionally, three surface water and sediment samples were collected and analyzed for TCL/TAL analytes. The sediment samples were also analyzed for TPH and VOCs. Low levels of SVOCs and inorganics were detected in the sediment samples. It was considered likely that the SVOCs were associated with runoff from the adjacent railroad bed (Figure 2-1). Metal concentrations were low with the exception of one antimony concentration which was detected at a level potentially of concern and selected for ecological risk assessment (see Section 12.8). Several VOCs typically associated with laboratory contaminants were detected in surface water samples. Metals concentrations were relatively low, and no PCB or pesticide compounds were detected. For the surface water samples, low levels of VOCs and metals were detected.

12.2.2 Summary of Conclusions

Previous investigations indicated corroded metals exposed at the landfill surface that did not appear to be migrating to surface water or sediments. Low levels of SVOCs found in sediments were attributed to the nearby railroad bed. Metals in groundwater, at levels potentially of concern, were found along with VOCs at relatively low levels. One subsurface soil sample showed elevated levels of ethylhexylphthalate.

12.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Confirm previous metals and VOC results in all wells.
- Gauge impact of low-flow groundwater sampling technique on turbidity.
- Compare groundwater metals levels to background.
- Determine vertical extent of metals impact if metals results in groundwater are confirmed to be site related.

12.3 RI FIELD INVESTIGATIONS

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

- Sampling and analysis of groundwater samples from the seven existing monitoring wells (Section 12.3.1).
- Measurement of static-water levels in the seven existing wells (Section 12.3.1).

12.3.1 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, two rounds of static-water-level measurements were collected. The first round of measurements was collected on August 7, 1995, the second on October 17, 1995. Static-water levels were measured from the top of PVC riser using an electronic water-level indicator (m-scope) or an interface probe recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 97.08 to 97.74 feet above MSL during the first round of measurements and from approximately 95.96 to 96.92 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 12-1. Monitoring well characteristics are summarized in Table 12-1a.

Groundwater Sampling

Groundwater samples were obtained from the seven existing monitoring wells (MW10-01 through MW10-07) in July 1995 to determine groundwater quality at the site and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. Figure 12-1 shows sample locations. Field measurements collected during purging were pump rate (L/min), water level, Ph, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, B&R Environmental purged the wells, using the micro-purge protocol, to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purge and sample process.

B&R Environmental submitted eight groundwater samples (10 GW 01 through 10 GW 07), including one duplicate (Dup-14), to Lancaster Laboratories for TCL VOC, TAL metals, nitrite/nitrate, ammonia, COD,

TABLE 12-1
SITE 10 STATIC-WATER-LEVEL MEASUREMENT SUMMARY
NWS EARLE, COLTS NECK, NEW JERSEY

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

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

Table 12-1a
Site 10 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW10-01	27.5	NS	112.86	NS	4	12.5 -27.5	10.5 - 27.5	1/13/86
MW10-02	22	NS	110.22	NS	4	7 - 22	5 - 22	1/15/86
MW10-03	25	NS	109.77	NS	4	10 - 25	17 - 25	1/14/86
MW10-04	22.5	111.25	113.0	NS	4	7.5 - 22.5	5 - 23[3]	1/17/91
MW10-5	21.0	109.3	111.31	NS	4	6 - 21	5 - 23[3]	1/18/91
MW10-6	17.0	103.58	106.35	106.50	4	2 - 17	1 - 17.5[3]	2/19/81
MW10-7	19.5	106.07	107.97	108.20	4	5 - 19.5	4 - 20[3]	1/18/91

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.
NS Not surveyed.

TOC, phosphate, BOD, turbidity, sulfate, and chloride analyses. Sample log sheets are presented in Appendix D.

12.4 SITE CHARACTERISTICS

12.4.1 Geology

Regional mapping places Site 10 within the outcrop area of the Kirkwood Formation; upper colluvium may be present at the site. The upper colluvium has a maximum thickness of 10 feet, the Kirkwood Formation ranges between 60 to 100 feet in thickness, and the soil borings are no more than 27.5 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the upper colluvium and the Kirkwood and Vincentown Formations. Assuming a portion of the Kirkwood Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered gray pebbly sand (possibly representative of the upper colluvium), brownish-yellow, fine- to medium-grained sand (probably representative of the Kirkwood Formation), and olive and dark greenish-gray, glauconitic, fine- to medium-grained sand (probably representative of the Vincentown Formation). Mainside is located above the updip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation.

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

12.4.2 Hydrogeology

Groundwater in the upper colluvium, Kirkwood, and Vincentown aquifer beneath the site occurs under unconfined conditions and the geologic units are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 12-1. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 12-2 and 12-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the northwest, north, and north-northeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

Based on boring log descriptions, wells MW10-05 and MW10-07 wells were screened across the contact between the upper colluvium and the Kirkwood Formation and the contact between the Kirkwood and Vincentown Formations, and wells MW10-01 through MW10-04 and MW10-06 were screened across the contact between the Kirkwood and Vincentown Formations. The hydraulic conductivities calculated for

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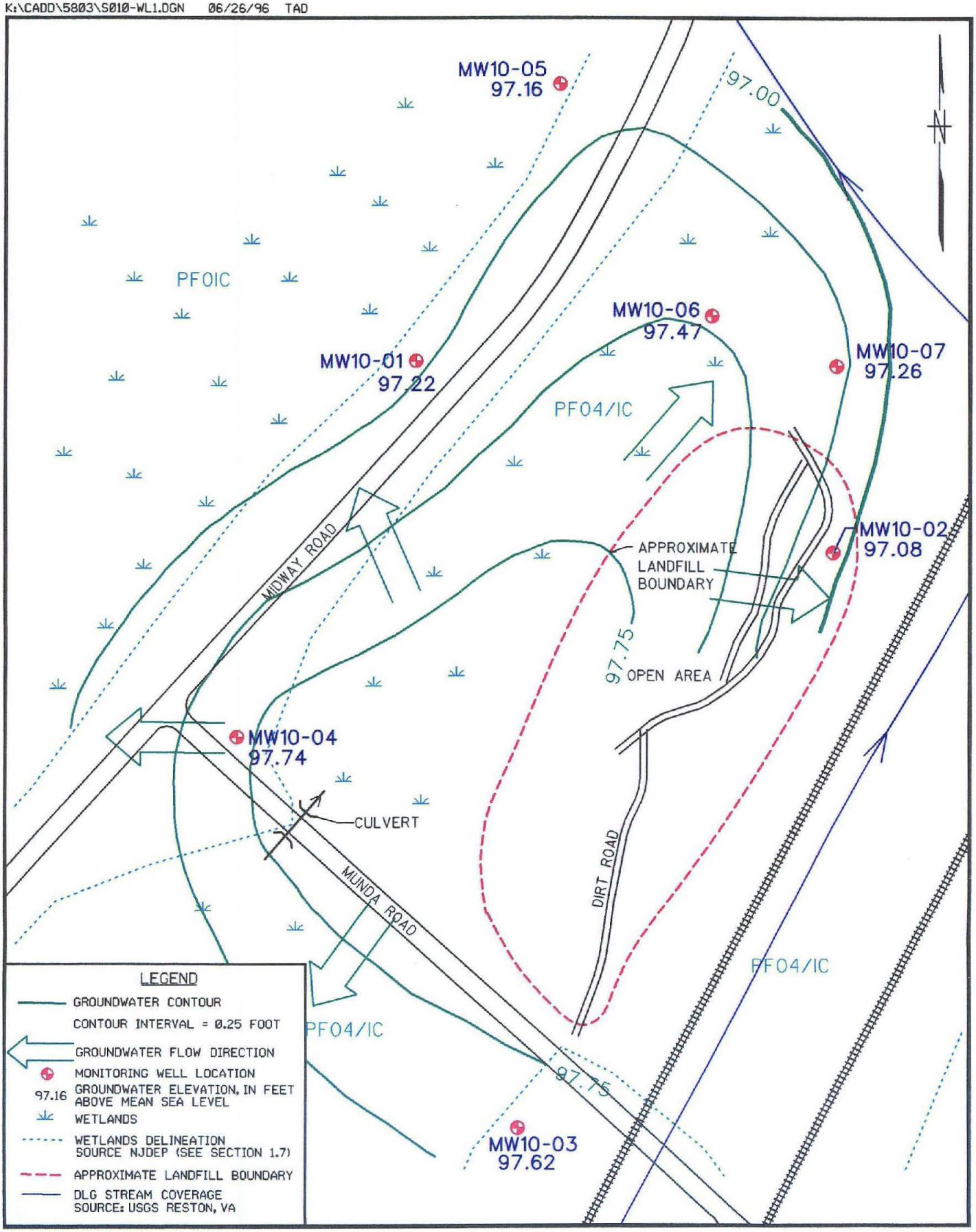

GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 10 - SCRAP METAL LANDFILL

FIGURE 12-2

0 100 200

SCALE IN FEET

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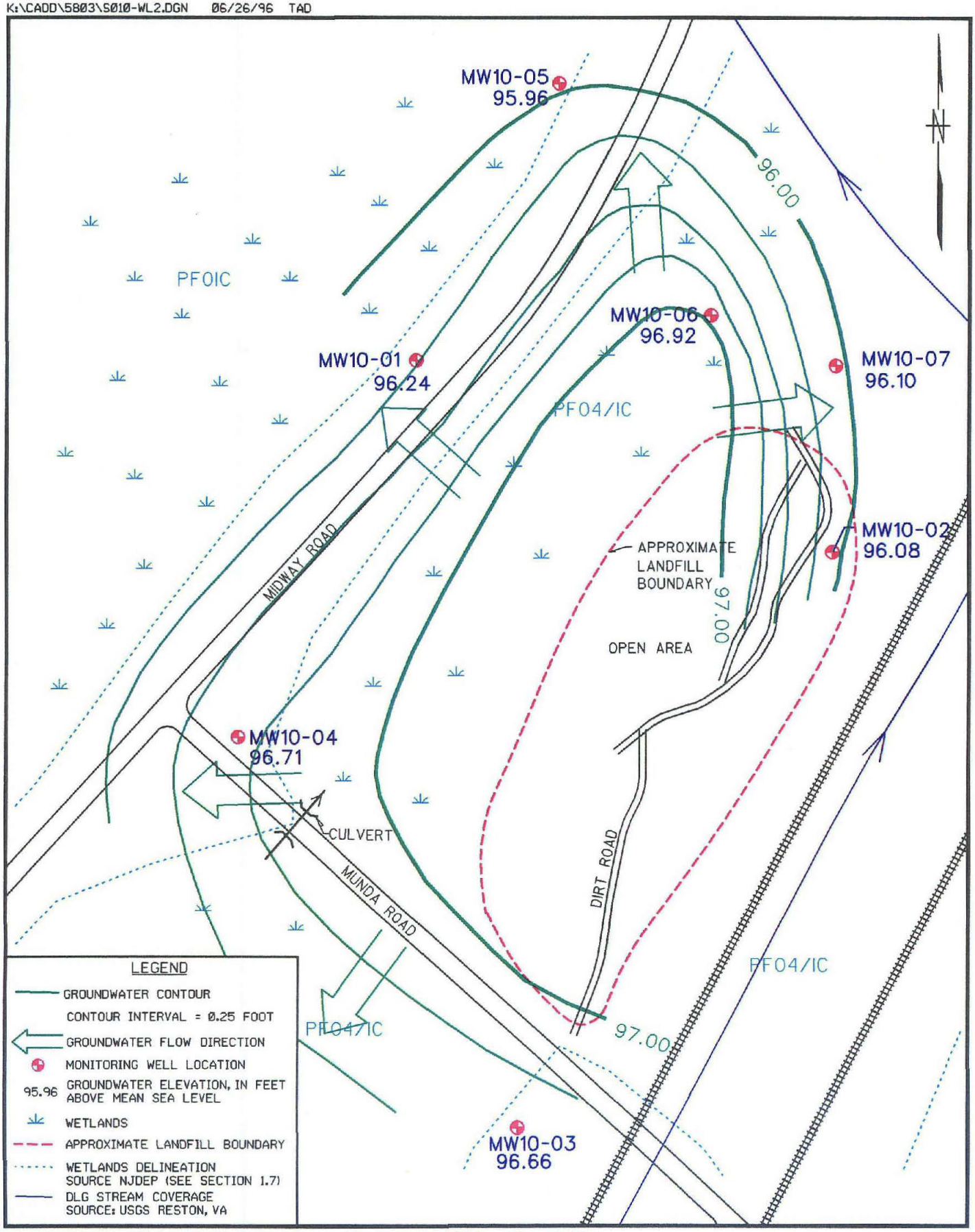

GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 10 - SCRAP METAL LANDFILL

FIGURE 12-3

0 100 200

SCALE IN FEET

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MW10-04 (Kirkwood and Vincentown Formations), MW10-05 (upper colluvium, Kirkwood Formation, and Vincentown Formation), and MW10-07 (upper colluvium, Kirkwood Formation, and Vincentown Formation) are 2.54 x 10^{-4} cm/sec (0.72 ft/day), 6.99 x 10^{-4} cm/sec (1.98 ft/day), and 1.75 x 10^{-3} cm/sec (4.97 ft/day), respectively.

12.5 NATURE AND EXTENT OF CONTAMINATION

12.5.1 Groundwater

Seven site-related groundwater samples (10 GW 01 through 10 GW 07) were collected at Site 10 (Figure 12-1). Table 12-2 presents the occurrence and distribution of inorganic chemicals detected in site-related groundwater samples and compares them to background as presented in Section 31. No organic compounds were detected in site-related groundwater samples collected at Site 10. Tables 12-2a and 12-2b presents a comparison of detected compounds to ARARs and TBCs. Figure 12-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

12.5.1.1 Inorganics

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

12.5.1.2 Miscellaneous Parameters

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

12.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 10 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 12.6.1.

TABLE 12-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 10
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

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

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

TABLE 12-2a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 10

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	10GW01	10GW01-DUP	10GW02	10GW03	10GW04	10GW05	ARARS & TBCs		
LOCATION:	10GW01	10GW01	10GW02	10GW03	10GW04	10GW05	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	2920 E	2860 E	1890 E	195	1160 E	1480 E	-	-	200
arsenic	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	4.7	50.0	-	8.00
barium	64.2	62.7	49.0	2.0	30.5	26.2	2000	2000 a	2000
beryllium	0.42	0.42	0.53	0.11 U	0.20	0.29	4.00	4000 e	20.0
cadmium	0.40	0.57	0.38 U	0.38 U	0.38 U	0.85	5.00	5.00 e	4.00
calcium	7040	6850	1240	3760	2760	1570	-	-	-
chromium, total	10.1	11.5	6.0	4.3	7.2	22.8	100 *	100 a	100
cobalt	3.3	3.3	2.7	2.4	2.1	3.9	-	-	-
copper	0.77 U	0.77 U	6.7	0.77 U	0.77 U	0.77 U	1300	-	1000
iron	319 E	387 E	279	186	451 E	16600 E	-	-	300
lead	2.6	2.5	1.5 U	1.5 U	1.5 U	2.1	15.0	-	10.0
magnesium	3330	3240	380	1520	1210	2750	-	-	-
manganese	146 E	142 E	32.0	2.9	13.0	16.8	-	-	50.0
mercury	0.10	0.11	0.084	0.11	0.085	0.11	2.00	2.00 b	2.00
nickel	10.6	8.1	6.2	5.4	1.6	7.7	100	100 a	100
potassium	2430	2420	775	574	1000	3090	-	-	-
silver	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U	1.5	-	100 a	-
sodium	31400	30200	2150	7760	9050	11700	-	-	50000
thallium	3.6 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.7 E J	3.6 UJ	2.00	0.400 a	10.0
vanadium	0.72	0.70	0.85	1.3	2.2	15.0	-	-	-
zinc	51.8 R	20.0 R	140 R	1.6 U	20.2 R	9.9 R	-	2000 a	5000

TABLE 12-2a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 10

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	10GW06	10GW07	---	---	---	---	ARARS & TBCs		
LOCATION:	10GW06	10GW07	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	ug/L	ug/L					ug/L	ug/L	ug/L
aluminum	1720 E	5820 E					-	-	200
arsenic	3.3 U	3.3 U					50.0	-	8.00
barium	75.6	38.5					2000	2000 a	2000
beryllium	0.14	1.8					4.00	4000 e	20.0
cadmium	0.45	0.38 U					5.00	5.00 e	4.00
calcium	1100	1840					-	-	-
chromium, total	7.9	3.2					100 *	100 a	100
cobalt	2.7	5.0					-	-	-
copper	0.77 U	0.77 U					1300	-	1000
iron	3740 E	1200 E					-	-	300
lead	1.5 U	1.5 U					15.0	-	10.0
magnesium	1390	2040					-	-	-
manganese	23.9	43.0					-	-	50.0
mercury	0.11	0.10					2.00	2.00 b	2.00
nickel	3.8	5.7					100	100 a	100
potassium	1170	6950					-	-	-
silver	0.94 U	0.94 U					-	100 a	-
sodium	7290	6360					-	-	50000
thallium	3.6 UJ	3.6 UJ					2.00	0.400 a	10.0
vanadium	8.0	7.1					-	-	-
zinc	124 R	1.6 U					-	2000 a	5000

TABLE 12-2a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 10
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

. - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

. - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 12-2b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 10

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		10GW01		10GW01-DUP		10GW02		10GW03		10GW04		ARARS & TBCs		
LOCATION:		10GW01		10GW01		10GW02		10GW03		10GW04		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI		1995 RI		1995 RI		1995 RI		1995 RI				
MISCELLANEOUS														
ammonia nitrogen	mg/L	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	-	30.0	0.500
biochemical oxygen demand	mg/L	4.0		4.0		2.0		3.0		5.0		-	-	-
chemical oxygen demand	mg/L	6.0	J	3.0	J	2.0	J	5.0	J	3.0	J	-	-	-
chloride	mg/L	60.0		64.0		3.0		8.0		18.0		-	-	250
nitrate nitrogen	mg/L	0.50	U	0.50	U	0.90		0.28	J	0.50	U	10.0	10.0	-
sulfate	mg/L	33.0		32.0		15.0		19.0		7.0	U	500	-	250
total organic carbon	mg/L	2.0		2.0		0.90	J	2.0		2.0		-	-	-
total phosphorus as PO4	mg/L	0.20	U	0.20	U	0.20	U	0.20	U	0.20	U	-	-	-
turbidity	ntu	3.1		3.2		1.6		3.2		2.9		-	-	-

SAMPLE NUMBER:		10GW05		10GW06		10GW07		---		---		ARARS & TBCs		
LOCATION:		10GW05		10GW06		10GW07		---		---		Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI		1995 RI		1995 RI								
MISCELLANEOUS														
ammonia nitrogen	mg/L	0.40	J	0.10	J	0.20	J					-	30.0	0.500
biochemical oxygen demand	mg/L	6.0		4.0		4.0						-	-	-
chemical oxygen demand	mg/L	22.0		31.0		12.0						-	-	-
chloride	mg/L	34.0		10.0		9.0						-	-	250
nitrate nitrogen	mg/L	0.50	U	0.50	U	0.50	U					10.0	10.0	-
sulfate	mg/L	10.0		28.0		58.0						500	-	250
total organic carbon	mg/L	6.0		13.0		5.0						-	-	-
total phosphorus as PO4	mg/L	0.40		0.20	U	0.20	U					-	-	-
turbidity	ntu	41.0		20.0		2.8						-	-	-

TABLE 12-2b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 10
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

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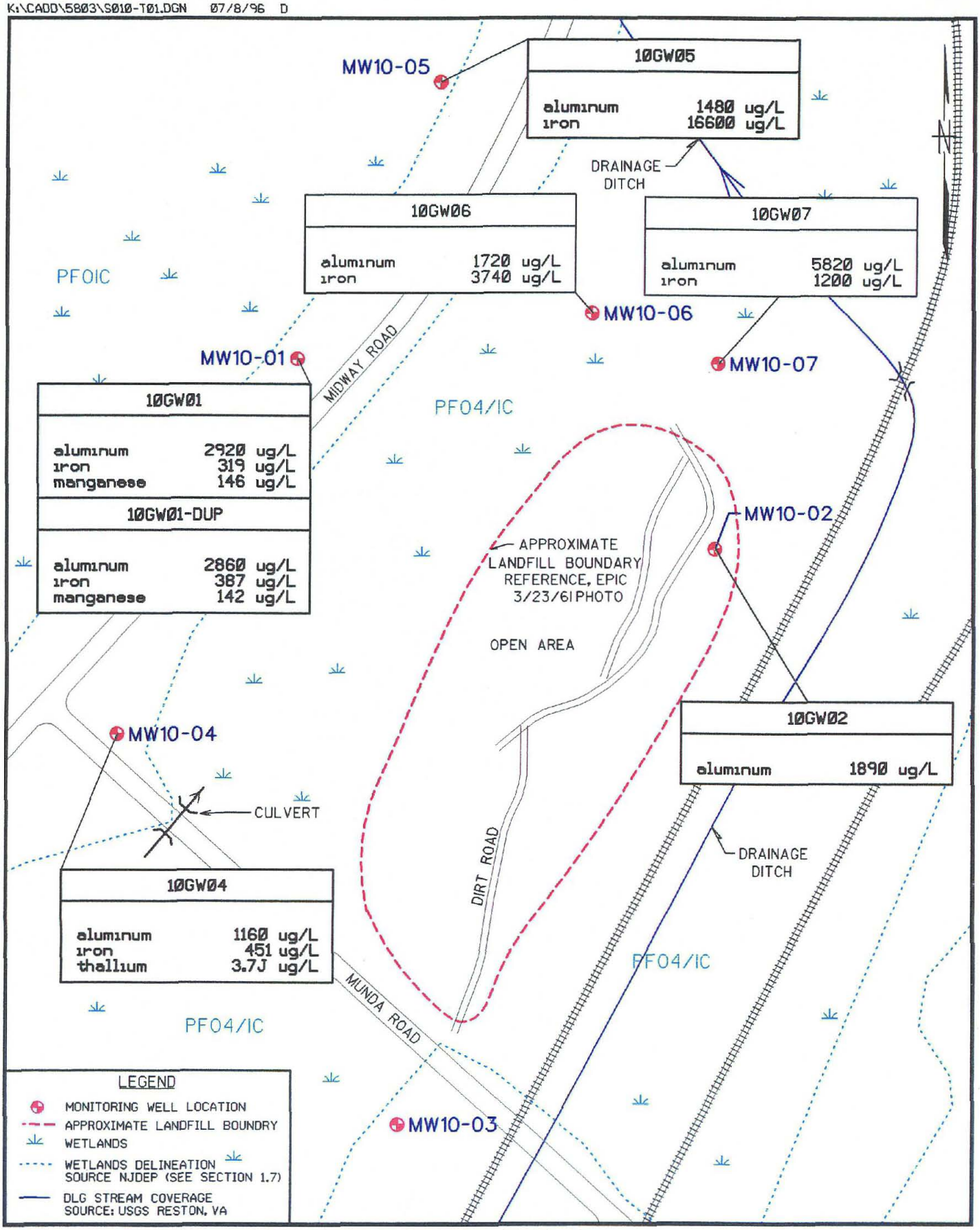

CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 10 - SCRAP METAL LANDFILL

FIGURE 12-4

0 100 200

SCALE IN FEET

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Persistence of detected chemicals in the environment is discussed in Section 12.6.2. Section 12.6.3 presents a brief discussion of contaminant trends.

12.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at the Site 10 indicate limited concentrations of metals in groundwater. No soil samples were collected at the site. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

12.6.2 Contaminant Persistence

For the detected metals, environmental transformations involve potential changes in oxidation state and complexation, which influence, solubility, sorption properties, and mobility in groundwater. The endpoints of environmental transformations may or may not be significantly different toxicologically or from a physical transport perspective. If the transformational process is known or suspected, product chemicals can be predicted and extent of transformation can be determined from chemical reaction rate data. Other transformational processes may be identified empirically from analytical data.

Because of more frequent contact with reactive dissolved species and catalysts when compared to unsaturated conditions, the contaminants found in saturated media (groundwater) are most likely to be transformed in the environment.

12.6.3 Observed Chemical Contaminant Trends

Most inorganic constituents detected in Site 10 groundwater samples were within similar concentration ranges as background groundwater samples. Arsenic, silver, and thallium results were near the limit of detection, which generally suggests no significant groundwater impact has been identified for these metals. A slightly elevated level of iron in monitoring well MW10-04, which is located near the intersection of Midway and Munda Roads, is not considered to be impacted by the landfill because this well may be hydrologically upgradient of the landfill (although the scrap metal disposal area contains shell casings that characteristically are comprised of iron, aluminum, zinc, and possibly other metal alloy components).

A previous investigation conducted in 1993 indicated elevated levels of several metals in groundwater samples at Site 10. However, these samples were collected as unfiltered groundwater using standard purging methods that can contribute to the presence of suspended solids due to turbidity. The elevated level of aluminum, for instance, in several of the 1993 sampling results indicates that a substantial portion of the detected metals was probably in suspended rather than dissolved form. The current investigation

utilized low-flow purge methods that minimize suspended solids generated during sampling. Results of the current sampling do not indicate elevated metals in groundwater at Site 10.

12.6.4 Conclusions

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

12.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 10. The risk assessment was performed using the approach outlined in Section 2.4. Table 12-3 provides the selected COPCs and representative concentrations of inorganics and organics in site-related groundwater. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of one for non-cancer risk and 1E-04 for cancer risk; therefore, additional risk analysis was performed according to EPA guidance, as discussed in Section 2.4.6. Section 12.7.1.4 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

12.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential and industrial receptors).

12.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 10 are 3.0E-05 (ingestion) and 5.8E-07 (dermal contact). The total groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or to formulate ARARs. The principal COPCs contributing to the groundwater

TABLE 12-3
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 10 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	5820	NONPARAMETRIC
ARSENIC	2.99	LOGNORMAL
BERYLLIUM	0.93	NORMAL
CADMIUM	0.55	NORMAL
COPPER	5.85	LOGNORMAL
IRON	7676.42	NORMAL
LEAD	2.15	LOGNORMAL
MERCURY	0.11	LOGNORMAL
SILVER	0.93	LOGNORMAL
THALLIUM	2.61	LOGNORMAL

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cancer risk are arsenic (ingestion, 53 percent of the cancer risk for this pathway) and beryllium (ingestion, 47 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future industrial employee assuming exposure to COPCs in groundwater at Site 10 are less than 1.0 for the ingestion and dermal contact exposure pathways. In addition, the HI (sum of HQs) is also less than 1.0; adverse noncarcinogenic effects are not expected when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial receptors exposed to groundwater at Site 10 in Tables 12-4 and 12-5, respectively.

12.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 10. In addition, this risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future child resident assuming exposure to groundwater. (Ingestion exposures contributed the significant portion of these risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 12.7.1.4 and presented in Tables 12-6 and 12-7, respectively.

12.7.1.3 Lead Results

No lead concentrations were found above the regulatory level of concern (400 mg/kg) in site sediments or the subsurface soil sample taken during the SI or RI/FS. Lead was found above the EPA action level (15 ug/L) in groundwater samples taken during the SI and RI/FS, but concentrations varied substantially among the several sampling rounds of a well. No lead concentration above the EPA action level was found in groundwater samples obtained from any site well via the low-flow sampling procedure during the 1995 RI.

The IEUBK Lead Model (v. 0.99) was also used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 10 exposures are presented in Appendix I.

TABLE 12-4
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 10
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
ALUMINUM	N/A	N/A
ARSENIC	1.6E-05	6.8E-09
BERYLLIUM	1.4E-05	5.7E-07
CADMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MERCURY	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
TOTAL RISK	3.0E-05	5.8E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 12-5
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 10
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
ALUMINUM	5.7E-02	4.7E-04
ARSENIC	9.8E-02	4.2E-05
BERYLLIUM	1.8E-03	7.5E-05
CADMIUM	1.1E-02	8.8E-05
COPPER	1.4E-03	9.8E-07
IRON	2.5E-01	2.1E-03
LEAD	N/A	N/A
MERCURY	3.6E-03	2.1E-05
SILVER	1.8E-03	3.7E-06
THALLIUM	3.2E-01	2.6E-03

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 12-6
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 10
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
ARSENIC	6.7E-05	1.6E-07	N/A
SILVER	N/A	N/A	N/A
TOTAL RISK	6.7E-05	1.6E-07	N/A

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 12-7
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 10
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - CHILD	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
ARSENIC	6.4E-01	1.3E-03	N/A
SILVER	1.2E-02	1.2E-04	N/A

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

12.7.1.4 Amended Risk Assessment

Because the conservative baseline risk assessment yielded total cancer risks greater than 1E-04 and a noncarcinogenic HI greater than 1.0 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 10, risks have been recalculated for future residential exposure to groundwater.

Comparison to Background

Aluminum, beryllium, cadmium, copper, iron, lead, mercury, and thallium were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 12-2 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

The estimated total cancer risks for the future lifetime resident for exposure to COPCs in groundwater at Site 10 are 6.7E-05 (ingestion) and 1.6E-07 (dermal contact). The total groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or to formulate ARARs. Arsenic was the COPC responsible for the groundwater cancer risk.

The estimated individual noncarcinogenic HQs for the future residential child assuming exposure to COPCs in groundwater at Site 10 are less than 1.0 for the ingestion and dermal contact exposure pathways. The HI (sum of HQs) is also less than 1.0; adverse noncarcinogenic effects are not expected when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to groundwater at Site 10 in Tables 12-6 and 12-7, respectively.

12.7.2 Conclusions

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

characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 10 in Table 12-8 for groundwater.

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

Human health risk assessment calculations did not include data from field sampling prior to the 1995 RI. Therefore, only groundwater scenarios were considered in this risk assessment. Conclusions from previous investigations indicated that Site 10 surface water or sediment pathways were not contributing a significant human health risk to potential receptors. However, a surface or subsurface soil sample taken in an area of exposed corroded shell casings would almost certainly show high metals concentrations. A subsequent feasibility study could take into account exposure to metal wastes protruding from the landfill.

12.8 ECOLOGICAL RISK

12.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

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

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major release pathways from Site 10 are overland runoff and, to a lesser extent, infiltration of contaminants. Precipitation runoff from the landfill may carry constituents to off-site surface water, sediments, and soils, primarily to the drainage ditch. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a

TABLE 12-8
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 10
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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	3.0E-05	6.7E-05^	N/A	N/A	7.4E-01	6.5E-01^	N/A	N/A
	Dermal Contact	N/A	5.8E-07	1.6E-07^	N/A	N/A	5.4E-03	1.4E-03^	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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	3.0E-05	6.7E-05	-	-	7.5E-01	6.5E-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 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
^ - Value from amended risk assessment.

contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to drainage ditch surface water that leads to the branch of Hockhockson Brook; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms. Groundwater to surface water discharge to the forested wetlands is precluded by the relative absence of surface water in these areas.

Exposure Routes

Terrestrial organisms may be exposed to site-related contaminants via incidental ingestion of soil and ingestion of contaminated food items. Terrestrial vegetation may also be exposed to contaminants in surface soils. Aquatic and semi-aquatic organisms inhabiting the drainage ditch or branch of Hockhockson Brook may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated prey. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water. Due to limited upland habitat on the site and the tendency for runoff to flow toward the drainage ditch, aquatic and semi-aquatic exposure routes were the main concern for Site 10.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1993 RI/FS surface water and sediment investigations. Results of RI/FS and 1995 RI surface soil samples were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

12.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential risks to ecological receptors from contaminants in sediments. Sediment ET values are presented in Table 2-29.

12.8.3 Preliminary Exposure Assessment

Representative exposure point contaminant concentrations in surface water and sediment used for this initial screening were obtained from 1993 RI/FS sampling. The maximum detected contaminant

concentrations in surface water and sediment were conservatively used as representative exposure point concentrations. Data from 1993 RI/FS and 1995 groundwater sampling were not used quantitatively because there was no significant variance from background concentration. The results of this sampling are discussed in detail below.

Three surface water and sediment samples were taken in the adjacent drainage ditch as part of 1993 RI/FS activities. Two samples were taken in the ditch north of the site, downstream from the site. The third sample was taken in the ditch, upstream from the site; this sample represented site-specific background conditions. Background concentrations used in this ecological risk assessment for qualitative comparison to representative exposure point concentrations were values for contaminants detected in the upgradient sample. No contaminants were detected in surface water samples that were not found in blanks, with the exception of a low detection of chloroform in the upstream sample, precluding quantitative assessment for surface water. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

12.8.3.2 Risk Characterization

In drainage ditch surface water, no contaminants were detected in the two downstream samples. In drainage ditch sediments, only antimony exceeded its ET value and was retained as a final COPC; antimony did not exceed a less conservative value. Aluminum and vanadium were conservatively retained as final COPCs since no suitable thresholds were available. The toxicological properties of all final COPCs are summarized in Appendix M.

12.8.4 Summary and Conclusions

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

No contaminants were detected in surface water that were not found in comparable concentrations in blanks. In sediments, only antimony exceed the most conservative ET, but its HQ value was indicative of low potential risk. Aluminum and vanadium were conservatively retained as final COPCs in sediments

since no ETs were available, but both were present at concentrations lower than in the upstream sample.

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

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

12.9 EVALUATION AND RECOMMENDATIONS

12.9.1 Evaluation Summary

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

Metals results from monitoring well low-flow samples were generally lower than concentrations found in previous (SI and RI/FS) samples, probably due to reduced turbidity in the sample.

Groundwater metals concentrations were generally in the range of background. Therefore, there does not appear to be a significant impact to groundwater from the site.

The calculated cancer risk indicates that the site is generally in the target acceptable range.

Concentrations of metals found in site subsurface soils and sediments were generally in the range of background and below ARARs and TBCs. However, as noted in Section 12.7.2, samples were not taken directly from exposed corroded metal wastes.

Typical aluminum and steel scrap, potentially associated with other metals as anti-corrosion treatments or coatings, interred at the site, appear to have limited potential for effect on human health or the environment.

Aluminum, iron, and manganese were found at concentrations above the corresponding GWQs but below the comparison to two times background.

12.9.2 Recommendations

Some sort of cover should be considered for source containment and to improve the appearance and/or utility of the site. For instance, the application of a gravel material may improve the site as a potential temporary open storage area. The integrity and long-term stability of the existing landfill cover could be evaluated in a focused feasibility study for this site.

13.0 SITE 11: CONTRACT ORDNANCE DISPOSAL AREA

13.1 SITE BACKGROUND AND PHYSICAL SETTING

Site 11 is a 2-acre site that was used for disposal of obsolete ordnance material for several years (dates unknown) (See Figure 13-1). The site was occasionally used from 1974 to 1977 for firefighting training. Training activities took place in two unlined pits, approximately 20 feet long. During firefighting training, reject vehicles were soaked with fuel or oil and ignited and then extinguished. Unburned fuel and waste oil used for ignition were allowed to evaporate or soak into the soil. It has been estimated that 50 gallons of oil per year may have been lost in this manner.

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

13.2 PREVIOUS INVESTIGATIONS

13.2.1 Summary of Activities and Results

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

During the 1993 SI, four soil borings were drilled and three monitoring wells were installed and sampled at the site perimeter. A soil sample from one of the soil borings had high concentrations of oil and grease. Eight soil samples (from 0.5 to 1.5 feet) were collected from the site during the 1993 RI/FS. Soil and groundwater samples were analyzed for explosives, TPH, and nitrite/nitrate. Analytical results indicated that no explosive compounds were present, although six samples showed low TPH results.

Two monitoring wells were installed during the RI/FS. All SI and RI/FS monitoring wells were sampled and analyzed for TCL volatiles, SVOCs, TAL metals/CN, pesticides/PCBs, and explosives. One semivolatile, three volatiles (common laboratory artifacts), and metals were detected in site wells. Groundwater results indicate that no pesticides, PCBs, or explosives were detected at the site. Similar results were obtained during later rounds of sampling at these wells.

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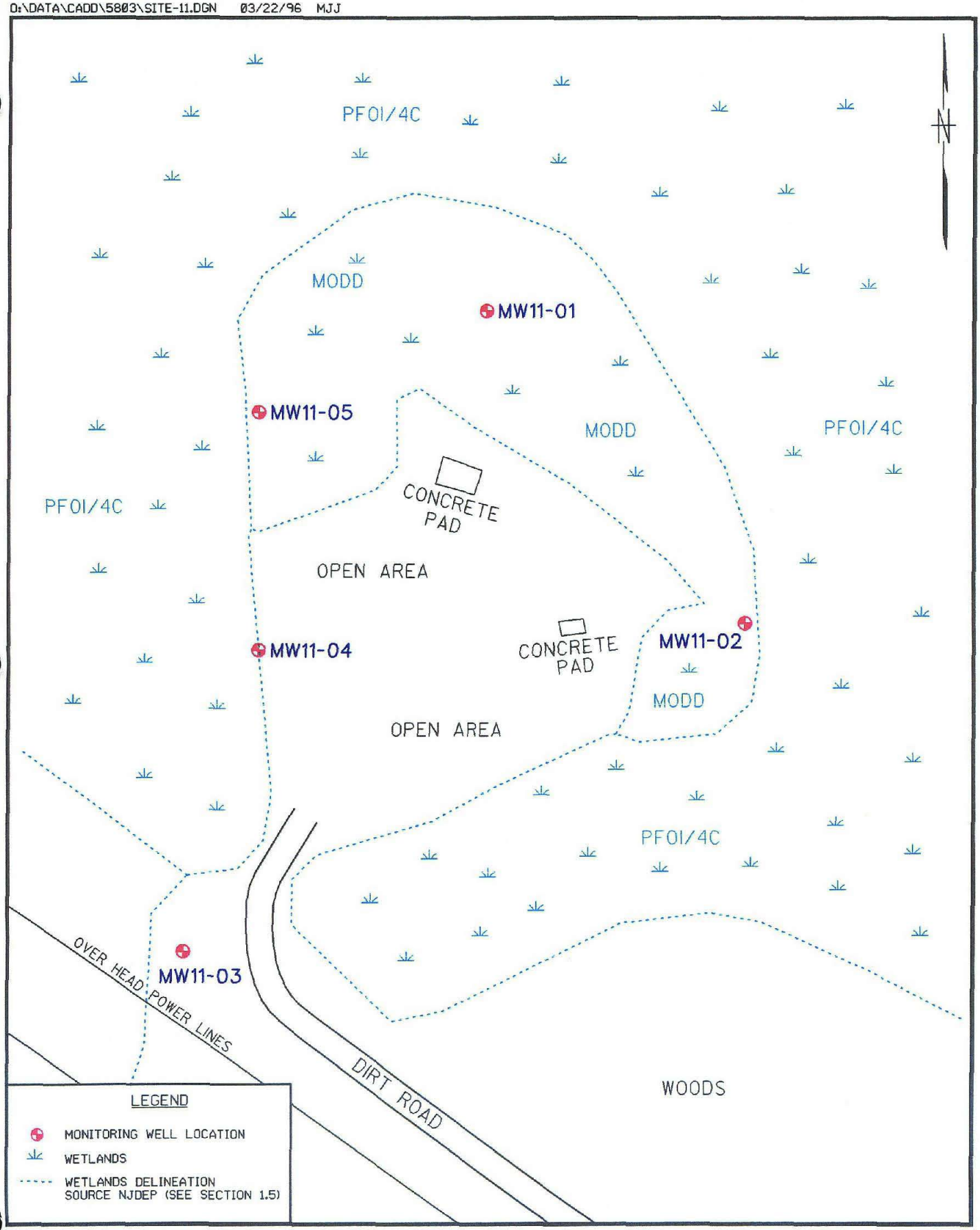

SAMPLE LOCATIONS

SITE 11 - CONTRACT ORDNANCE DISPOSAL AREA

FIGURE 13-1

0 100 200

SCALE IN FEET

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13.2.2 Summary of Conclusions

Previous investigations indicated that soils had been minimally impacted by petroleum hydrocarbons. Groundwater samples showed low levels of volatiles (potentially laboratory contaminants) and metals at concentrations of potential concern. An endangered plant, Knieskern's Beaked Rush, was observed on this site.

13.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Confirm previous VOC and metals results in all wells.
- Determines impact of turbidity on metals results by using low-flow groundwater sampling techniques.
- Compare metals results to background.

13.3 RI FIELD INVESTIGATIONS

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

- Sampling and analysis of groundwater from the five existing monitoring wells (Section 13.3.1).
- Measurement of static-water levels in the monitoring wells (Section 13.3.1).

13.3.1 Static-Water-Level Measurements and Groundwater Sampling

Static-Water-Level Measurements

Two rounds of static-water-level measurements were collected to define groundwater flow directions and horizontal and vertical groundwater gradients. The first round of water-level measurements was collected on August 7, 1995, the second on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to

the nearest 0.01 foot. The water-table elevation ranged from approximately 85.00 to 87.98 feet above MSL during the first round of measurements and from approximately 84.69 to 87.66 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 13-1. Monitoring well construction details are summarized in Table 13-1a.

Groundwater Sampling

Groundwater samples were obtained in July 1995 from the five existing monitoring wells to determine groundwater quality at the site and to provide data for use in the risk assessment and the evaluation of remedial alternatives. Field measurements collected during purging were pump rate (L/min), water level, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity. Prior to sampling, B&R Environmental purged the wells, using the micro-purge protocol, to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure little or no drawdown in water levels occurred throughout the purge and sample process. Figure 13-1 shows sample locations.

B&R Environmental submitted the five groundwater samples (11 GW 01 through 11 GW 05) to Lancaster Laboratories for TCL VOC and TAL metal analyses. Sample log sheets are presented in Appendix D.

13.4 SITE CHARACTERISTICS

13.4.1 Geology

Regional mapping places Site 11 within the outcrop area of the Vincentown Formation; upper colluvium may be present at the site. The upper colluvium has a maximum thickness of 10 feet, the Vincentown Formation ranges between 10 and 130 feet in thickness, and the soil borings are no more than 25 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the upper colluvium and the Vincentown Formation. In general, the borings encountered gray and black silt and white sand (possibly representative of the upper colluvium), and brownish-yellow, olive, glauconitic, fine- to medium-grained sand (probably representative of the Vincentown Formation).

Based upon the boring log descriptions, wells MW11-1, MW11-2, MW11-4, and MW11-5 penetrated the upper colluvium and the Vincentown Formation, and well MW11-3 penetrated the Vincentown Formation.

Table 13-1
Site 11 Static-Water-Level Measurement Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
MW11-01	2.91	87.91	85.00	3.22	87.91	84.69
MW11-02	3.90	89.66	85.76	4.22	89.66	85.44
MW11-03	9.22	97.20	87.98	9.54	97.20	87.66
MW11-04	4.26	91.00	86.74	4.53	91.00	86.47
MW11-05	3.63	89.46	85.83	3.91	89.46	85.55

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

Table 13-1a
Site 11 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW11-01	19	85.94	87.91	88.01	4	4 - 19	3.5 - 19	12/19/85
MW11-02	18	87.88	89.66	90.68	4	3 - 18	2.5 - 18	12/18/85
MW11-03	20	94.91	97.20	97.41	4	5 - 20	3 - 20	12/18/85
MW11-04	14.50	88.48	91.00	91.11	4	4.2 - 14.5	3.8 - 25[3]	1/14/91
MW11-05	13.7	87.08	89.46	89.60	4	3.7 - 13.7	2.5 - 14.5[3]	1/15/91

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 4-5 for more accurate measurements.
(2) In feet above mean sea level.
(3) Filter pack extends beneath screened interval.

13.4.2 Hydrogeology

Groundwater in the upper colluvium and Vincentown aquifer beneath the site occurs under unconfined conditions and the geologic units are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 13-1. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 13-2 and 13-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

Based on boring log descriptions, well MW11-04 was screened across the contact between the upper colluvium and the Vincentown Formation, and wells MW11-01 through MW11-03 and MW11-05 were screened in the Vincentown Formation. The hydraulic conductivities calculated for MW11-02 (Vincentown Formation) and MW11-04 (upper colluvium and Vincentown Formation) are 3.56×10^{-4} cm/sec (1.01 ft/day) and 8.64×10^{-4} cm/sec (2.45 ft/day), respectively.

13.5 NATURE AND EXTENT OF CONTAMINATION

13.5.1 Groundwater

Five groundwater samples (11 GW 01 through 11 GW 05) were collected at Site 11 (Figure 13-1). Tables 13-2 and 13-3 present the occurrence and distribution of inorganic and organic chemicals in site-related groundwater samples and compare them to background as presented in section 31. Table 13-3 presents the occurrence and distribution of organic chemicals in background and site-related groundwater samples. Table 13-2a presents a comparison of detected compounds to ARARs and TBCs. Figure 13-4 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

13.5.1.1 Inorganics

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

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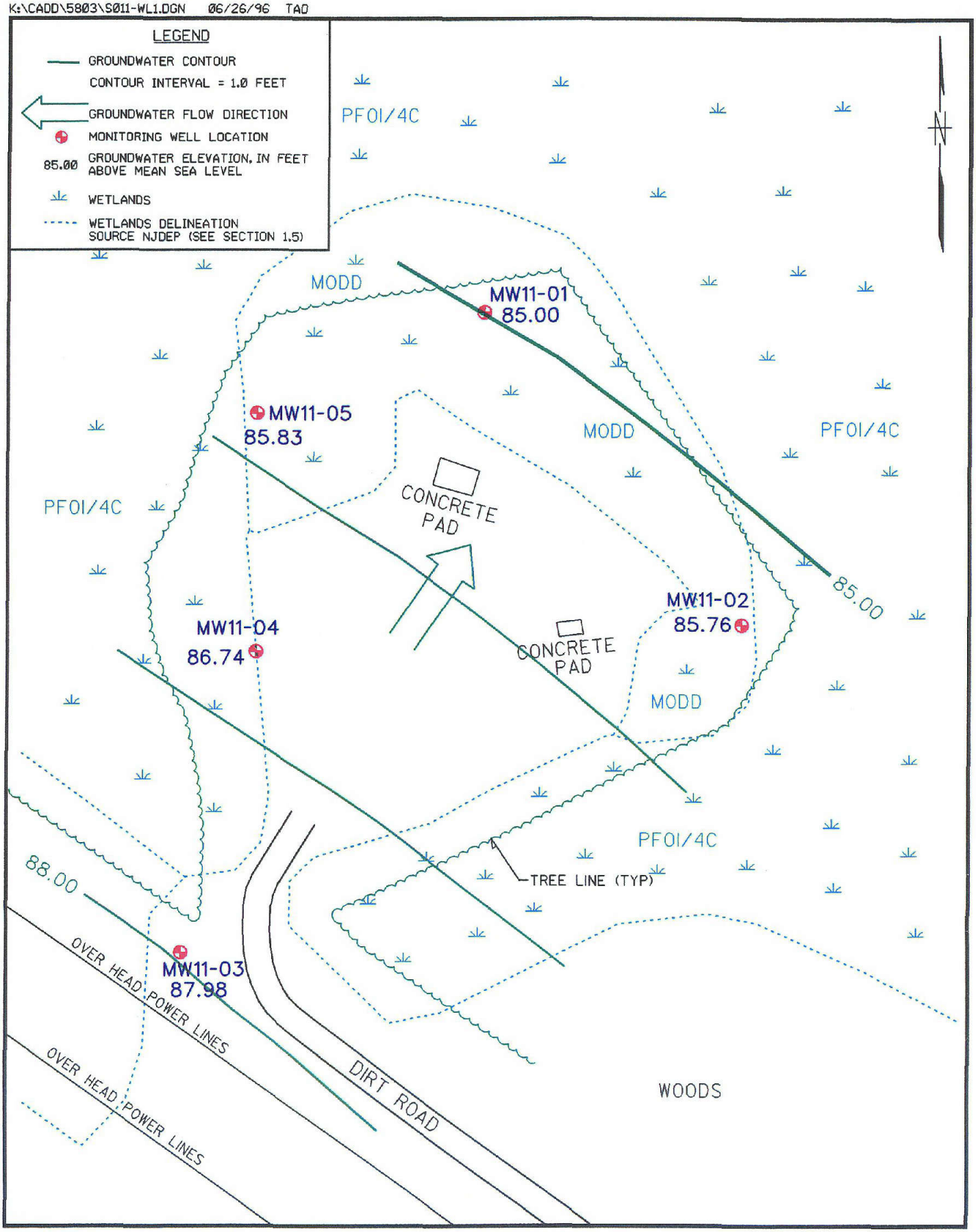

GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 11 - CONTRACT ORDNANCE DISPOSAL AREA

FIGURE 13-2

0 100 200

SCALE IN FEET

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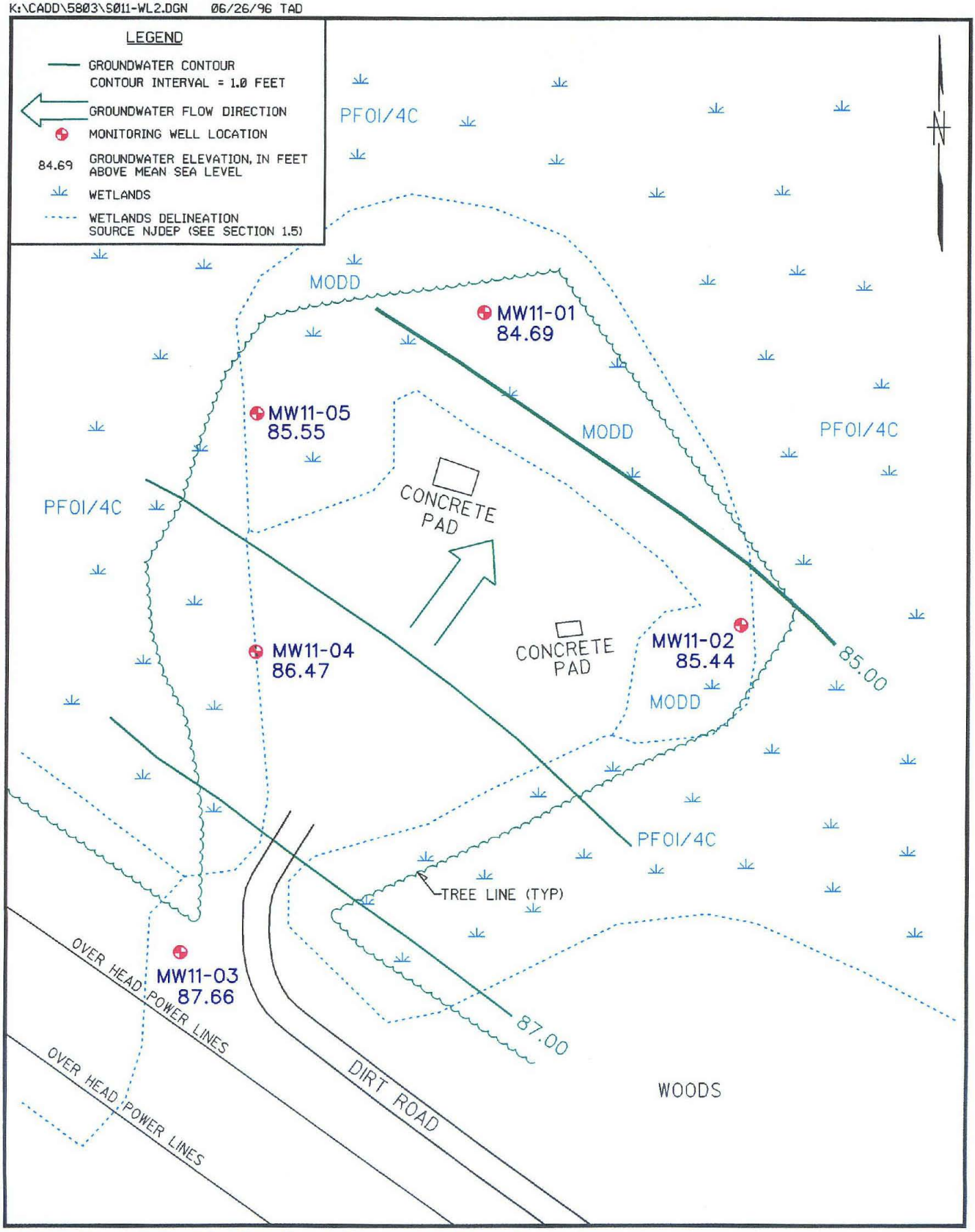
K:\CADD\5803\S011-WL2.DGN 06/26/96 TAD



GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 11 - CONTRACT ORDNANCE DISPOSAL AREA

FIGURE 13-3

0 100 200

SCALE IN FEET

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TABLE 13-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 11
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	REPRESENTATIVE CONCENTRATION
ALUMINUM*	11 / 11	287 - 7870	5097.82	5 / 5	177 - 3010	1913.40	NO	3010
BARIUM*	11 / 11	2.6 - 518	229.60	5 / 5	27.4 - 518	131.68	NO	337.63
CADMIUM*	5 / 11	0.6 - 1.9	1.21	3 / 5	0.57 - 0.62	0.43	NO	0.62
CALCIUM	11 / 11	506 - 17200	8306.55	5 / 5	274 - 2090	999.60	NO	2090
CHROMIUM	NOT DETECTED	-	-	5 / 5	4.4 - 31	21.34	YES	31.00
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 5	0.63 - 1.8	1.03	NO	1.73
COPPER*	9 / 11	0.79 - 13.5	6.53	5 / 5	0.85 - 13.5	3.57	NO	13.50
IRON	11 / 11	153 - 7690	4197.09	5 / 5	166 - 4310	2793.20	NO	4310
LEAD*	3 / 11	2.1 - 3	2.44	1 / 5	3	1.20	NO	3.00
MAGNESIUM	11 / 11	273 - 27400	8449.64	5 / 5	811 - 2240	1394.20	NO	2240
MANGANESE	11 / 11	3.3 - 65	46.18	5 / 5	5.1 - 18	12.24	NO	18.00
MERCURY*	11 / 11	0.005 - 0.12	0.12	5 / 5	0.013 - 0.12	0.09	NO	0.12
NICKEL	10 / 11	0.81 - 25.5	11.98	5 / 5	1 - 4.7	2.38	NO	4.70
POTASSIUM	11 / 11	350 - 3245	2810.55	5 / 5	1140 - 2160	1578.00	NO	2064.66
SODIUM	11 / 11	1850 - 11650	8449.09	5 / 5	2200 - 3530	2938.00	NO	3530
VANADIUM	10 / 11	0.69 - 42.25	16.48	4 / 5	1.4 - 13.5	7.84	NO	13.50
ZINC*	6 / 9	3.7 - 348	178.61	1 / 5	348	70.27	NO	218.29

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

TABLE 13-3
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 11
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
CHLOROFORM	NOT DETECTED	-	-	3 / 5	1 - 3	3

TABLE 13-2a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 11

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	11GW01	11GW02	11GW03	11GW04	11GW05	---	ARARS & TBCs		
LOCATION:	11GW01	11GW02	11GW03	11GW04	11GW05	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI				
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	ug/L	ug/L
aluminum	177	1260 E	3010 E J	2350 E	2770 E		-	-	200
barium	38.6	27.4	518	40.8	33.6		2000	2000 a	2000
cadmium	0.38 U	0.38 U	0.60	0.62	0.57		5.00	5.00 e	4.00
calcium	739	274	2090	922	973		-	-	-
chromium, total	11.4	4.4	28.9	31.0	31.0		100 *	100 a	100
cobalt	0.63	1.8	0.83	0.89	1.0		-	-	-
copper	1.4	0.85	13.5	1.0	1.1		1300	-	1000
iron	166	1180 E	4310 E J	4120 E	4190 E		-	-	300
lead	1.5 UJ	1.5 UJ	3.0	1.5 UJ	1.5 UJ		15.0	-	10.0
magnesium	1330	811	1500	2240	1090		-	-	-
manganese	5.1	15.4	15.3 J	7.4	18.0		-	-	50.0
mercury	0.11 J	0.12 J	0.013	0.12 J	0.11 J		2.00	2.00 b	2.00
nickel	1.0	4.7	3.2	1.9	1.1		100	100 a	100
potassium	1480	1140	2160	1670	1440		-	-	-
sodium	2390	3490	3530	3080	2200		-	-	50000
vanadium	0.61 U	1.4	13.5	11.7	12.3		-	-	-
zinc	1.6 U	1.9 R	348	1.6 U	1.6 U		-	2000 a	5000
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	ug/L	ug/L
chloroform	3.0 J	10.0 U	2.0 J	1.0 J	10.0 U		100	100 e	6.00

TABLE 13-2a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 11
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

* - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

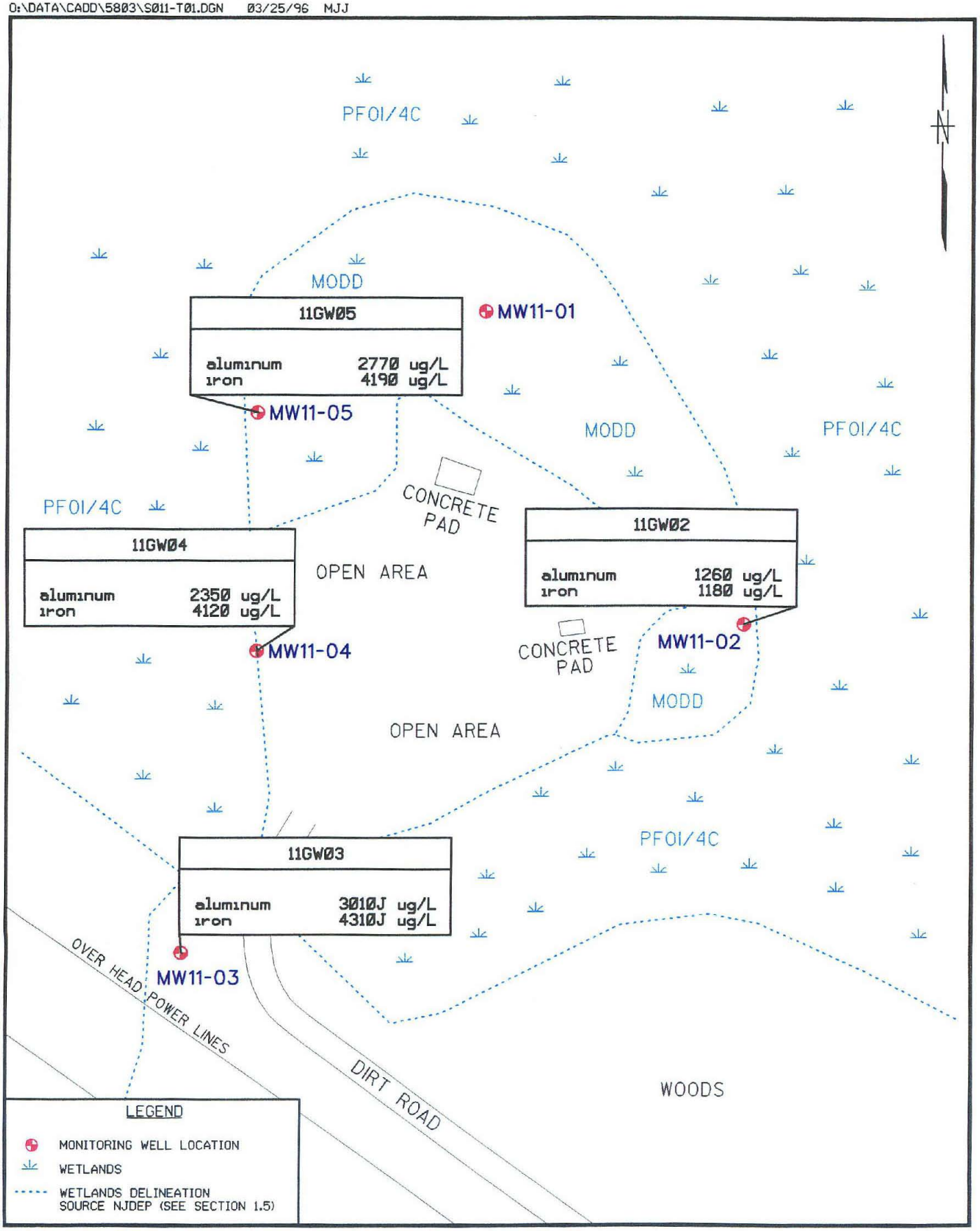
b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

O:\DATA\CADD\5803\S011-T01.DGN 03/25/96 MJJ



CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 11 - CONTRACT ORDNANCE DISPOSAL AREA

FIGURE 13-4

0 100 200

SCALE IN FEET

Brown & Root Environmental

13.5.1.2 Organics

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

13.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 11 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 13.6.1. Persistence of detected chemicals in the environment is discussed in Section 13.6.2. Section 13.6.3 presents a brief discussion of contaminant trends.

13.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at the Site 11 indicate low levels of chloroform and limited concentrations of metals in groundwater. No soil samples were collected at the site during the RI. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to Table 13-2 chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

Chloroform exhibits a relatively high solubility, vapor pressure, and air-water partition coefficient (Henry's law constant). This compound is characteristically mobile in the environment (either through soil gas migration or groundwater transport).

The presence of suspended solids in groundwater sample 11 GW 03 and 11 GW 05 is suggested by elevated aluminum levels and slightly elevated turbidity readings of 743 and 119 NTU respectively. Elevated sampling endpoint turbidity values were 74 nephelometric turbidity units (NTU) and 119 NTU in samples 11 GW 03 and 11 GW 05, respectively. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given a geologic formation which does not include conditions conducive to solution channeling or fracture-based flow. Despite efforts such as installation of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure, low-turbidity samples could not be collected at these wells.

13.6.2 Contaminant Persistence

For the classes of detected chemicals, environmental persistence varies widely. Transformation of a chemical to its degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The by-product

chemical(s) may or may not be significantly different toxicologically or different from a physical transport perspective. If the transformational process is known or suspected, product chemicals can be predicted and extent of transformation can be determined from chemical reaction rate data. Other transformational processes may be identified empirically from analytical data.

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

For the detected metals, environmental transformations involve potential changes in oxidation state and complexation, which in turn impact speciation, solubility, sorption properties, and mobility in groundwater.

13.6.3 Observed Chemical Contaminant Trends

Groundwater has not been impacted from fuel-related volatile aromatic hydrocarbons from former fire training operations. Chloroform was the only detected VOC. Chloroform is not generally associated with fuel oils. Chloroform was detected at low levels (below quantitation limits) in three of five monitoring wells in the current investigation. It was not detected in any of the associated blanks. Chloroform results for MW11-01 (a downgradient well) in the current investigation are consistent with detections observed in three rounds of sampling in a 1993 investigation. However, monitoring wells MW11-03 (upgradient) and MW11-04 (side gradient and adjacent to the estimated fill area) each exhibited low-level positive detections in the current investigation but were not matched by positive detections in two of the three rounds of sampling in 1993.

Most inorganic constituents detected in Site 11 groundwater samples were similar in concentration to background ranges, which generally suggests no significant groundwater impact has been identified for these chemicals. Monitoring well MW11-03, which is located hydraulically upgradient from the site, displayed slightly elevated levels of aluminum, barium and zinc. Downgradient well MW 11-05 contained aluminum at a level similar to that found in upgradient well MW 11-03.

13.6.4 Conclusions

Substances detected in the groundwater at Site 11 do not indicate that significant impacts from site-related activities has occurred. One VOC, chloroform, appeared at trace level in one downgradient well; however, chloroform detection in an upgradient wells suggests that the presence of this compound is not site

related. One downgradient well revealed a concentration of aluminum slightly greater than the background range; however, the level was similar to that found in an upgradient well.

13.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 11. The risk assessment was performed using the approach outlined in Section 2.4. Table 13-4 provides the selected COPCs and representative concentrations of inorganics and organics in site-related groundwater. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non cancer risk, therefore additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 13.7.1.4 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

13.7.1 Risk Characterization

The results of the risk assessment are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential and industrial receptors).

13.7.1.1 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in groundwater at Site 11 are 6.4E-08 (ingestion) and 6.3E-10 (dermal contact). The total groundwater cancer risk is below the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or formulate ARARs.

The estimated noncarcinogenic HIs for the future industrial employee assuming exposure to COPCs in groundwater at Site 11 are 2.5E-01 (ingestion) and 2.0E-03 (dermal contact). Adverse noncarcinogenic health effects are not expected when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic adverse effects are presented for future industrial receptors exposed to groundwater at Site 11 in Tables 13-5 and 13-6, respectively.

TABLE 13-4
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 11 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	3010	NONPARAMETRIC
BARIUM	337.63	NORMAL
CADMIUM	0.62	LOGNORMAL
COPPER	13.5	NORMAL
LEAD	3	LOGNORMAL
MERCURY	0.12	LOGNORMAL
ZINC	218.29	NORMAL
CHLOROFORM	3.00	NONPARAMETRIC

TABLE 13-5
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 11
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
CHLOROFORM	6.4E-08	6.3E-10
ALUMINUM	N/A	N/A
BARIUM	N/A	N/A
CADMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MERCURY	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	6.4E-08	6.3E-10

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS VALUE

TABLE 13-6
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 11
GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
CHLOROFORM	2.9E-03	2.9E-05
ALUMINUM	2.9E-02	2.4E-04
BARIUM	4.7E-02	4.8E-04
CADMIUM	1.2E-02	9.9E-05
COPPER	3.3E-03	2.3E-06
IRON	1.4E-01	1.2E-03
LEAD	N/A	N/A
MERCURY	3.9E-03	2.3E-05
ZINC	7.1E-03	1.2E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS VALUE

13.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future residential child assuming exposure to groundwater. (Ingestion exposure contributed the significant portion of this risk.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 13.7.1.4 and presented in Tables 13-7 and 13-8, respectively.

13.7.1.3 Lead Results

Lead was found above the EPA action level (15 ug/L) in groundwater samples taken during the SI and RI/FS, but concentrations varied substantially between the sampling rounds of a given well. No lead concentration above the EPA action level was found in groundwater samples obtained from any site well via the low flow sampling procedure during the 1995 RI.

The IEUBK Lead Model (v. 0.99) was used also to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 11 exposures are presented in Appendix I.

13.7.1.4 Amended Risk Assessment

Because the conservative preliminary baseline risk assessment yielded a noncarcinogenic HI greater than 1.0 for the future residential child assuming exposure to COPCs in groundwater at Site 11, risks have been recalculated for future residential exposure to groundwater.

Comparison to Background

Aluminum, beryllium, barium, cadmium, copper, lead, mercury, and zinc were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 13-2 presents the comparison of COPCs to background concentrations.

The estimated total cancer risks for the future lifetime resident assuming exposure to COPCs in groundwater at Site 11 are 2.7E-07 (ingestion), 2.0E-08 (dermal contact), and 3.5E-06 (inhalation of volatiles). The groundwater cancer risk is within the 1E-04 to 1E-06 target acceptable risk range. The COPC contributing to the groundwater cancer risk is chloroform (inhalation of volatiles, 100% of the cancer risk for this pathway).

TABLE 13-7
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 11
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	2.7E-07	2.0E-08	3.5E-06
TOTAL RISK	2.7E-07	2.0E-08	3.5E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS VALUE

TABLE 13-8
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 11
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - CHILD	GROUNDWATER DERMAL CONTACT - CHILD	INHALATION OF VOAS IN GW - ADULT
CHLOROFORM	1.9E-02	1.1E-03	N/A

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS VALUE

The estimated noncarcinogenic HIs for the future residential child assuming exposure to COPCs in groundwater at Site 11 are less than 1.0 for the ingestion and dermal contact exposure pathways. Adverse noncarcinogenic effects are not expected when the HI is below 1.0.

Estimated carcinogenic risks and noncarcinogenic adverse effects are presented for future residential receptors exposed to groundwater at Site 11 in Tables 13-7 and 13-8, respectively.13.7.2

Conclusions

Groundwater was sampled at Site 11. The potential receptors considered for this site were future industrial and residential receptors. The cancer risks associated with the future residential (groundwater) exposure scenario was approximately 3E-06; near the lower end of the acceptable target risk range. The noncarcinogenic HIs associated with the future industrial and future residential (groundwater) exposure scenarios were below 1.0; the cutoff point below which adverse effects are not expected to occur. Lead concentrations at the site were below the EPA action level for public water supplies and are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99). Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 11 in Table 13-9 for groundwater.

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

Previous investigations indicated that soils had been minimally impacted by petroleum hydrocarbons. Groundwater samples showed low levels of volatiles (potentially laboratory contaminants) and metals at concentrations of potential concern. In addition, the RI/FS report concluded that impacts to site soils were negligible and that the petroleum hydrocarbons detected in soils are expected to degrade over time.

13.8 ECOLOGICAL RISK

13.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 11 is a circular, open field approximately 2 acres in size. Scattered pitch pines and grasses are present throughout the site, with soils normally saturated at ten inches. Most of the site has been classified as wetlands, but standing water and moist soils are ephemeral. No waterways or drainage ditches exist in the area, and water tends to perch on the site after heavy rainfall. The closest surface water is a branch of Hockhockson Brook located approximately 300 yards to the north; thus, the site is located in the Hockhockson Brook Watershed. The surrounding areas to the northwest, north, east, and

TABLE 13-9
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 11
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/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
Groundwater	Ingestion	N/A	6.4E-08	2.7E-07^	N/A	N/A	2.5E-01	1.9E-02^	N/A	N/A
	Dermal Contact	N/A	6.3E-10	2.0E-08^	N/A	N/A	2.0E-03	1.1E-03^	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.5E-06^	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	6.5E-08	3.8E-06	-	-	2.5E-01	2.0E-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 volatile noncarcinogenics 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
^ - Value from amended risk assessment.

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southeast are classified as forested wetlands and are dominated by Atlantic white cedar and red maple. Soils in these areas are Atsion sands characterized by a thick layer of black organic muck over grey-streaked sand. Upland woods are located south of the site, along the overhead powerlines, and are predominantly chestnut oak, white oak, and mountain laurel. The entire area provides excellent habitat, primarily for terrestrial receptors. The border of the site provides an extensive "edge effect", that can potentially attract a wide variety of wildlife found on the base, such as bobwhite quail, ruffed grouse, and cottontail rabbit. No sensitive habitats, other than the wetlands, exist on or near the site. However, a federally threatened plant species, the knieskern's beakrush (*Rhynchospora knieskernii*), has been identified on the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

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

Exposure Routes

Terrestrial animals associated with Site 11 may be exposed to surface soil contaminants via incidental ingestion of soil and ingestion of contaminated food items. Terrestrial plants may also be exposed to contaminants in soils. Terrestrial receptors may also come into contact with contaminants in Site 11 surface water by using it as drinking water, although this pathway is generally insignificant. Semi-aquatic organisms inhabiting the wetlands may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated prey, although the ephemeral nature of surface water precludes the existence of an extensive aquatic community. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water, but the absence of surface water near the site inhibits this pathway.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in previous SI and RI/FS activities for this site. In particular, contaminants detected in Site 11 soils were considered preliminary COPCs.

13.8.2 Summary and Conclusions

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

Six soil samples were taken around the site from 6 to 18 inches below ground surface during 1993 RI/FS activities; no samples from 0 to 6 inches were taken. Data from these samples indicated that no explosives were present in site soils but that some low levels of petroleum hydrocarbons were present. Groundwater samples taken during the RI/FS indicated the presence of some slightly elevated concentrations of VOCs and metals. Groundwater samples taken during 1995 RI activities contained slightly elevated levels of some metals and chloroform. The 1993 RI/FS report concluded that due the presence of the threatened plant species on the site, future disturbance of surface soils is not desirable. Soil samples taken from 0 to 6 inches may provide a limited amount of additional information on the nature and extent of soil contamination at the site, but data from additional soil samples would also be of limited use since no soil remediation would be appropriate with the presence of the threatened plant. In addition, the RI/FS report concluded that impacts to site soils were negligible and that the petroleum hydrocarbons detected in soils are expected to degrade over time. No runoff of contaminants from the site is expected to occur, nor any groundwater to surface water discharge. For these reasons, the nature and extent of contamination in Site 11 surface soils could be more further defined, but subsequent data would be of little practical use. Hence, further study or remediation based on ecological concerns at Site 11 is considered unwarranted. However, monitoring of the status of the knieskern's beakrush on the site should be considered.

13.9 EVALUATION AND RECOMMENDATIONS

13.9.1 Evaluation Summary

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

Metals results from monitoring well low flow samples were generally lower than concentrations found in previous (SI and RI/FS) samples, probably due to reduced turbidity in the sample.

Groundwater metals concentrations were generally in the range of background. Therefore there does not appear to be a significant impact to groundwater from the site.

Further study or remediation based on ecological concerns at Site 11 is considered undesireable, in that it may interfere with propogation of knieskern's beakrush.

13.9.2 Recommendations

Monitoring of the status of the knieskern's beakrush on the site should be considered.

14.0 SITE 12: BATTERY STORAGE AREA

14.1 SITE BACKGROUND AND PHYSICAL SETTING

The battery storage area is a paved area next to the loading dock east of Building R-10. This area was 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 SI, batteries have not been stored at the site for several years. It is unknown if a release to the environment occurred at the site in the past. No source of visible contamination, such as batteries, other residues, stressed vegetation, or surface soil staining, is present at the site. Infiltration is limited by an asphalt parking lot that covers the site. Surface runoff is directed to a stormwater collection basin that discharges through a concrete culvert to a drainage swale and eventually to a marsh north of the site. An underground storage tank was located in this general area, but it has been removed. Figure 14-1 is a map of the site.

14.2 PREVIOUS INVESTIGATIONS

14.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and on-site inspection. The site was not recommended 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 stormwater 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, R-10 installed at the northeast corner of building R-10, was located approximately adjacent to the former battery storage area. The UST 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, with minor rust and pitting. Four confirmation soil samples were obtained from the excavation sidewalls, and two samples were taken

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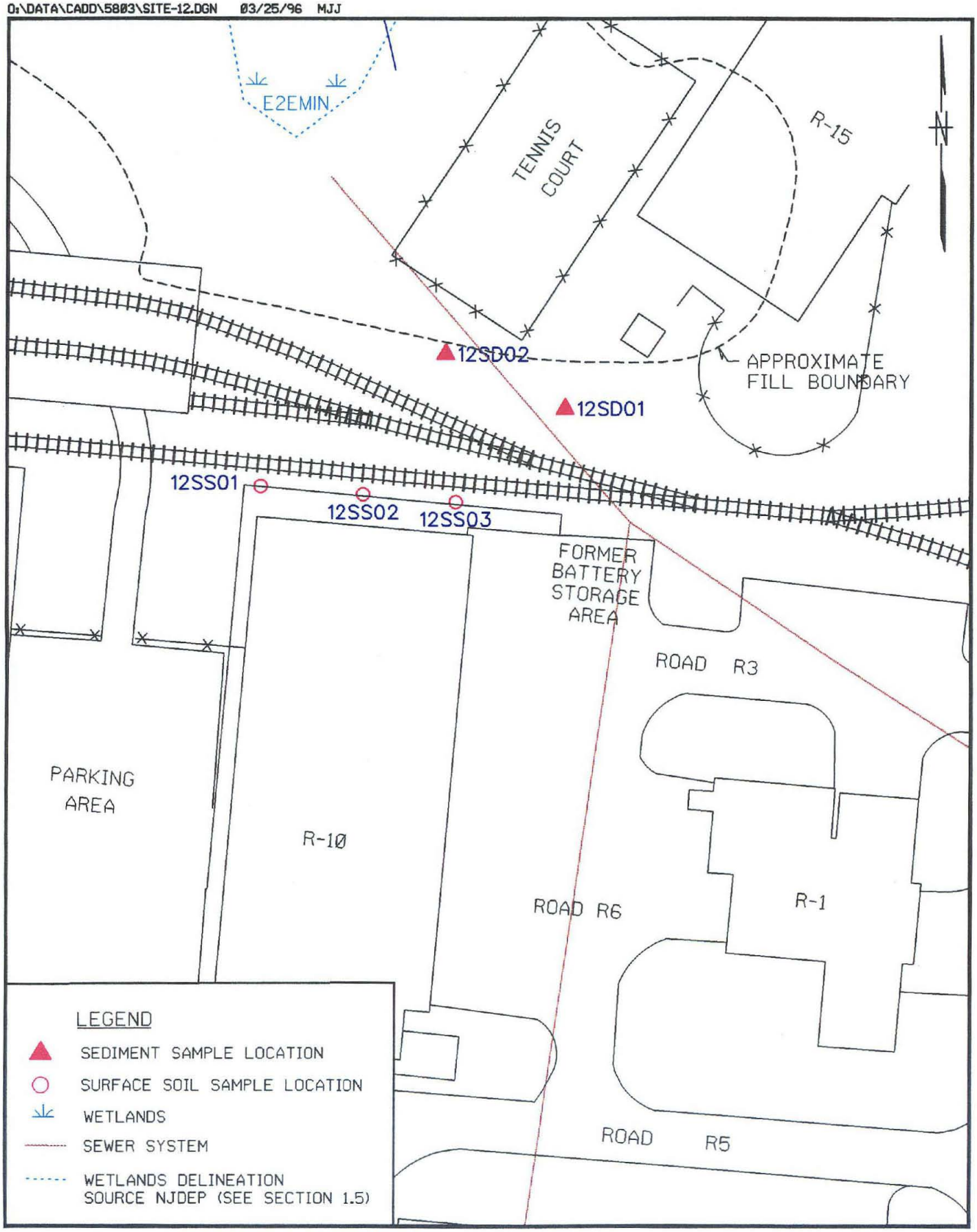

SAMPLE LOCATIONS

SITE 12 - BATTERY STORAGE AREA

0 50 100

SCALE IN FEET

FIGURE 14-1

Brown & Root Environmental

from the excavated soils. The excavation sidewall samples were analyzed for TPH, and all were found to contain a concentration less than the method detection limit, 56 - 61 mg/kg. The two soil pile samples showed TPH of 460 mg/kg and 520 mg/kg. The soil was disposed as non-hazardous.

14.2.2 Summary of Conclusions

Elevated levels of lead and other metals were observed in surface water, sediments and surface soil.

14.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objectives:

- Sample surface soil in the area of the loading dock to determine if it is impacted.
- Compare data to background levels and risk based criteria.
- Sample additional downgradient and sediments in areas where sedimentation (ponding) may have occurred.

14.3 RI FIELD INVESTIGATIONS

In August 1995, B&R Environmental conducted the following field investigation activities at Site 12:

- Sampling and analysis of surface soil (Section 14.3.1)
- Sampling and analysis of sediment (Section 14.3.2)

B&R Environmental surveyed to establish the horizontal locations and vertical elevations of the surface soil and sediment sample locations.

No samples were taken in the area labeled "Battery Storage Area" (Figure 14-1) 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.

14.3.1 Surface Soil Sampling

Four surface soil samples (12 SS 01 through 12 SS 03), including one duplicate (Dup-16), were collected in August 1995 to determine if soil contamination exists on site from past operations. The surface soil samples collected from an unpaved area located at the northern end of Building R-10 near the loading

dock and railroad tracks were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, and TAL metals analyses. Figure 14-1 shows sample locations. The samples were collected from 0 to 6 inches bgs using stainless-steel trowels and placed directly into the appropriate bottleware. The surface vegetation was removed before sampling. The surface soil samples consisted of red brown to black, coarse-grained sand with pebbles. Sample log sheets are presented in Appendix D.

14.3.2 Sediment Sampling

B&R Environmental collected three sediment samples (12 SED 01 and 12 SED 02), including one duplicate (Dup-16), in August 1995 to determine sediment quality downgradient of the site (Figure 14-1). The sediment samples were collected using a stainless-steel trowel from 0 to 6 inches bgs and consisted of dark brown to dark orange, coarse-grained sand with pebbles and gravel. The sediment material was placed directly into the required bottleware via the stainless-steel trowel. The sediment samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOCs, TCL pesticides, and TAL metals analyses. Sample log sheets are provided in Appendix D.

14.4 SITE CHARACTERISTICS

14.4.1 Geology

Regional mapping places Site 12 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges between 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 the site 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 agrees 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.

14.4.2 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 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 contour maps for Site 6, is toward the north and northwest. The direction of groundwater flow in the aquifer beneath Site 17, as indicated by both the August and October groundwater contour maps for Site 17, is toward the northwest.

14.5 NATURE AND EXTENT OF CONTAMINATION

14.5.1 Surface Soils

Three surface soil samples were collected in Site 12: 12 SS 01 through 12 SS 03 (Figure 14-1). Tables 14-1 and 14-2 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background as presented in Section 31. Table 14-1a presents a comparison of detected compounds to ARARs and TBCs. Figure 14-2 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

14.5.1.1 Inorganics

Higher concentrations of certain metals, notably lead and zinc, were seen in surface soil samples. The highest concentrations of these metals in Site 12 surface soil samples were seen in samples 12 SS 02 and 12 SS 03. Metals present at concentrations greater than background in surface soil samples include the following: antimony, barium, cadmium, copper, lead, magnesium, manganese, and zinc. Note that zinc results were qualified rejected (R), based upon data validation, so that zinc data for these three samples could not be used in the risk assessment. However, zinc is believed to be present. Mercury was present at levels greater than background in 12 SS 02, and nickel and vanadium were present at levels greater than background in 12 SS 03.

14.5.1.2 Organics

PAHs were present at levels greater than background in surface soils, with the highest levels occurring in sample 12 SS 03. Benz(a)anthracene, benzo(a)pyrene, carbazole, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzofuran, indeno(1,2,3-cd)pyrene, fluoranthene, fluorene, naphthalene, and pyrene, were detected in site-related surface soil samples at levels ranging from 44 ug/kg to 15,500 ug/kg. Many of these compounds are typically associated with treated lumber such as could be found on the adjacent railroad track.

4,4'-DDT (43 ug/kg to 420 ug/kg) and 4,4'-DDE (16 ug/kg to 330 ug/kg) were each detected in two background surface soil samples. These pesticides were detected at similar levels in site-related surface soil samples, with concentrations ranging from 51 ug/kg to 460 ug/kg for 4,4'-DDT and at 29 ug/kg for 4,4'-DDE. Other pesticides including 4,4'-DDD (19 ug/kg), aldrin (2 ug/kg), alpha-chlordane (4.7 ug/kg to 9.05 ug/kg), and gamma-chlordane (1.8 ug/kg to 14 ug/kg) were also detected in surface soil samples collected at Site 12. PCE was detected in one site-related surface soil sample (12 SS 01) at a concentration of 3 ug/kg.

TABLE 14-1
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL AT SITE 12
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	3 / 3	3530 - 7825	5228.33	NO	7825
ANTIMONY	NOT DETECTED	-	-	3 / 3	0.76 - 71.5	25.42	YES	71.5
ARSENIC	4 / 4	1.35 - 14.4	13.43	3 / 3	5.1 - 10.7	7.67	NO	10.7
BARIUM	4 / 4	1.85 - 31	22.53	3 / 3	28.7 - 188.5	134.73	YES	188.5
BERYLLIUM*	1 / 4	0.28	0.39	3 / 3	0.05 - 0.47	0.27	NO	0.47
CADMIUM	1 / 4	0.57	0.67	3 / 3	1.4 - 8.25	4.55	YES	8.25
CALCIUM	4 / 4	40.1 - 519	551.80	3 / 3	1610 - 23550	15520.00	YES	23550
CHROMIUM*	4 / 4	7.8 - 59.5	69.05	3 / 3	39.6 - 96.3	63.07	NO	96.3
COBALT	2 / 4	0.75 - 5	3.15	3 / 3	3.1 - 7.9	5.20	YES	7.9
COPPER	4 / 4	0.97 - 8.4	10.06	3 / 3	23.2 - 282.5	124.20	YES	282.5
IRON*	4 / 4	3745 - 62500	52402.50	3 / 3	17500 - 37450	25083.33	NO	37450
LEAD	4 / 4	1.8 - 39.4	37.30	3 / 3	68.6 - 1130	740.87	YES	1130
MAGNESIUM	4 / 4	71.7 - 619	578.85	3 / 3	413 - 6825	3062.67	YES	6825
MANGANESE	4 / 4	3.45 - 214	128.33	3 / 3	133 - 334	202.33	YES	334
MERCURY	4 / 4	0.035 - 0.17	0.18	3 / 3	0.395 - 0.87	0.56	YES	0.87
NICKEL	2 / 4	1.8 - 7.2	5.18	3 / 3	6.8 - 49.9	22.70	YES	49.9
POTASSIUM	4 / 4	95 - 792	912.50	3 / 3	649 - 851.5	741.17	NO	851.5
SILVER	2 / 4	0.37 - 0.67	0.69	2 / 3	1.1 - 1.7	0.97	YES	1.7
SODIUM	4 / 4	17.5 - 86.2	78.30	3 / 3	76.3 - 685	309.43	YES	685
THALLIUM*	2 / 4	0.7 - 1.9	1.64	1 / 3	2.1	0.98	NO	2.1
VANADIUM	4 / 4	11.05 - 64	70.13	3 / 3	18 - 252	96.40	YES	252

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

TABLE 14-2
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOIL AT SITE 12
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
2-METHYLNAPHTHALENE	NOT DETECTED	-	-	2 / 3	150 - 170	170
4,4'-DDD	NOT DETECTED	-	-	1 / 2	19	19
4,4'-DDE	2 / 4	16 - 330	277.86	1 / 2	29	29
4,4'-DDT	2 / 4	43 - 420	355.71	3 / 3	51 - 460	460
ACENAPHTHENE	NOT DETECTED	-	-	2 / 3	53 - 64	64
ACENAPHTHYLENE	NOT DETECTED	-	-	2 / 3	110 - 135	135
ALDRIN	NOT DETECTED	-	-	1 / 3	2	2
ALPHA-CHLORDANE	NOT DETECTED	-	-	2 / 3	4.7 - 9.05	9.05
ANTHRACENE	NOT DETECTED	-	-	3 / 3	44 - 945	945
BENZO(A)ANTHRACENE	NOT DETECTED	-	-	3 / 3	210 - 3900	3900
BENZO(A)PYRENE	NOT DETECTED	-	-	3 / 3	250 - 2250	2250
BENZO(B)FLUORANTHENE	NOT DETECTED	-	-	3 / 3	610 - 10350	10350
BENZO(G,H,I)PERYLENE	NOT DETECTED	-	-	3 / 3	800 - 2300	2300
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	3 / 3	87 - 1220	1220
BUTYLBENZYLPHTHALATE	1 / 4	220	220	1 / 3	130	130
CARBAZOLE	NOT DETECTED	-	-	3 / 3	45 - 980	980
CHRYSENE	NOT DETECTED	-	-	3 / 3	320 - 8200	8200
DI-N-BUTYLPHTHALATE	2 / 4	45 - 48	48	2 / 3	100 - 110	110
DIBENZ(A,H)ANTHRACENE	NOT DETECTED	-	-	3 / 3	59 - 540	540
DIBENZOFURAN	NOT DETECTED	-	-	2 / 3	48 - 63	63
FLUORANTHENE	2 / 4	40 - 84	84	3 / 3	320 - 13300	13300
FLUORENE	NOT DETECTED	-	-	2 / 3	87 - 94	94
GAMMA-CHLORDANE	NOT DETECTED	-	-	3 / 3	1.8 - 14	14
INDENO(1,2,3-CD)PYRENE	NOT DETECTED	-	-	3 / 3	340 - 2500	2500
NAPHTHALENE	NOT DETECTED	-	-	2 / 3	83 - 130	130
PHENANTHRENE	NOT DETECTED	-	-	3 / 3	140 - 1900	1900
PYRENE	1 / 4	46	46	3 / 3	380 - 15500	15500
TETRACHLOROETHENE	NOT DETECTED	-	-	1 / 3	3	3

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TABLE 14-1a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 12

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	12SS01	12SS02	12SS03	12SS03-DUP	---	---	ARARS & TBCs		
LOCATION:	12SS01	12SS02	12SS03	12SS03	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI					
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**			**mg/kg**	**mg/kg**	**mg/kg**
aluminum	3530	4330	7980	7670			-	-	-
antimony	0.76	71.5 E	3.6	4.4			14.0	340	-
arsenic	10.7	5.1	6.6	7.8			20.0	20.0	-
barium	28.7	187	188	189			700	47000	-
beryllium	0.47	0.050	0.37	0.23			1.00	1.00	-
cadmium	1.4 E	4.0 E	7.8 E	8.7 E			1.00	100	-
calcium	1610	21400	20000	27100			-	-	-
chromium, total	53.3 J	39.6 J	85.6 J	107 J			-	500	-
cobalt	4.6	3.1	7.5	8.3			-	-	-
copper	23.2	66.9	226	339			600	600	-
iron	20300	17500	34600	40300			-	-	-
lead	68.6	1130 E	978 E	1070 E			400	600	-
magnesium	413	1950 J	3250 J	10400 J			-	-	-
manganese	133	140	295	373			-	-	-
mercury	0.42	0.87	0.42	0.37			14.0	270	-
nickel	6.8	11.4	49.1	50.7			250	2400	-
potassium	649	723	893	810			-	-	-
silver	0.21 U	1.7	1.1	1.1			110	4100	-
sodium	76.3	167	200	1170			-	-	-
thallium	0.82 U	0.86 U	2.1 E	1.0 U			2.00	2.00	-
vanadium	18.0	19.2	245	259			370	7100	-
zinc	214 R	835 R	1500 R	1570 E R			1500	1500	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**
2-methylnaphthalene	170 J	150 J	460 U	460 U			-	-	-
acenaphthene	380 U	64.0 J	57.0 J	49.0 J			3400000	10000000	100000
acenaphthylene	380 U	110 J	140 J	130 J			-	-	-
anthracene	44.0 J	350 J	490	1400			10000000	10000000	100000
benzo(a)anthracene	210 J	1600 E J	2300 E J	5500 E J			900	4000	500000

TABLE 14-1a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 12

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	12SS01	12SS02	12SS03	12SS03-DUP	---	---	ARARS & TBCs		
LOCATION:	12SS01	12SS02	12SS03	12SS03	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI					
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**
benzo(a)pyrene	250 J	1100 E J	1700 E J	2800 E J			660	660	100000
benzo(b)fluoranthene	610	4600 E J	8700 E J	12000 E J			900	4000	50000
benzo(g,h,i)perylene	800	1700 J	2200 J	2400 J			-	-	-
bis(2-ethylhexyl)phthalate	87.0 J	960 J	1700 J	740 J			49000	210000	100000
butylbenzylphthalate	380 U	410 UJ	150 J	110 J			1100000	10000000	100000
carbazole	45.0 J	600	1100	860			-	-	-
chrysene	320 J	2800 J	6400 J	10000 E J			9000	40000	500000
di-n-butylphthalate	380 U	100 J	70.0 J	150 J			5700000	10000000	100000
dibenz(a,h)anthracene	59.0 J	300 J	490 J	590 J			660	660	100000
dibenzofuran	380 U	63.0 J	48.0 J	460 U			-	-	-
fluoranthene	320 J	4600	9600	17000			2300000	10000000	100000
fluorene	380 U	94.0 J	80.0 J	94.0 J			2300000	10000000	100000
indeno(1,2,3-cd)pyrene	340 J	1300 E J	2300 E J	2700 E J			900	4000	500000
naphthalene	83.0 J	130 J	460 U	460 U			230000	4200000	100000
phenanthrene	140 J	1400	1900	1900			-	-	-
pyrene	380 J	6000 J	12000 J	19000 J			1700000	10000000	100000
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**
tetrachloroethene	3.0 J	12.0 UJ	14.0 UJ	14.0 U			4000	6000	1000
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDD	19.0 JN	23.0 R	4.6 U	8.0 U			3000	12000	50000
4,4'-DDE	3.9 U	29.0 J	7.6 R	14.0 R			2000	9000	50000
4,4'-DDT	51.0	460	190 J	200 JN			2000	9000	500000
aldrin	2.0 U	2.1 U	2.0 J	0.89 R			40.0	170	50000
alpha-BHC	2.0 U	0.17 R	0.26 R	0.23 R			-	-	-
alpha-chlordane	2.0 U	4.7 JN	7.1	11.0			-	-	-
endosulfan sulfate	3.8 U	4.1 U	4.6 U	27.0 R			340000	6200000	50000
endrin aldehyde	3.9 U	25.0	46.0 J	74.0 JN			-	-	-
gamma-BHC (Lindane)	0.072 R	0.067 R	2.4 U	2.4 U			520	2200	50000

TABLE 14-1a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 12

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	12SS01		12SS02		12SS03		12SS03-DUP		---		---		ARARS & TBCs		
LOCATION:	12SS01		12SS02		12SS03		12SS03		---		---		NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI		1995 RI		1995 RI		1995 RI								
PESTICIDES	ug/kg		ug/kg		ug/kg		ug/kg						ug/kg	ug/kg	ug/kg
gamma-chlordane	1.8	J	12.0	JN	14.0	J	22.0	R					-	-	-
heptachlor	2.0	U	0.40	R	0.62	R	0.43	R					150	650	50000
heptachlor epoxide	0.60	R	2.5	R	2.4	U	2.4	U					-	-	-
methoxychlor	8.4	R	21.0	U	24.0	U	24.0	U					280000	5200000	50000

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

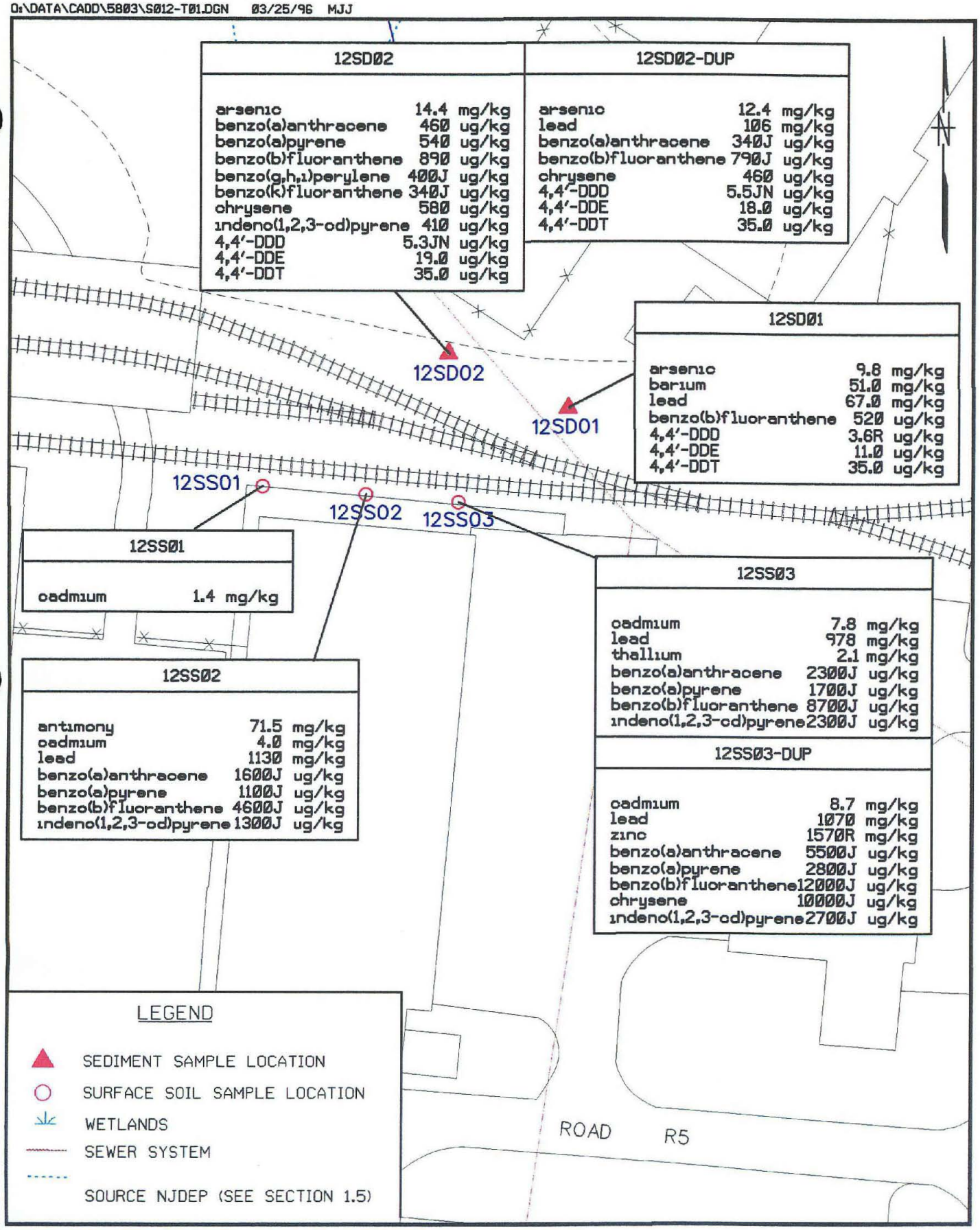
R - Positive result is considered rejected based on exceedance of data validation quality control criteria.

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

- - No standard is available for this chemical in this classification.



CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 12 - BATTERY STORAGE AREA

FIGURE 14-2

0 50 100

SCALE IN FEET

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14.5.2 Sediment

Two sediment samples were collected at Site 12: 12 SED 01 and 12 SED 02 (Figure 14-1). Tables 14-3 and 14-4 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background. Table 14-3a presents a comparison of detected compounds to ARARs and TBCs. Figure 14-2 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

14.5.2.1 Inorganics

The two site-related sediment samples revealed barium, iron, and manganese at levels greater than background. Arsenic, lead, and zinc were also detected at levels similar to or slightly greater than the upper range observed in background samples.

14.5.2.2 Organics

PAHs including benz(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene, and fluorene were detected in background sediment samples at a range from 140 ug/kg to 1,800 ug/kg. Similar levels of PAHs were detected in sediment samples collected at Site 12. Bis(2-ethylhexyl) phthalate (280 ug/kg to 520 ug/kg) was detected in two site-related sediment samples but was not detected in background samples.

4,4'-DDT (43 ug/kg to 420 ug/kg), 4,4'-DDD (4.9 ug/kg to 21 ug/kg), 4,4'-DDE (16 ug/kg to 330 ug/kg), endosulfan I (0.45 ug/kg), and endrin ketone (1.6 ug/kg) were detected in background sediment samples. These pesticides were detected in site-related sediment samples collected at Site 12 at levels ranging from 11 ug/kg to 19 ug/kg for 4,4'-DDE, 240 ug/kg to 410 ug/kg for endosulfan I, at 35 ug/kg for 4,4'-DDT, 5.4 ug/kg for 4,4'-DDD, and 49 ug/kg for endrin ketone. Alpha-BHC (0.19 ug/kg) and alpha-chlordane (1 ug/kg to 1.2 ug/kg) were also detected in sediment samples collected at Site 12.

14.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 12 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 14.6.1. Persistence of detected chemicals in the environment is discussed in Section 14.6.2. Section 14.6.3 presents a brief discussion of contaminant trends.

TABLE 14-3
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 12
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	2 / 2	5220 - 7690	6455.00	YES	7690
ARSENIC	2 / 3	2.4 - 6.2	5.95	2 / 2	9.8 - 13.4	11.6	YES	13.4
BARIUM	3 / 3	3.9 - 10.6	14.07	2 / 2	29.85 - 51	40.425	YES	51
BERYLLIUM*	1 / 3	0.57	0.67	2 / 2	0.575 - 0.66	0.6175	NO	0.66
CALCIUM	3 / 3	179 - 518	685.33	2 / 2	4670 - 9050	6860	YES	9050
CHROMIUM*	3 / 3	4.3 - 56	43.13	2 / 2	26.7 - 29.65	28.175	NO	29.65
COBALT*	1 / 3	2.1	3.30	2 / 2	1.9 - 1.95	1.925	NO	1.95
COPPER*	3 / 3	1.5 - 13	12.47	2 / 2	24.25 - 25.6	24.925	YES	25.6
IRON	3 / 3	228 - 7650	6578.67	2 / 2	25350 - 39000	32175	YES	39000
LEAD	3 / 3	4.6 - 34.3	30.60	2 / 2	67 - 75.5	71.25	YES	75.5
MAGNESIUM	3 / 3	60.7 - 256	306.47	2 / 2	2440 - 2880	2660	YES	2880
MANGANESE	3 / 3	4.6 - 9.2	13.80	2 / 2	111.5 - 127	119.25	YES	127
MERCURY*	1 / 3	0.068	0.05	2 / 2	0.012 - 0.0355	0.02375	NO	0.0355
NICKEL*	2 / 3	2.1 - 6	7.93	2 / 2	4 - 5.45	4.725	NO	5.45
POTASSIUM	2 / 3	86.1 - 681	589.40	2 / 2	1680 - 2360	2020	YES	2360
SODIUM	3 / 3	26.6 - 116	115.27	2 / 2	119 - 125	122	YES	125
VANADIUM*	3 / 3	5.9 - 42.7	36.93	2 / 2	23.6 - 30.85	27.225	NO	30.85
ZINC	3 / 3	14.2 - 26.9	37.33	2 / 2	34.1 - 62.5	48.3	YES	62.5

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

TABLE 14-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 12
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-METHYLNAPHTHALENE	NOT DETECTED	-	-	1 / 2	51.5	51.5
BENZO(A)ANTHRACENE	2 / 3	140 - 560	560	2 / 2	250 - 460	460
BENZO(A)PYRENE	2 / 3	160 - 590	590	2 / 2	320 - 540	540
BENZO(B)FLUORANTHENE	2 / 3	150 - 490	490	2 / 2	520 - 890	890
BENZO(G,H,I)PERYLENE	2 / 3	130 - 380	380	2 / 2	240 - 355	355
BENZO(K)FLUORANTHENE	2 / 3	150 - 470	470	2 / 2	180 - 295	295
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	2 / 2	67 - 95	95
CHRYSENE	2 / 3	250 - 940	940	2 / 2	280 - 520	520
DIBENZ(A,H)ANTHRACENE	NOT DETECTED	-	-	2 / 2	60 - 79.5	79.5
FLUORANTHENE	2 / 3	300 - 1800	1800	2 / 2	350 - 590	590
INDENO(1,2,3-CD)PYRENE	2 / 3	110 - 310	310	2 / 2	240 - 410	410
NAPHTHALENE	NOT DETECTED	-	-	1 / 2	49	49
PHENANTHRENE	2 / 3	200 - 1900	1900	2 / 2	110 - 195	195
PYRENE	2 / 3	350 - 1900	1900	2 / 2	310 - 545	545
4,4'-DDD	2 / 3	4.9 - 21	21	1 / 1	5.3	5.3
4,4'-DDE	1 / 3	1.7	1.7	2 / 2	11 - 19	19
4,4'-DDT	1 / 3	19	19	2 / 2	35 - 35	35
ALPHA-BHC	NOT DETECTED	-	-	1 / 2	0.19	0.19
ALPHA-CHLORDANE	NOT DETECTED	-	-	2 / 2	1 - 1.2	1.2
GAMMA-CHLORDANE	1 / 3	0.095	0.095	2 / 2	0.54 - 0.79	0.79

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TABLE 14-3a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 12

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	12SD01	12SD02	12SD02-DUP	---	---	---	---	ARARS & TBCs
LOCATION:	12SD01	12SD02	12SD02	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI					
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**					**mg/kg**
aluminum	7690	5850	4590					-
arsenic	9.8 E	14.4 E	12.4 E					8.20 L
barium	51.0 E	31.5	28.2					40.0 B
beryllium	0.66	0.72	0.43					-
calcium	4670	10900	7200					-
chromium, total	26.7	28.8	30.5					81.0 L
cobalt	1.9	2.4	1.5					50.0 T
copper	25.6	19.6	28.9					34.0 L
iron	39000	27100	23600					-
lead	67.0 E	45.0	106 E					47.0 L
magnesium	2880	3520	1360					-
manganese	127	120	103					460 O
mercury	0.012 J	0.045 J	0.026 J					0.150 L
nickel	4.0	6.0	4.9					21.0 L
potassium	2360	2150	1210					-
sodium	119	147	103					-
vanadium	23.6	31.9	29.8					-
zinc	34.1	59.2	65.8					150 L
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**					**ug/kg**
2-methylnaphthalene	360 U	53.0 J	50.0 J					330 F
benzo(a)anthracene	250 J	460 E	340 E J					330 F
benzo(a)pyrene	320 J	540 E	430 J					430 L
benzo(b)fluoranthene	520 E	890 E	790 E J					330 F
benzo(g,h,i)perylene	240 J	400 E J	310 J					330 F
benzo(k)fluoranthene	180 J	340 E J	250 J					330 F
bis(2-ethylhexyl)phthalate	67.0 J	80.0 J	110 J					890000000 S
chrysene	280 J	580 E	460 E					330 F
dibenz(a,h)anthracene	60.0 J	97.0 J	62.0 J					330 F

TABLE 14-3a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 12

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	12SD01		12SD02		12SD02-DUP		---	---	---	---	ARARS & TBCs
LOCATION:	12SD01		12SD02		12SD02		---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI		1995 RI		1995 RI						
SEMIVOLATILES	**ug/kg**		**ug/kg**		**ug/kg**						**ug/kg**
fluoranthene	350	J	680		500						2900 Q
indeno(1,2,3-cd)pyrene	240	J	410	E	320	J					330 F
naphthalene	360	U	51.0	J	47.0	J					480 P
phenanthrene	110	J	210	J	180	J					850 Q
pyrene	310	J	600		490						660 L
PESTICIDES	**ug/kg**		**ug/kg**		**ug/kg**						**ug/kg**
4,4'-DDD	3.6	E R	5.3	E JN	5.5	E JN					1.60 L
4,4'-DDE	11.0	E	19.0	E	18.0	E					2.20 L
4,4'-DDT	35.0	E	35.0	E	35.0	E					1.60 L
alpha-BHC	1.9	U	0.19	J	2.0	U					3.70 S
alpha-chlordane	1.0	J	1.2	J	1.2	J					7.00 O
gamma-BHC (Lindane)	1.9	U	0.070	R	2.0	U					-
gamma-chlordane	0.54	J	0.79	J	1.0	J					7.00 O
heptachlor epoxide	1.9	U	2.0	U	0.57	JN					5.00 O

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

14.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 12 indicate the presence of lead, zinc, and other metals in surface soil, with lower levels of metals present in sediment samples. PAHs and pesticides were detected at levels greater than background in surface soil and, to a lesser degree, in sediments at Site 12. PCE was detected at a trace level in one surface soil and PCBs were detected at low levels in sediment but were not detected in surface soil. The physical transport data for the detected contaminants are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

The former battery storage area occupied portions of a paved area adjacent to Building R-10. Infiltration is limited by an asphalt parking lot that covers the site. With the exception of PCE, contaminants detected in the surface soil and sediments at Site 12 have low potential for impacts to groundwater. The detected PAHs, and pesticides exhibit low solubility and are strongly bound to soil. Inorganic compounds also have a strong tendency to adsorb onto soil/sediment particles, a factor that greatly reduces their mobility. However, processes that transport surface soil particles, such as fugitive dust emissions and erosional transport via surface water pathways, can lead to migration of contaminated media. Surface water runoff at the site is directed to a stormwater collection basin, which discharges water through a concrete culvert, to a drainage swale, and eventually to the marsh area north of the site.

Lead, the major component of the forklift batteries stored at Site 12, was found at concentrations similar to background levels in sediments but at a higher level than background in surface soil. Lead and other metals can migrate by erosional effects of wind or surface water. The potential for lead in the soil to enter the groundwater or surface water exists and would be increased if the pH of surface soils were to decrease.

PCE, which was detected in one surface soil sample, is considered volatile, soluble, and mobile in groundwater. PCE will readily leach from soils and migrate in the subsurface through groundwater transport and soil vapor migration. Volatilization from surface soils is a significant fate process.

14.6.2 Contaminant Persistence

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

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

PCE, which was detected at a trace level in one surface soil, is considered to have low persistence due to its high volatility and solubility. In addition, PCE in the subsurface can be slowly degraded by microorganisms to simpler chlorinated ethenes.

14.6.3 Observed Chemical Contaminant Trends

The detected surface soil contamination indicates elevated levels of several organics and metals. A potential for groundwater contamination with lead also cannot be ruled out, since groundwater quality was not determined during this or previous investigations. The potential for leaching to groundwater would be controlled by factors such as the chemical form of lead, soil cation exchange capacity, soil pH, and the buffering capacity of subsurface soil. Since the site was a temporary storage area rather than a battery reclaiming area, it is unlikely that groundwater pH would be affected.

Organic contaminants in surface soil and sediment fall into three classes: PAHs (which are considered relatively immobile), pesticides (which have varying degrees of mobility), and volatiles (which are considered mobile). Of these classes, the detected levels of PAHs are the highest, although the overall potential for PAH migration impacts is lowest. PAH levels in site-related surface soils were notably greater than levels in background in surface soil samples. Levels of PAHs in site-related sediment samples were within a range similar to background sediment samples.

The significance of a single detection of PCE at levels below quantitation limits is unclear since VOCs were not detected elsewhere in site-related samples and are not related to known previous site activities. Based upon the limited detection, it is safe to conclude that there is not widespread potential for groundwater contamination with PCE resulting from this site.

14.6.4 Conclusions

The principal concern is metals and organics in surface soils in a small area in the vicinity of the north end of Building R-10 near the loading dock and railroad tracks. Some degree of migration of surface soil could occur through windblown particulates or through runoff and erosional dispersion; however, the greatest concern is from compounds near the surface that could be accidentally ingested via direct contact with soil.

With the exception of PCE, which is of questionable origin, compounds detected in the surface soil and sediments at Site 12 have low potential for impacts to groundwater. Samples collected along the surface water drainage pathway do not indicate significant migration of lead through erosional soil transport.

The significance of a single detection of PCE at trace levels in surface soil cannot be determined. The presence of this chemical might be attributable to a spill or off-site source.

14.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 12. The risk assessment was performed using the approach outlined in Section 2.4 and includes, for all receptor pathways, a comprehensive application of the more rigorous methods for eliminating COPCs by comparing results to background and quantifying dermal absorption (discussed in Section 2.4.6).

Tables 14-5 and 14-6 provide the selected COPCs and representative concentrations of inorganics and organics in site-related surface soil and sediment, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, 2.4.1.3, and 2.4.6. For surface soil and sediment, all detected organic compounds were retained as COPCs. Aluminum, beryllium, chromium, iron, and thallium were eliminated from consideration as surface soil COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Beryllium, chromium, cobalt, mercury, nickel, and vanadium were eliminated from consideration as sediment COPCs based on a comparison of average levels to twice the background level. Tables 14-1 and 14-3 present the comparison of COPCs to background concentrations for metals in surface soil and sediment, respectively. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

14.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of current land use (industrial employee) and hypothetical future land use (recreational receptors).

14.7.1.1 Current Industrial Employee

The estimated total cancer risks for the current industrial employee for exposure to COPCs in surface soil at Site 12 are 1.7E-05 (ingestion), 5.5E-06 (dermal contact), and 6.3E-09 (inhalation of COPCs in fugitive

TABLE 14-5
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE SOIL - SITE 12
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	7825	NONPARAMETRIC
ANTIMONY	71.5	NONPARAMETRIC
ARSENIC	10.7	NONPARAMETRIC
BARIUM	188.5	NONPARAMETRIC
BERYLLIUM	0.47	NONPARAMETRIC
CADMIUM	8.25	NONPARAMETRIC
CHROMIUM	96.3	NONPARAMETRIC
COBALT	7.9	NONPARAMETRIC
COPPER	282.5	NONPARAMETRIC
LEAD	1130	NONPARAMETRIC
MANGANESE	334	NONPARAMETRIC
MERCURY	0.87	NONPARAMETRIC
NICKEL	49.9	NONPARAMETRIC
SILVER	1.7	NONPARAMETRIC
THALLIUM	2.1	NONPARAMETRIC
VANADIUM	252	NONPARAMETRIC
2-METHYLNAPHTHALENE*	170	NONPARAMETRIC
4,4'-DDD*	19	NONPARAMETRIC
4,4'-DDE*	29	NONPARAMETRIC
4,4'-DDT*	460	NONPARAMETRIC
ACENAPHTHENE*	64	NONPARAMETRIC
ACENAPHTHYLENE*	135	NONPARAMETRIC
ALDRIN*	2	NONPARAMETRIC
ALPHA-CHLORDANE*	9.05	NONPARAMETRIC
ANTHRACENE*	945	NONPARAMETRIC
BENZO(A)ANTHRACENE*	3900	NONPARAMETRIC
BENZO(A)PYRENE*	2250	NONPARAMETRIC
BENZO(B)FLUORANTHENE*	10350	NONPARAMETRIC
BENZO(G,H,I)PERYLENE*	2300	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	1220	NONPARAMETRIC
BUTYLBENZYLPHTHALATE*	130	NONPARAMETRIC
CARBAZOLE*	980	NONPARAMETRIC
CHRYSENE*	8200	NONPARAMETRIC
DI-N-BUTYLPHTHALATE*	110	NONPARAMETRIC
DIBENZ(A,H)ANTHRACENE*	540	NONPARAMETRIC
DIBENZOFURAN*	63	NONPARAMETRIC
FLUORANTHENE*	13300	NONPARAMETRIC
FLUORENE*	94	NONPARAMETRIC
GAMMA-CHLORDANE*	14	NONPARAMETRIC
INDENO(1,2,3-CD)PYRENE*	2500	NONPARAMETRIC
NAPHTHALENE*	130	NONPARAMETRIC
PHENANTHRENE*	1900	NONPARAMETRIC
PYRENE*	15500	NONPARAMETRIC
TETRACHLOROETHENE*	3	NONPARAMETRIC

* - UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

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TABLE 14-6
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 12
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	7690	NONPARAMETRIC
ARSENIC	13.4	NONPARAMETRIC
BARIUM	51	NONPARAMETRIC
BERYLLIUM	0.66	NONPARAMETRIC
COPPER	25.6	NONPARAMETRIC
IRON	39000	NONPARAMETRIC
LEAD	75.5	NONPARAMETRIC
MANGANESE	127	NONPARAMETRIC
ZINC	62.5	NONPARAMETRIC
2-METHYLNAPHTHALENE*	51.5	NONPARAMETRIC
4,4'-DDD*	5.4	NONPARAMETRIC
4,4'-DDE*	18.5	NONPARAMETRIC
4,4'-DDT*	35	NONPARAMETRIC
ALPHA-BHC*	0.19	NONPARAMETRIC
ALPHA-CHLORDANE*	1.2	NONPARAMETRIC
AROCLOR-1248*	460	NONPARAMETRIC
BENZO(A)ANTHRACENE*	540	NONPARAMETRIC
BENZO(A)PYRENE*	890	NONPARAMETRIC
BENZO(B)FLUORANTHENE*	355	NONPARAMETRIC
BENZO(G,H,I)PERYLENE*	295	NONPARAMETRIC
BENZO(K)FLUORANTHENE*	95	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	520	NONPARAMETRIC
CHRYSENE*	79.5	NONPARAMETRIC
DIBENZ(A,H)ANTHRACENE*	590	NONPARAMETRIC
DIETHYLPHTHALATE*	0.895	NONPARAMETRIC
ENDOSULFAN I*	410	NONPARAMETRIC
ENDRIN KETONE*	49	NONPARAMETRIC
FLUORANTHENE*	195	NONPARAMETRIC
FLUORENE*	545	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

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dust). The total surface soil cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or formulate standards and criteria (ARARs). The principal COPCs contributing to the surface soil cancer risk are benzo(a)pyrene (ingestion, 34 percent of the cancer risk for this pathway), arsenic (ingestion, 33 percent of the cancer risk for this pathway; dermal contact, 100 percent of the cancer risk for this pathway), and benzo(b)fluoranthene (ingestion, 15 percent of the cancer risk for this pathway).

The estimated RME noncarcinogenic HIs for the current industrial employee, assuming exposure to surface soil, are 3.5E-01 (ingestion), 3.9E-02 (dermal contact), and 9.7E-04 (inhalation of dusts). Adverse noncarcinogenic health effects are not anticipated because the sum of these HIs is below 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for current industrial receptors exposed to surface soils at Site 12 in Tables 14-7 and 14-8, respectively.

14.7.1.2 Future Residential Receptor

The estimated total RME cancer risks for the future lifetime resident assuming exposure to COPCs in surface soil at Site 12 are 7.7E-05 (ingestion), 1.8E-05 (dermal contact), and 3.9E-09 (inhalation of COPCs in fugitive dust). The surface soil cancer risk falls in the upper end the 1E-04 to 1E-06 target acceptable risk range. The principal COPCs contributing to the surface soil cancer risk are benzo(a)pyrene (ingestion, 34 percent of the cancer risk for this pathway), arsenic (ingestion, 33 percent of the cancer risk for this pathway; dermal contact, 100 percent of the cancer risk for this pathway), and benzo(b)fluoranthene (ingestion, 15 percent of the cancer risk for this pathway).

For the future residential child, the estimated noncarcinogenic HI was greater than 1.0 for exposure to surface soil via ingestion; therefore, these risks were grouped according to target organ. The resulting final RME HI was greater than 1.0 for the heart (HI of 2.4; principal COPC - antimony). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Central tendency assumptions were applied to calculate non-cancer risks for the future residential child for exposure to surface soil via ingestion, dermal contact, and inhalation. The sum of these central tendency HIs was calculated 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.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to surface soil at Site 12 in Tables 14-9 and 14-10, respectively. Estimated central tendency noncarcinogenic risks are presented for exposure to surface soil for the future residential child in Table 14-10a.

TABLE 14-7
RME CARCINOGENIC RISK TO CURRENT INDUSTRIAL RECEPTORS - SITE 12
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
2-METHYLNAPHTHALENE	N/A	N/A	N/A
4,4'-DDD	1.6E-09	N/A	3.0E-13
4,4'-DDE	3.4E-09	N/A	6.4E-13
4,4'-DDT	5.5E-08	N/A	1.2E-11
ACENAPHTHENE	N/A	N/A	N/A
ACENAPHTHYLENE	N/A	N/A	N/A
ALDRIN	1.2E-08	N/A	2.6E-12
ALPHA-CHLORDANE	4.1E-09	N/A	9.1E-13
ANTHRACENE	N/A	N/A	N/A
BENZO(A)ANTHRACENE	9.9E-07	N/A	2.2E-10
BENZO(A)PYRENE	5.7E-06	N/A	1.2E-09
BENZO(B)FLUORANTHENE	2.6E-06	N/A	5.7E-10
BENZO(G,H,I)PERYLENE	N/A	N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	6.0E-09	N/A	1.1E-12
BUTYLBENZYLPHTHALATE	N/A	N/A	N/A
CARBAZOLE	6.8E-09	N/A	1.3E-12
CHRYSENE	2.1E-08	N/A	4.5E-12
DI-N-BUTYLPHTHALATE	N/A	N/A	N/A
DIBENZ(A,H)ANTHRACENE	1.4E-06	N/A	3.0E-10
DIBENZOFURAN	N/A	N/A	N/A
FLUORANTHENE	N/A	N/A	N/A
FLUORENE	N/A	N/A	N/A
GAMMA-CHLORDANE	6.4E-09	N/A	1.4E-12
INDENO(1,2,3-CD)PYRENE	6.4E-07	N/A	1.4E-10
NAPHTHALENE	N/A	N/A	N/A
PHENANTHRENE	N/A	N/A	N/A
PYRENE	N/A	N/A	N/A
TETRACHLOROETHENE	5.5E-11	N/A	1.0E-14
ANTIMONY	N/A	N/A	N/A
ARSENIC	5.6E-06	5.5E-06	3.1E-09
BARIUM	N/A	N/A	N/A
CADMIUM	N/A	N/A	6.7E-10
COBALT	N/A	N/A	N/A
COPPER	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
MANGANESE	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
TOTAL RISK	1.7E-05	5.5E-06	6.3E-09

N/A = NOTAPPLICABLE, NO TOXICITY VALUE OR ABSORPTION FACTOR HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 14-8
RME NONCARCINOGENIC HQS, CURRENT INDUSTRIAL RECEPTORS - SITE 12
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
2-METHYLNAPHTHALENE	N/A	N/A	N/A
4,4'-DDD	N/A	N/A	N/A
4,4'-DDE	N/A	N/A	N/A
4,4'-DDT	9.0E-04	N/A	1.7E-07
ACENAPHTHENE	1.0E-06	N/A	1.9E-10
ACENAPHTHYLENE	N/A	N/A	N/A
ALDRIN	6.5E-05	N/A	1.2E-08
ALPHA-CHLORDANE	1.5E-04	N/A	2.7E-08
ANTHRACENE	3.1E-06	N/A	5.7E-10
BENZO(A)ANTHRACENE	N/A	N/A	N/A
BENZO(A)PYRENE	N/A	N/A	N/A
BENZO(B)FLUORANTHENE	N/A	N/A	N/A
BENZO(G,H,I)PERYLENE	N/A	N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	6.0E-05	N/A	1.1E-08
BUTYLBENZYLPHTHALATE	6.4E-07	N/A	1.2E-10
CARBAZOLE	N/A	N/A	N/A
CHRYSENE	N/A	N/A	N/A
DI-N-BUTYLPHTHALATE	1.1E-06	N/A	2.0E-10
DIBENZ(A,H)ANTHRACENE	N/A	N/A	N/A
DIBENZOFURAN	1.5E-05	N/A	2.9E-09
FLUORANTHENE	3.3E-04	N/A	6.0E-08
FLUORENE	2.3E-06	N/A	4.3E-10
GAMMA-CHLORDANE	2.3E-04	N/A	4.2E-08
INDENO(1,2,3-CD)PYRENE	N/A	N/A	N/A
NAPHTHALENE	3.2E-06	N/A	5.9E-10
PHENANTHRENE	N/A	N/A	N/A
PYRENE	5.1E-04	N/A	9.4E-08
TETRACHLOROETHENE	2.9E-07	N/A	5.4E-11
ANTIMONY	1.7E-01	N/A	3.2E-05
ARSENIC	3.5E-02	3.4E-02	6.5E-06
BARIUM	2.6E-03	N/A	4.8E-05
CADMIUM	1.6E-02	5.0E-03	8.2E-06
COBALT	1.3E-04	N/A	2.4E-08
COPPER	6.9E-03	N/A	1.3E-06
LEAD	N/A	N/A	N/A
MANGANESE	6.5E-02	N/A	8.6E-04
MERCURY	8.5E-03	N/A	1.9E-06
NICKEL	2.4E-03	N/A	4.5E-07
SILVER	3.3E-04	N/A	6.2E-08
VANADIUM	3.5E-02	N/A	6.5E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE OR ABSORPTION FACTOR HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 14-9
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 12
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION - LIFETIME	SURFACE SOIL DERMAL CONTACT - LIFETIME	INHALATION OF COPCS IN FUGITIVE DUST - LIFETIME
2-METHYLNAPHTHALENE	N/A	N/A	N/A
4,4'-DDD	7.1E-09	N/A	1.8E-13
4,4'-DDE	1.5E-08	N/A	3.9E-13
4,4'-DDT	2.4E-07	N/A	7.5E-12
ACENAPHTHENE	N/A	N/A	N/A
ACENAPHTHYLENE	N/A	N/A	N/A
ALDRIN	5.3E-08	N/A	1.6E-12
ALPHA-CHLORDANE	1.8E-08	N/A	5.6E-13
ANTHRACENE	N/A	N/A	N/A
BENZO(A)ANTHRACENE	4.5E-06	N/A	1.3E-10
BENZO(A)PYRENE	2.6E-05	N/A	7.6E-10
BENZO(B)FLUORANTHENE	1.2E-05	N/A	3.5E-10
BENZO(G,H,I)PERYLENE	N/A	N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	2.7E-08	N/A	6.8E-13
BUTYLBENZYLPHTHALATE	N/A	N/A	N/A
CARBAZOLE	3.1E-08	N/A	7.8E-13
CHRYSENE	9.4E-08	N/A	2.8E-12
DI-N-BUTYLPHTHALATE	N/A	N/A	N/A
DIBENZ(A,H)ANTHRACENE	6.2E-06	N/A	1.8E-10
DIBENZOFURAN	N/A	N/A	N/A
FLUORANTHENE	N/A	N/A	N/A
FLUORENE	N/A	N/A	N/A
GAMMA-CHLORDANE	2.8E-08	N/A	8.7E-13
INDENO(1,2,3-CD)PYRENE	2.9E-06	N/A	8.5E-11
NAPHTHALENE	N/A	N/A	N/A
PHENANTHRENE	N/A	N/A	N/A
PYRENE	N/A	N/A	N/A
TETRACHLOROETHENE	2.4E-10	N/A	6.2E-15
ANTIMONY	N/A	N/A	N/A
ARSENIC	2.5E-05	1.8E-05	1.9E-09
BARIUM	N/A	N/A	N/A
CADMIUM	N/A	N/A	4.1E-10
COBALT	N/A	N/A	N/A
COPPER	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
MANGANESE	N/A	N/A	N/A
MERCURY	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
TOTAL RISK	7.7E-05	1.8E-05	3.9E-09

N/A = NOTAPPLICABLE, NO TOXICITY VALUE OR ABSORPTION FACTOR HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 14-10
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 12
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN										
SUBSTANCE	SURFACE SOIL INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	THYROID	SURFACE SOIL DERMAL CONTACT - CHILD	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
2-METHYLNAPHTHALENE	N/A										N/A	N/A
4,4'-DDD	N/A										N/A	N/A
4,4'-DDE	N/A										N/A	N/A
4,4'-DDT	1.2E-02				1.2E-02						N/A	1.8E-07
ACENAPHTHENE	1.4E-05			1.4E-05	1.4E-05						N/A	2.0E-10
ACENAPHTHYLENE	N/A										N/A	N/A
ALDRIN	8.5E-04				8.5E-04		8.5E-04		8.5E-04		N/A	1.3E-08
ALPHA-CHLORDANE	1.9E-03				1.9E-03		1.9E-03		1.9E-03		N/A	2.9E-08
ANTHRACENE	4.0E-05										N/A	6.0E-10
BENZO(A)ANTHRACENE	N/A										N/A	N/A
BENZO(A)PYRENE	N/A										N/A	N/A
BENZO(B)FLUORANTHENE	N/A										N/A	N/A
BENZO(G,H,I)PERYLENE	N/A										N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	7.8E-04				7.8E-04				7.8E-04		N/A	1.2E-08
BUTYLBENZYLPHTHALATE	8.3E-06										N/A	1.2E-10
CARBAZOLE	N/A										N/A	N/A
CHRYSENE	N/A										N/A	N/A
DI-N-BUTYLPHTHALATE	1.4E-05								1.4E-05		N/A	2.1E-10
DIBENZ(A,H)ANTHRACENE	N/A										N/A	N/A
DIBENZOFURAN	2.0E-04										N/A	3.0E-09
FLUORANTHENE	4.3E-03	4.3E-03		4.3E-03	4.3E-03						N/A	6.4E-08
FLUORENE	3.0E-05	3.0E-05					3.0E-05				N/A	4.5E-10
GAMMA-CHLORDANE	3.0E-03				3.0E-03		3.0E-03		3.0E-03		N/A	4.5E-08
INDENO(1,2,3-CD)PYRENE	N/A										N/A	N/A
NAPHTHALENE	4.2E-05	4.2E-05		4.2E-05							N/A	6.2E-10
PHENANTHRENE	N/A										N/A	N/A
PYRENE	6.6E-03			6.6E-03							N/A	9.9E-08
TETRACHLOROETHENE	3.8E-06				3.8E-06						N/A	5.7E-11
ANTIMONY	2.3E+00	2.3E+00									N/A	3.4E-05
ARSENIC	4.6E-01		4.6E-01								2.8E-01	6.8E-06
BARIUM	3.4E-02	3.4E-02				3.4E-02		3.4E-02	3.4E-02		N/A	5.1E-05
CADMIUM	2.1E-01			2.1E-01							4.1E-02	8.7E-06
COBALT	1.7E-03	1.7E-03								1.7E-03	N/A	2.5E-08
COPPER	9.0E-02	9.0E-02		9.0E-02	9.0E-02						N/A	1.4E-06
LEAD	N/A	N/A					N/A				N/A	N/A
MANGANESE	8.5E-01						8.5E-01				N/A	9.1E-04
MERCURY	1.1E-01			1.1E-01			1.1E-01		1.1E-01		N/A	2.1E-06
NICKEL	3.2E-02						3.2E-02				N/A	4.8E-07
SILVER	4.3E-03		4.3E-03								N/A	6.5E-08
VANADIUM	4.6E-01										N/A	6.9E-06
HI BY TARGET ORGAN		2.4E+00	4.6E-01	4.2E-01	1.1E-01	3.4E-02	1.0E+00	3.4E-02	1.5E-01	1.7E-03		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 14-10a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 12
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN										
SUBSTANCE	SURFACE SOIL INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	SKELETAL MUSCLE	REPRO-DUCTIVE SYSTEM	THYROID	SURFACE SOIL DERMAL CONTACT - CHILD	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
2-METHYLNAPHTHALENE	N/A										N/A	N/A
4,4'-DDD	N/A										N/A	N/A
4,4'-DDE	N/A										N/A	N/A
4,4'-DDT	3.0E-03				3.0E-03						N/A	9.0E-08
ACENAPHTHENE	6.8E-06			6.8E-06	6.8E-06						N/A	2.0E-10
ACENAPHTHYLENE	N/A										N/A	N/A
ALDRIN	2.9E-04				2.9E-04		2.9E-04		2.9E-04		N/A	8.6E-09
ALPHA-CHLORDANE	5.2E-04				5.2E-04		5.2E-04		5.2E-04		N/A	1.6E-08
ANTHRACENE	9.5E-06										N/A	2.8E-10
BENZO(A)ANTHRACENE	N/A										N/A	N/A
BENZO(A)PYRENE	N/A										N/A	N/A
BENZO(B)FLUORANTHENE	N/A										N/A	N/A
BENZO(G,H,I)PERYLENE	N/A										N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	2.4E-04				2.4E-04				2.4E-04		N/A	7.2E-09
BUTYLBENZYLPHTHALATE	4.2E-06										N/A	1.2E-10
CARBAZOLE	N/A										N/A	N/A
CHRYSENE	N/A										N/A	N/A
DI-N-BUTYLPHTHALATE	7.0E-06								7.0E-06		N/A	2.1E-10
DIBENZ(A,H)ANTHRACENE	N/A										N/A	N/A
DIBENZOFURAN	1.0E-04										N/A	3.0E-09
FLUORANTHENE	9.7E-04	9.7E-04		9.7E-04	9.7E-04						N/A	2.9E-08
FLUORENE	1.5E-05	1.5E-05					1.5E-05				N/A	4.5E-10
GAMMA-CHLORDANE	9.9E-04				9.9E-04		9.9E-04		9.9E-04		N/A	3.0E-08
INDENO(1,2,3-CD)PYRENE	N/A										N/A	N/A
NAPHTHALENE	2.1E-05	2.1E-05		2.1E-05							N/A	6.2E-10
PHENANTHRENE	N/A										N/A	N/A
PYRENE	1.6E-03			1.6E-03							N/A	4.7E-08
TETRACHLOROETHENE	1.9E-06				1.9E-06						N/A	5.7E-11
ANTIMONY	4.1E-01	4.1E-01									N/A	1.2E-05
ARSENIC	1.6E-01		1.6E-01								2.0E-01	4.9E-06
BARIUM	1.2E-02	1.2E-02				1.2E-02		1.2E-02	1.2E-02		N/A	3.6E-05
CADMIUM	5.8E-02			5.8E-02							2.3E-02	4.8E-06
COBALT	5.5E-04	5.5E-04								5.5E-04	N/A	1.7E-08
COPPER	2.0E-02	2.0E-02		2.0E-02	2.0E-02						N/A	5.9E-07
LEAD	N/A	N/A					N/A				N/A	N/A
MANGANESE	2.6E-01						2.6E-01				N/A	5.5E-04
MERCURY	3.6E-02			3.6E-02			3.6E-02		3.6E-02		N/A	1.3E-06
NICKEL	7.3E-03						7.3E-03				N/A	2.2E-07
SILVER	1.2E-03		1.2E-03								N/A	3.7E-08
VANADIUM	8.8E-02										N/A	2.6E-06
	HI BY TARGET ORGAN	4.4E-01	1.6E-01	1.2E-01	2.6E-02	1.2E-02	3.0E-01	1.2E-02	5.0E-02	5.5E-04		

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

14.7.1.3 Future Recreational Receptor

The estimated total RME cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 12 are 2.8E-07 (ingestion) and 2.8E-08 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range.

The estimated RME HIs for the future recreational child, assuming exposure to COPCs in sediment during wading, are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic effects are not expected when the HIs are below 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to sediment at Site 12 in Tables 14-11 and 14-12, respectively.

14.7.1.4 Lead Results

Lead has been found at concentrations exceeding the EPA screening level (400 mg/kg) in site soils during the 1995 RI and in past investigations.

The IEUBK Lead Model (v. 0.99) was used to characterize risks from lead in soil, dust, and water for future residential children (ages 0 through 6), who are considered to be the most sensitive receptor group at Site 12. The simulated range of blood-lead values that might occur in a population as a result of exposures to lead was compared to a guideline level of 10 ug/dL. Based on model results, 58.3 percent of residential children exposed under similar conditions might have blood-lead levels above 10 ug/dL. This exceeds a protective guideline of 5 percent for the maximum proportion of individuals with blood levels above 10 ug/dL (EPA, 1994). The model inputs assumed were default parameter values, 1,130 mg/kg lead in site-related soils, and 2.3 ug/L lead in groundwater (background groundwater levels were assumed due to lack of available data). The IEUBK population histograms for default and Site 12 exposures are presented in Appendix I.

14.7.2 Conclusions

Surface soil and sediment were sampled at Site 12. The potential receptors considered for this site were current industrial and future residential and recreational receptors. The RME cancer risk associated with the future residential (surface soil) exposure scenario was in the upper end of the 1E-04 to 1E-06 target acceptable risk range. Arsenic (via ingestion and dermal contact with surface 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 noncarcinogenic HI associated with the future residential (surface soil) exposure scenario exceeded 1.0, the cutoff point below which adverse effects are not expected to occur. Antimony (via ingestion) was the principal COPC that

TABLE 14-11
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 12
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDD	1.4E-11	N/A
4,4'-DDE	7.1E-11	N/A
4,4'-DDT	1.3E-10	N/A
ALPHA-CHLORDANE	1.7E-11	N/A
2-METHYLNAPHTHALENE	N/A	N/A
BENZO(A)ANTHRACENE	3.7E-09	N/A
BENZO(A)PYRENE	4.3E-08	N/A
BENZO(B)FLUORANTHENE	7.1E-09	N/A
BENZO(G,H,I)PERYLENE	N/A	N/A
BENZO(K)FLUORANTHENE	2.4E-10	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	1.5E-11	N/A
CHRYSENE	4.2E-11	N/A
DIBENZ(A,H)ANTHRACENE	6.4E-09	N/A
FLUORANTHENE	N/A	N/A
GAMMA-CHLORDANE	1.1E-11	N/A
INDENO(1,2,3-CD)PYRENE	3.3E-09	N/A
NAPHTHALENE	N/A	N/A
PHENANTHRENE	N/A	N/A
PYRENE	N/A	N/A
ALPHA-BHC	1.3E-11	N/A
ARSENIC	2.2E-07	2.8E-08
BARIUM	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	2.8E-07	2.8E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE OR ABSORBANCE FACTOR HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 14-12
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 12
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDD	NA	NA
4,4'-DDE	NA	NA
4,4'-DDT	8.9E-06	NA
ALPHA-CHLORDANE	2.6E-06	NA
2-METHYLNAPHTHALENE	NA	NA
BENZO(A)ANTHRACENE	NA	NA
BENZO(A)PYRENE	NA	NA
BENZO(B)FLUORANTHENE	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA
BENZO(K)FLUORANTHENE	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6.1E-07	NA
CHRYSENE	NA	NA
DIBENZ(A,H)ANTHRACENE	NA	NA
FLUORANTHENE	1.9E-06	NA
GAMMA-CHLORDANE	1.7E-06	NA
INDENO(1,2,3-CD)PYRENE	NA	NA
NAPHTHALENE	1.6E-07	NA
PHENANTHRENE	NA	NA
PYRENE	2.3E-06	NA
ALPHA-BHC	NA	NA
ARSENIC	5.7E-03	7.1E-04
BARIUM	9.3E-05	NA
IRON	1.7E-02	NA
LEAD	NA	NA
MANGANESE	3.2E-03	NA
ZINC	2.7E-05	NA

N/A = NOT APPLICABLE, NO TOXICITY VALUE OR ABSORBANCE FACTOR HAS BEEN ESTABLISHED FOR THIS CHEMICAL

contributed to the HI exceeding 1.0 for this exposure scenario. However, the RME estimate for the future residential receptor is probably overconservative because a central tendency calculation shows that the HI is more likely to be below 1.0.

The RME cancer risk associated with the current industrial (surface soil) exposure scenario was approximately 2E-05; within the target acceptable risk range. The cancer risk associated with the future recreational (sediment) exposure scenario via ingestion and dermal contact was below 1E-06. Noncarcinogenic HIs associated with the future residential and current industrial (surface soil) exposure scenarios and the future recreational (sediment) exposure scenario were below 1.0; the cutoff point below which adverse effects are not expected to occur.

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 might be expected 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), which collected a limited numbers of samples (3) over a small portion of the site, the lead risk assessment is probably overconservative because most areas at the site are not expected to yield lead concentrations as high as the calculated RME representative concentration.

Risk characterization results (total RME cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 12 in Table 14-13 for surface soil and sediment. Table 14-13a presents the relevant central tendency risk estimates associated with potential receptors for surface soil.

14.8 ECOLOGICAL RISK ASSESSMENT

14.8.1 Preliminary Problem Formulation and Ecological Effects Characterization

Habitat Types and Ecological Receptors

The entire area formerly used to store batteries near Building R-10 and the adjacent loading dock is paved, graveled, or developed. Mowed turfgrass areas and a small drainage depression are located immediately to the north of the railroad tracks. Other developed areas are located north, northeast, east, and west of the site. It is unknown whether any contaminant releases have occurred at the site, and no stained soil or stressed turfgrass is evident. Runoff from the developed areas enters a man-hole east of Building R-10 and discharges to the edge of a marsh approximately 200 feet northwest of the site. The marsh is a large tidal salt marsh dominated by *Phragmites*, that connects with Sandy Hook Bay. Ware Creek, located in the salt marsh northwest of the site, is approximately 1,000 feet away.

TABLE 14-13
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 12
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	1.7E-05^	N/A	7.7E-05^	N/A	3.5E-01^	N/A	2.4E+00@	N/A	N/A
	Dermal Contact	5.5E-06^	N/A	1.8E-05^	N/A	3.9E-02^	N/A	3.2E-01^	N/A	N/A
	Inhalation of Fugitive Dust	6.3E-09^	N/A	3.9E-09^	N/A	9.7E-04^	N/A	1.0E-03^	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	2.8E-07^	N/A	N/A	N/A	N/A	2.6E-02^
	Dermal Contact	N/A	N/A	N/A	2.8E-08^	N/A	N/A	N/A	N/A	7.1E-04^
Groundwater	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 Volatiles*	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		2.3E-05	-	9.5E-05	3.1E-07	3.9E-01	-	2.7E+00	-	2.6E-02

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.

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TABLE 14-13a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 12
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	4.4E-01@	N/A	N/A
	Dermal Contact	N/R	N/A	N/R	N/A	N/R	N/A	2.2E-01^	N/A	N/A
	Inhalation of Fugitive Dust	N/R	N/A	N/R	N/A	N/R	N/A	6.1E-04^	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/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 Volatiles*	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	-	-	-	-	6.7E-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.

RI Site 6 is located approximately 250 feet north of Site 12, and is also adjacent to the salt marsh. In addition, RI Site 17 is located approximately 600 feet to the southwest and RI Site 15 is located 1,500 feet to the south. All four sites are located within the Ware Creek watershed. Since the area is developed, little to no ecological habitat is present on the site proper. The salt marsh northwest of the site provides excellent and extensive habitat. Most wetland species found in the Waterfront area, including semi-aquatic mammals and wading birds, are expected to utilize the marsh. No sensitive habitats, other than the wetlands, and no threatened or endangered species are present on or near the site.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major release pathway from Site 12 is overland runoff of contaminants. Precipitation runoff at Site 12 may carry constituents to nearby surface waters, sediments, and surface soils, primarily to the edge of the marsh via the storm water outfall and the small drainageway north of the railroad tracks.

Nonetheless, the drainageway is rather flat and water tends to perch rather than run off towards the marsh. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. However, infiltration and subsequent groundwater to surface water contaminant migration is severely limited since paved and hard packed graveled areas impede infiltration on the site.

Exposure Routes

Direct exposure to contaminants in soil for terrestrial ecological receptors, both plant and animal, is expected to be minimal at Site 12 since the site is mostly developed. Terrestrial receptors may come into contact with contaminants in Site 12 surface water by using it as a source of drinking water, although exposure via this route is assumed to be insignificant. Therefore, evaluation of potential risks to terrestrial plants and animals on the site proper was not applicable. Aquatic, semi-aquatic, and terrestrial organisms inhabiting the marsh to the north may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into marsh surface water, although this is expected to be minimal. No aquatic habitat is present in the drainage depression. Thus, aquatic exposure routes were not applicable in that area.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were all contaminants detected in 1995 RI sampling activities for this site. In particular, contaminants detected in Site 12 sediments were considered preliminary COPCs. Contaminants in surface soil samples taken in the developed areas were not germane to quantitative assessment, but

were evaluated qualitatively. Contaminants in surface water and sediment samples taken as part of the 1993 SI were also evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

14.8.1.2 Ecological Effects Assessment

Ecotox threshold (ET) values were utilized for screening potential risks from contaminated sediments. Although the marsh receives a saltwater influence, the sediment samples were taken in the drainageway, which only contains occasional runoff. As a result, estuarine ET values were not used at the site. Sediment ET values are presented in Table 2-29.

14.8.2 Preliminary Exposure Assessment and Risk Characterization

14.8.2.1 Preliminary Exposure Assessment

Contaminant concentrations in sediments used for representative exposure point contaminant concentrations in this screening were obtained from 1995 RI samples. Samples were taken in the drainageway north of the railroad tracks to investigate any potential overland contaminant migration. The samples were essentially moist soils, rather than aquatic sediments, but were conservatively evaluated as sediments. Surface water and sediment samples taken at the storm water outfall during the SI, and 1995 RI surface soil samples taken on the developed areas, are discussed qualitatively in Section 14.8.3. Background concentrations presented for comparative purposes are the maximum values detected in facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

14.8.2.2 Risk Characterization

The inorganics arsenic (HQ = 1.63), barium (HQ = 1.28), and lead (HQ = 1.61) exceeded ET values in sediments and were retained as final COPCs (Table 14-14). Aluminum and vanadium were conservatively

TABLE 14-14
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 12
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Inorganics						
Aluminum	2/2	3940	7690	NA		Retained-No suitable threshold available
Arsenic	2/2	6.2	13.4	8.2/70	1.63/0.2	Retained-HQ > 1
Barium	2/2	10.6	51	40	1.28	Retained-HQ > 1
Beryllium	2/2	0.57	0.66	NA		Retained-No suitable threshold available
Chromium	2/2	56	29.65	81	0.39	Eliminated-Does not exceed threshold
Cobalt	2/2	2.1	1.95	50	0.04	Eliminated-Does not exceed threshold
Copper	2/2	13	25.6	34	0.75	Eliminated-Does not exceed threshold
Lead	2/2	34.3	75.5	47/218	1.61/0.35	Retained-HQ > 1
Manganese	2/2	9.2	127	460	0.28	Eliminated-Does not exceed threshold
Mercury	2/2	0.068	0.036	0.15	0.23	Eliminated-Does not exceed threshold
Nickel	2/2	6	5.45	21	0.25	Eliminated-Does not exceed threshold
Vanadium	2/2	42.7	30.85	NA		Retained-No suitable threshold available
Zinc	2/2	26.9	62.5	150	0.42	Eliminated-Does not exceed threshold
Organics[3]						
2-Methylnapthalene	1/2	ND	51.5	330	0.16	Eliminated-Does not exceed threshold
4,4'-DDD	1/1	21	5.3	1.6/46	3.31/0.11	Retained-HQ > 1
4,4'-DDE	2/2	1.7	19	2.2/27	8.63/0.70	Retained-HQ > 1
4,4'-DDT	2/2	19	35	1.6/46	21.9/0.76	Retained-HQ > 1
Alpha-BHC	1/2	ND	0.19	3.70	0.05	Eliminated-Does not exceed threshold
Alpha-Chlordane	2/2	ND	1.2	7	0.17	Eliminated-Does not exceed threshold
Benzo(a)anthracene	2/2	560	460	330/1600	1.39/0.29	Retained-HQ > 1
Benzo(a)pyrene	2/2	590	540	430/1600	1.26/0.34	Retained-HQ > 1
Benzo(b)fluoranthene	2/2	490	890	330/1700	2.69/0.52	Retained-HQ > 1
Benzo(g,h,i)perylene	2/2	380	355	330/1700	1.08/0.21	Retained-HQ > 1
Benzo(k)fluoranthene	2/2	470	295	330	0.89	Eliminated-Does not exceed threshold
Bis(2-ethylhexyl)phthalate	2/2	ND	95	8.90E+08	1.06E-07	Eliminated-Does not exceed threshold
Chrysene	2/2	940	520	330/2800	1.58/0.19	Retained-HQ > 1
Dibenz(a,h)anthracene	2/2	ND	79.5	330	0.24	Eliminated-Does not exceed threshold
Fluoranthene	2/2	1800	590	2900	0.20	Eliminated-Does not exceed threshold

TABLE 14-14
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 12
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Gamma-Chlordane	2/2	0.095	0.79	7	0.11	Eliminated-Does not exceed threshold
Indendo(1,2,3-cd)pyrene	2/2	310	410	330/1700	1.24/0.24	Retained-HQ > 1
Napthalene	1/2	ND	49	480	0.10	Eliminated-Does not exceed threshold
Phenanthrene	2/2	1900	195	850	0.23	Eliminated-Does not exceed threshold
Pyrene	2/2	1900	545	660	0.83	Eliminated-Does not exceed threshold

ND = None detected
NA = No suitable threshold was available
1 When two values are presented, the left value is the most conservative available and the right value is a less conservative value, if available. In these instances, two HQ values are presented.
2 Contaminants were retained as final COPCs if the most conservative ET value available was exceeded.
3 All organic values are in μg/kg.

retained as final COPCs since no suitable ET values were available. The pesticide 4,4'-DDT and its analogs and several PAHs exceeded the most conservative ET values available and were retained as final COPCs, but did not exceed less conservative values. The toxicological properties of all final COPCs are summarized in Appendix M.

14.8.3 Summary and Conclusions

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 which 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 perch in the depression rather than flow towards the marsh. Infiltration of contaminants and subsequent groundwater to surface water migration is considered to be insignificant since most of the site is paved or developed.

A surface water and sediment sample were taken at the stormwater 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. Some elevated levels of metals and some PAHs were detected in those samples. The adjacent railroad bed may be 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 in 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 of 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 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. Additional surface water and sediment samples appear to be needed for Site 6 (Section 9). Site 6-related samples taken near Site 12 may help determine any potential impact of Site 12 contaminants, but additional samples based on ecological concerns at Site 12 appear to be unwarranted. Since significant contaminant inputs from Site 12 are not present, and since a discrete source is not evident at Site 12, remediation based on ecological concerns also appears to be unwarranted.

14.9 EVALUATION AND RECOMMENDATIONS

The baseline risk assessment indicated that potential low-level risks might exist for future residential child receptors, based on antimony and lead in surface soil. OSWER directive 9355.4-12, which applies to CERCLA sites, does not mandate remedial action whenever lead concentrations, like those at Site 12, exceed the 400 mg/kg screening guideline, but rather calls for further evaluation to determine whether specific protective measures are necessary, given the particular land use scenario. The area near this NWS Earle site is already developed and the Navy indicates that future land use is likely to remain similar to current patterns unless a major base realignment occurs. Thus, the child receptor model applied in this risk assessment is overprotective for the current and probable future scenarios. Although EPA has not formally adopted a lead exposure characterization model for adults, areas not frequented by children are, in some cases, considered for a somewhat higher (2,000 mg/kg to 5,000 mg/kg) action level for intervention or abatement, respectively (EPA, 1994a).

If the future residential scenario is applicable, before deciding on corrective action, a different sampling strategy than the one which located hot spots in this RI should determine the areal boundaries of impacted soil and a more accurate representative concentration. If the affected area is considerably less than 1/4 acre (the area of a typical residential dwelling), then a future residential child may be expected to incidentally ingest soil from other, less contaminated areas in addition to the smaller contaminated area, which lowers the effective exposure level as estimated in the risk assessment.

The ecological assessment for this site concluded that there is little potential for ecological impacts from Site 12 due to the site's developed status, the lack of significant migration pathways, and lack of significant impacts from the site to nearby wetlands. Therefore, the overall recommendations for this site are to consider only a conditional industrial land use at this time or, alternatively, to collect a small number of additional samples in order to estimate the area of impacted surface soil and more realistically recalculate lead exposures for the future residential receptor.

15.0 SITE 13: DEFENSE PROPERTY DISPOSAL OFFICE YARD

15.1 SITE BACKGROUND AND PHYSICAL SETTING

The defense property disposal office yard (DPDO yard) is an area of fill material extending into a marsh near the rail classification yards. Activities at the site included storage of scrap metals and batteries and the burial of material, such as cars, trucks, electronic equipment, clothing/shoes, sheet metal, furniture, scrap metal, and batteries. Additionally, batteries were broken open at the site for lead recovery, and acid was drained onto the ground. Obvious fill material is present at the ground surface at several places across the site.

The top of the site is flat, and there is little topographic relief. Runoff from the site drains to the marsh to the north and west to a perennial drainage that flows to Hockhockson Brook. A fence surrounds the DPDO yard, although this fence is not located at the edge of the landfill. The extent of fill material was not clearly defined by previous investigations. The toe of the landfill extends into the marsh area and is clearly defined by an abrupt decrease in elevation of several feet between the top of the landfill slope and the marsh. Figure 15-1 is a map of the site. Groundwater flow is generally to the north-northwest, based on groundwater-level measurements.

15.2 PREVIOUS INVESTIGATIONS

15.2.1 Summary of Activities and Results

The 1983 IAS consisting of interviews, concluded minimal impact based on site use as a storage area. The site was not recommended for a confirmation study.

During the SI, six soil, three sediment, and three surface water samples were collected. The soil samples were collected from 0 to 3 feet bgs from the area in and around the landfill. The sediment and surface water samples were collected in the drainage west of the site. Soil samples were analyzed for SVOCs, PCBs, metals, and cyanide. Low levels of metals, pesticides, PCBs, and SVOCs were detected in soil samples. Elevated levels of two semivolatiles were also detected. Sediment samples were analyzed for SVOCs, pesticides, and PCBs. Low levels of pesticides, PCBs, and SVOCs were detected. Surface water samples were analyzed for SVOCs, PCBs, pesticides, metals, and cyanide. Elevated levels of several metals were present in samples. No SVOCs, pesticides, or PCBs were detected in surface water.

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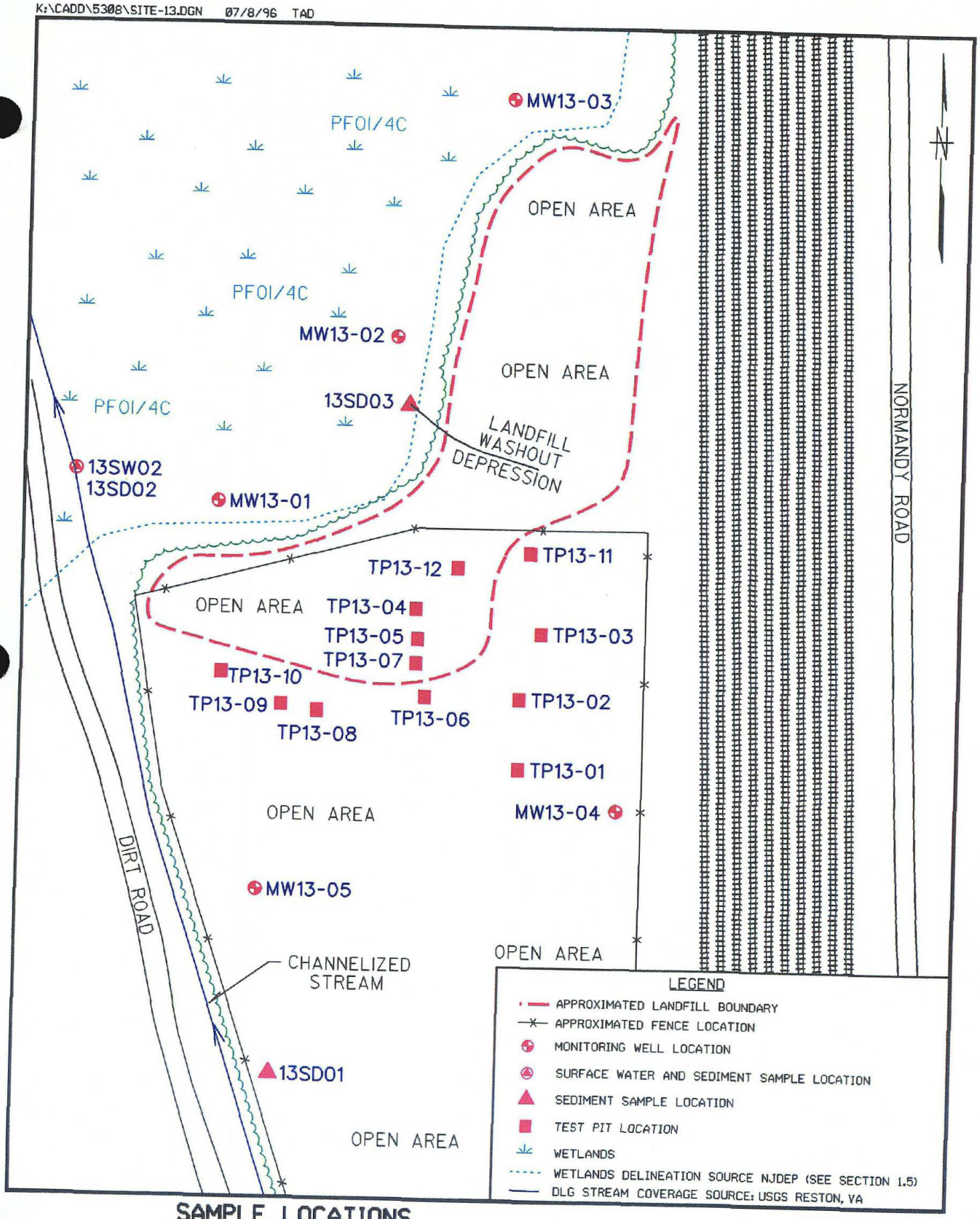


SAMPLE LOCATIONS
SITE 13 - DRMO YARD

0 100 200
SCALE IN FEET

FIGURE 15-1

Brown & Root Environmental

15.2.2 Summary of Conclusions

Pesticides, PCBs, and metals were detected in the soils. Lower levels of pesticides (DDE) and PCBs were detected in one downgradient sediment sample. Metals were detected in surface waters. Analysis of aerial photos identified landfill at north end of site.

15.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objective:

- Determine extent and composition of filled area by digging test pits.
- Evaluate surface water and groundwater contaminant transport.
- Install monitoring wells to determine groundwater quality and flow direction.
- Compare data to background levels and risk based criteria.

15.3 RI FIELD INVESTIGATIONS

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 13:

- Excavation of 12 test pits (Section 15.3.1)
- Sampling and analysis of surface water (Section 15.3.2)
- Sampling and analysis of sediment (Section 15.3.3)
- Drilling and installation of five shallow permanent monitoring wells (Section 15.3.4)
- Sampling and analysis of groundwater from the wells (Section 15.3.4)
- Measurement of static-water levels in the wells (Section 15.3.4)
- Performance of slug tests in two of the wells (Section 15.3.5)

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the test pit locations, surface water and sediment sample locations, and the permanent monitoring wells. Surveying notes are provided in Appendix F.

15.3.1 Test Pits

Twelve test pits (13 TP 01 through 13 TP 12) were excavated in June 1995, along the southern end of the DPDO Yard. Figure 15-1 shows sample and test pit locations. The test pits were excavated at the site to better define the edge of the landfill. A backhoe was used to excavate an area approximately 3 to 4 feet wide, 8 to 13 feet long, and 4 to 10 feet deep. The material encountered during excavation generally consisted of brown, olive, or yellowish-brown silty sand with some wood branches and logs. Four of the test pits encountered industrial-type waste (13 TP 04, 13 TP 05, 13 TP 07, and 13 TP 12) consisting of crushed 55-gallon drums, used shell casings, electric cables, metal doors, a compressor, and rubber material. A maximum HNu reading of approximately 50 to 90 ppm was noted from the interior of a crushed drum which had a petroleum odor. A distinct transition line (waste/natural soil) was observed in the southern end of 13 TP 07. Figure 15-1 shows the approximate landfill boundary based on test pit results and visual observation in the field. Test pit log forms are presented in Appendix E.

In general, the material in the backhoe bucket was screened with an HNu, a description was made, and a photograph of the test pit was taken. The test pits were then backfilled with the material that was removed. No samples were collected for chemical analysis.

15.3.2 Surface Water Sampling

Three surface water samples were proposed in the work plan; however, due to dry conditions during the summer, only one surface water sample was collected in June 1995. The surface water sample (13 SW 02) and duplicate sample (DUP-03) were collected to determine potential off-site impacts via surface runoff (Figure 15-1). The samples were collected from the drainage ditch that parallels the western side of the landfill, downstream of the landfill (north of the northern fence line). The surface water samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, BOD, TPH, ammonia, phosphate, COD, TOC, nitrite/nitrate, turbidity, chloride, and explosives analyses. Sample log sheets are presented in Appendix D.

B&R Environmental collected the surface water samples by dipping the sample bottle directly into the water. Field measurements collected during sampling included pH, specific conductance, temperature, turbidity, dissolved oxygen, and salinity.

15.3.3 Sediment Sampling

Four sediment samples, including one field duplicate (13 SED 01, 13 SED 02, DUP-03, and 13 SED 03), were collected in June and August 1995 from drainage pathways along the drainage ditch that parallels

the landfill to determine if compounds are moving off site by sediment transport (Figure 15-1). Samples 13 SED 02 and DUP-03 were collected in June 1995 downstream of the landfill (north of the northern fence line) along the drainage ditch and submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TOC, pH, moisture, and explosive analyses. The sediment consisted of light brown silty sand with some gravel. Sample 13 SED 01 was collected in August 1995 from an outfall pipe that discharges into the drainage ditch from the site. The sediment material consisted of light brown silty sand with trace amounts of organics and gravel. Sample 13 SED 03 was collected in August 1995 from a drainage ditch located along the toe of the landfill. Samples 13 SED 01 and 13 SED 03 were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TPH, TOC, pH, and moisture analyses. TCL SVOC was inadvertently not analyzed. A portion of each sample was submitted to GP Environmental Services for explosives analysis. The sediment material consisted of light brown to light gray silty sand with trace amounts of gravel. Sample logsheets are presented in Appendix D.

Sediment samples were collected using a stainless-steel trowel from 0 to 6 inches below the sediment/water interphase or below ground surface. The sediment material was transferred directly to the required bottleware via the stainless-steel trowel.

15.3.4 Permanent Monitoring Well Installation, Static-Water-Level Measurements, and Groundwater Sampling

Monitoring Well Installation

B&R Environmental installed five shallow permanent monitoring wells (MW13-01 through MW13-05) in June 1995 to determine groundwater quality upgradient, downgradient, and side gradient of the landfill and to define groundwater flow directions (Figure 15-1). Wells MW13-01, MW13-02, and MW13-03 were installed downgradient of the toe north of the landfill in the wetlands, and well MW13-04 was installed sidegradient east of the landfill. The borings ranged in depth from 15 to 17 feet; water was encountered between 4 and 8.5 feet below grade during drilling. The borings were drilled to approximately 8 to 10 feet below the water table and completed as cased wells, screened across the water table. Monitoring well characteristics are summarized in Table 15-1.

Subsurface soil samples were collected continuously from ground surface to the water table by a driving 2-inch O.D. (outside diameter) by 24-inch-long split-barrel sampler. The samples were screened with an HNu and visually inspected for evidence of contamination (such as staining and odors) and for lithologic description. HNu readings were less than 10 ppm action level in construction of monitoring wells MW13-01

Table 15-1
Site 13 Monitoring Well Characteristics Summary
NWS Earle, Colts Neck, New Jersey

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Elevation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad	Top of PVC Riser	Top of Standpipe				
MW13-01	15	84.19	86.04	86.43	2	4 - 15	5 - 15	6/23/95
MW13-02	15	83.04	85.09	85.44	2	4 - 15	5 - 15	6/23/95
MW13-03	15	81.28	83.26	83.69	2	4 - 15	5 - 15	6/23/95
MW13-04	16	92.18	93.85	94.30	2	4 - 16	6 - 16	6/24/95
MW13-05	17	93.67	95.54	96.06	2	5 - 17	7 - 17	6/24/95

Note: All wells were constructed with Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 15-2 for more accurate measurements.
(2) In feet above mean sea level.

through MW13-05. A slight sulfur odor was noted at the 4-6 feet interval in MW13-03. Soil boring log sheets were prepared for each boring to evaluate subsurface lithologies (see Appendix C).

The wells were constructed with 2-inch I.D., flush-jointed and threaded, NSF-certified, Schedule 40 PVC well casing and 0.10-foot slotted PVC well screen fitted with a PVC bottom cap. Ten-foot screens were installed in the wells. The annular space between the well screen and the borehole was packed with Morie No. 1 sand to a height of approximately 1 to 2 feet above the top of the screen (due to the shallow depth to groundwater, only 1 foot of sand above the top of screen was used in MW13-01 through MW13-03). An approximately 2-foot annular seal, consisting of bentonite pellets, was placed on top of the filter pack. The remainder of the well annulus was backfilled with a cement grout to a height approximately 1 foot below the ground surface. The wells were completed with 2-foot-high standpipes. A concrete pad was later poured at the ground surface, keyed 1 foot into the well annulus. Monitoring well construction sheets are in Appendix C.

The wells were developed a minimum of 24 hours after installation. Groundwater temperature, pH, conductivity, turbidity, dissolved oxygen, and water level were monitored during development. All wells were developed until removed water was visibly clear of suspended solids.

Static-Water-Level Measurements

To define groundwater flow directions and horizontal and vertical groundwater gradients, B&R Environmental collected two rounds of static-water-level measurements. The first round of water-level measurements was collected on August 7, 1995, and the second on October 17, 1995. Static-water levels were measured from the top of the PVC riser using an electronic water-level indicator (M-scope) or an interface probe and recorded to the nearest 0.01 foot. The water-table elevation ranged from approximately 78.86 to 82.69 feet above MSL during the first round of measurements and from approximately 78.88 to 82.71 feet above MSL during the second round of measurements. Water-level measurements are summarized in Table 15-2.

Groundwater Sampling

B&R Environmental obtained groundwater samples from the five newly installed monitoring wells (MW13-01 through MW13-05) to determine groundwater quality and to provide data for use in the risk assessment and the evaluation of remedial action alternatives. The wells were sampled in August 1995. Field measurements collected during purging were pump rate (L/min), water level, pH, conductivity, temperature, turbidity, dissolved oxygen, and salinity.

TABLE 15-2
SITE 13 STATIC-WATER-LEVEL MEASUREMENT SUMMARY
NWS EARLE, COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
MW13-01	5.62	86.04	80.42	5.67	86.04	80.37
MW13-02	5.28	85.09	79.81	5.27	85.09	79.82
MW13-03	4.40	83.26	78.86	4.38	83.26	78.88
MW13-04	11.16	93.85	82.69	11.30	93.85	82.55
MW13-05	12.88	95.54	82.66	12.83	95.54	82.71

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

Prior to sampling, B&R Environmental purged the wells using the micro-purge protocol to reduce turbidity until groundwater parameters stabilized within acceptable limits. Care was taken to ensure that little or no drawdown in water levels occurred throughout the purge and sample process.

The five groundwater samples (13 GW 01 through 13 GW 05) were submitted to Lancaster Laboratories and GP Environmental Services for selected analyses. Sample information is summarized in Table 15-3. At the request of NORTHDIV, two samples (13 GW 01 and 13 GW 03) were also analyzed for TAL dissolved metals because of difficulty in obtaining the target (low) stable turbidity required by the micro-purge technique. Sample log sheets are presented in Appendix D.

After data validation, during the preparation of the RI report, it was noted that one well (MW13-02) showed 11.0 ug/l of vinyl chloride. A resample of the well, obtained on December 6, 1995, confirmed the vinyl chloride [10J ug/L (J is estimated)] and showed a low detection of 1,2-dichloroethene (2J ug/L). The data from December 6, 1995 were not validated using the full EPA procedure.

15.3.5 Slug Testing

Rising-head slug tests were performed in July 1995 in wells MW13-4 and MW13-5. Results from the slug tests were used to calculate hydraulic permeability. B&R Environmental performed the rising-head slug tests by removing a solid slug and measuring the rate of rise of water level back to equilibrium. Slug test data were collected as described in Section 2.1.1.4. Hydraulic permeability (K) calculations are presented in Appendix H.

15.4 SITE CHARACTERISTICS

15.4.1 Geology

Regional mapping places Site 13 within the outcrop area of the Vincentown Formation. The Vincentown Formation ranges between 10 and 130 feet in thickness and the soil borings are no more than 19 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Vincentown Formation. In general, the borings encountered alternating beds of yellowish-brown to brown, micaceous, silty, fine- to medium-grained sand and olive, glauconitic, silty sand and sand.

15.4.2 Hydrogeology

Groundwater in the Vincentown aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations are summarized in Table 15-2. Groundwater elevations

TABLE 15-3
SITE 13 GROUNDWATER SAMPLING SUMMARY
NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER	ANALYTICAL PARAMETERS	LABORATORY
13 GW 01	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, TAL dissolved metals, nitrite/nitrate, BOD, chloride, sulfate, ammonia, phosphate, COD, and TOC	Lancaster Laboratory
	Explosives	GP Environmental Services
13 GW 02	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, TPH, TOC, COD, phosphate, ammonia, BOD, nitrite/nitrate, chloride, and sulfate	Lancaster Laboratory
	Explosives	GP Environmental Services
13 GW 03	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, TAL dissolved metals, nitrite/nitrate, BOD, chloride, sulfate, ammonia, phosphate, COD, and TOC	Lancaster Laboratory
	Explosives	GP Environmental Services
13 GW 04	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, ammonia, COD, TOC, phosphate, BOD, nitrite/nitrate, turbidity, chloride, and sulfate	Lancaster Laboratory
	Explosives	GP Environmental Services
13 GW 05	TCL VOC, TCL SVOC, TCL pesticide/PCBs, TAL metals, nitrite/nitrate, BOD, sulfate, chloride, ammonia, phosphate, COD, and TOC	Lancaster Laboratory
	Explosives	GP Environmental Services

for August 1995 and October 1995 are contoured on Figures 15-2 and 15-3, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is north-northwest. There does not appear to be a significant seasonal variation in groundwater flow direction.

The hydraulic conductivity calculated for MW13-04 is 2.64 x 10^{-5} cm/sec (0.75 ft/day). Appendix H contains slug test data and calculations.

15.5 NATURE AND EXTENT OF CONTAMINATION

15.5.1 Sediment

Three sediment samples were collected at Site 13: 13 SD 01 through 13 SD 03 (Figure 15-1). Tables 15-4 and 15-5 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background as presented in Section 31. Table 15-5 presents the occurrence and distribution of organic chemicals in Site 13 background and site-related samples. Tables 15-4a and 15-4b present a comparison of detected compounds to ARARS and TBCs. Figure 15-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

15.5.1.1 Inorganics

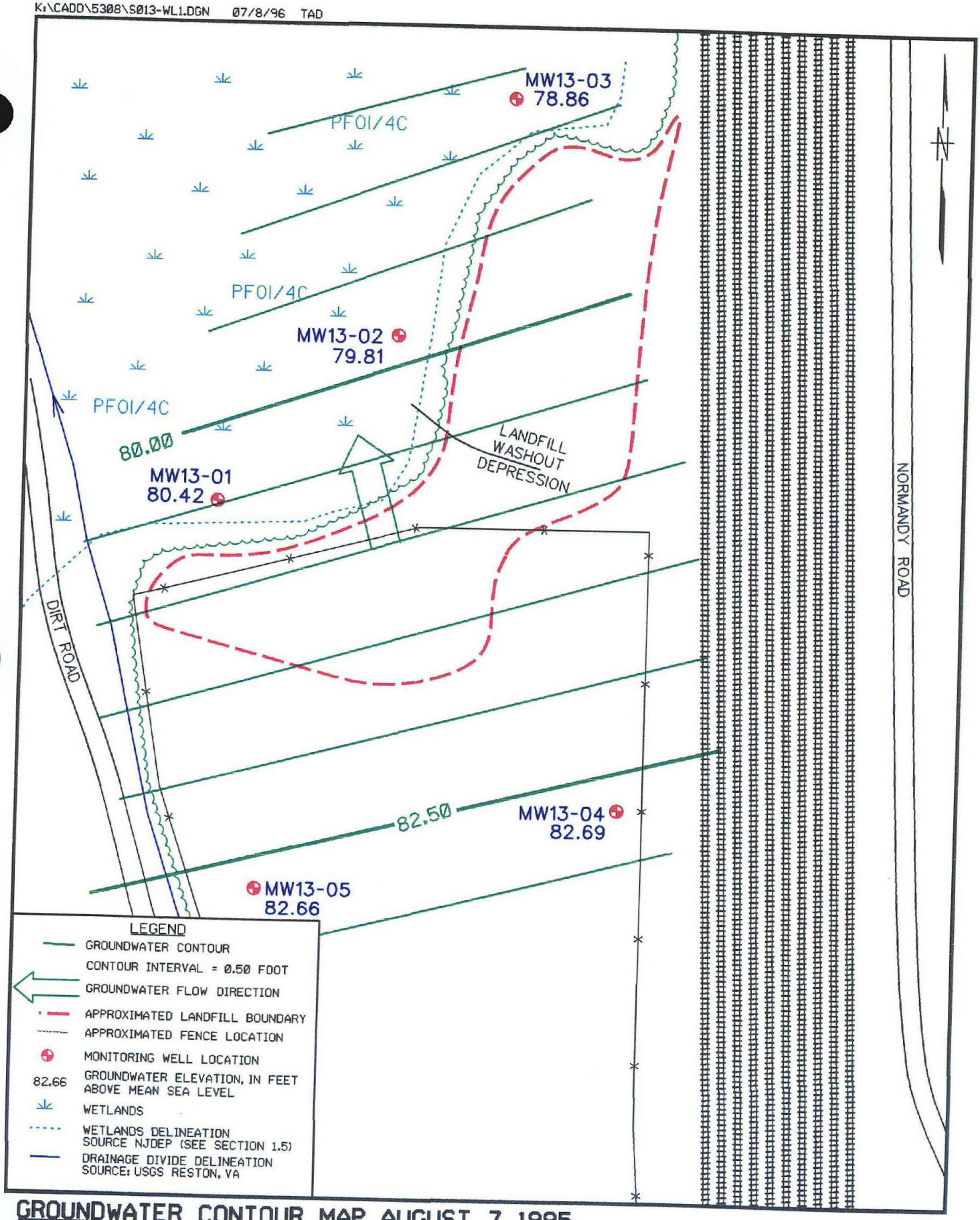
Concentrations of most metals in site-related sediment samples were similar to background ranges. Antimony, cadmium, and silver were detected at low levels in site-related sediment samples (the highest levels were in 13 SD 03) but were not found in background sediments. Lead was detected in 13 SD 03 at a level slightly greater than the ranges found in background samples.

15.5.1.2 Organics

The following PAHs, phthalates, and pesticides were detected in site-related sediment samples at levels generally within background concentration range. Benzo(b)fluoranthene (48 ug/kg), chrysene (56 ug/kg), fluoranthene (81 ug/kg), pyrene (67.5 ug/kg), and diethyl phthalate (51 ug/kg) were each detected in one site-related sediment sample. Gamma-chlordane (0.16 ug/kg), 4,4'-DDE (2.45 ug/kg), and 4,4'-DDT (6.4 ug/kg) were each detected in one site-related sediment sample.

Several compounds were detected in site-related sediment samples that were not found in background sediment samples. Aroclor 1254 (58 ug/kg to 3,900 ug/kg) was detected in all three site-related sediment

K:\CADD\5308\S013-WL1.DGN 07/8/96 TAD



GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 13 - DRMO YARD

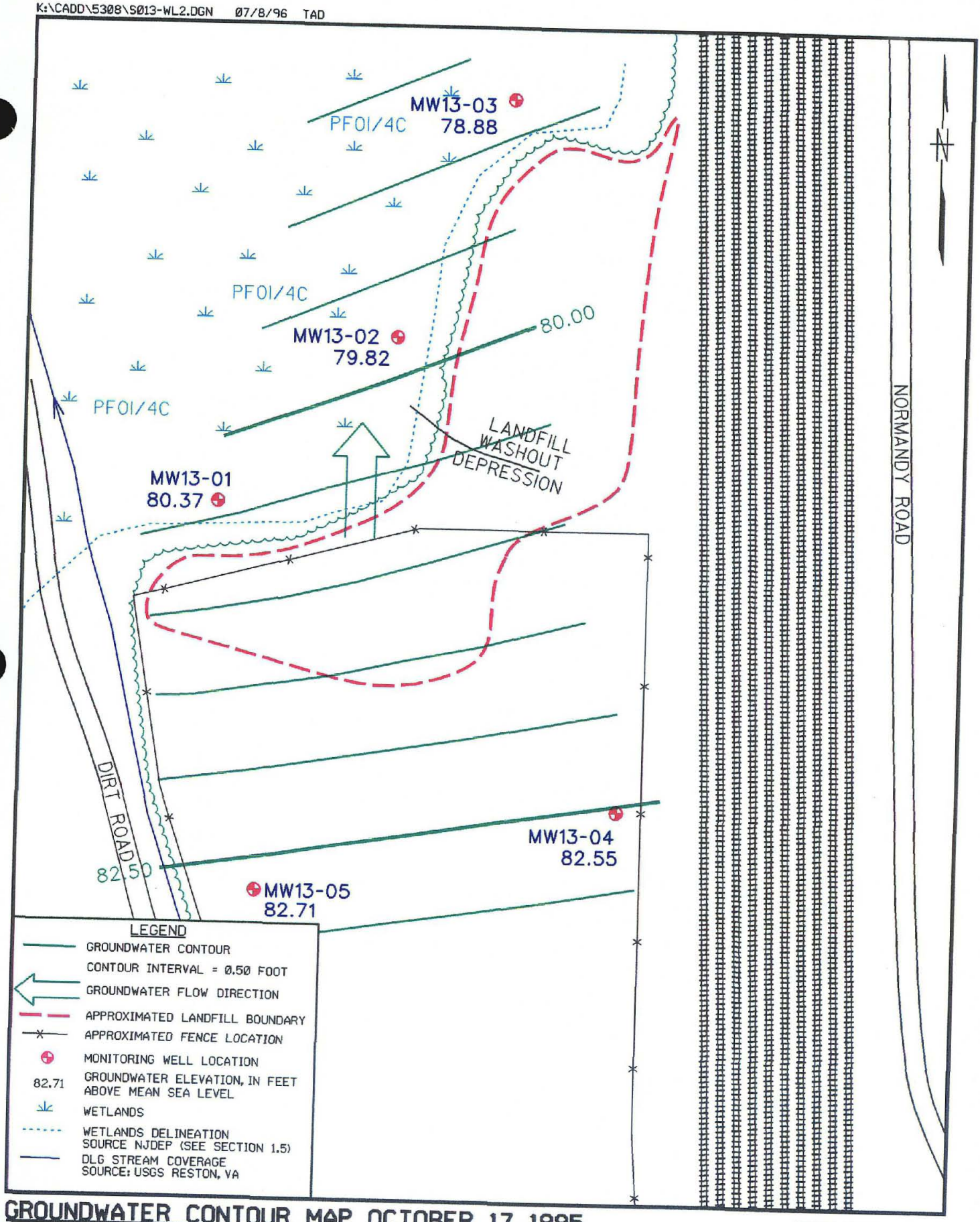
0 100 200

SCALE IN FEET

FIGURE 15-2

Brown & Root Environmental

K:\CADD\5308\S013-WL2.DGN 07/8/96 TAD



GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 13 - DRMO YARD

0 100 200

SCALE IN FEET

FIGURE 15-3

Brown & Root Environmental

TABLE 15-4
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 13
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	1150 - 2170	1728.33	NO	2170
ANTIMONY	NOT DETECTED	-	-	2 / 3	0.56 - 2.5	2.12	YES	2.5
ARSENIC	2 / 3	2.4 - 6.2	5.95	3 / 3	2.3 - 4.2	3.53	NO	4.2
BARIUM	3 / 3	3.9 - 10.6	14.07	3 / 3	5.6 - 9.3	7.27	NO	9.3
BERYLLIUM	1 / 3	0.57	0.67	2 / 3	0.12 - 0.32	0.18	NO	0.32
CADMIUM	NOT DETECTED	-	-	2 / 3	0.35 - 0.47	0.40	YES	0.47
CALCIUM	3 / 3	179 - 518	685.33	3 / 3	81.1 - 347.25	201.45	NO	347.25
CHROMIUM	3 / 3	4.3 - 56	43.13	3 / 3	23.2 - 72.5	42.97	NO	72.5
COBALT	1 / 3	2.1	3.30	2 / 3	0.43 - 0.57	0.58	NO	0.57
COPPER	3 / 3	1.5 - 13	12.47	3 / 3	2.9 - 32.7	14.40	YES	32.7
IRON	3 / 3	228 - 7650	6578.67	3 / 3	4355 - 9180	6921.67	YES	9180
LEAD	3 / 3	4.6 - 34.3	30.60	3 / 3	10.1 - 94.3	45.57	YES	94.3
MAGNESIUM	3 / 3	60.7 - 256	306.47	3 / 3	156 - 441	253.00	NO	441
MANGANESE	3 / 3	4.6 - 9.2	13.80	3 / 3	10.9 - 21.9	14.78	YES	21.9
MERCURY	1 / 3	0.068	0.05	3 / 3	0.0295 - 0.19	0.10	YES	0.19
NICKEL	2 / 3	2.1 - 6	7.93	2 / 3	2.4 - 3	2.22	NO	3
POTASSIUM	2 / 3	86.1 - 681	589.40	3 / 3	308 - 1530	763.00	YES	1530
SILVER	NOT DETECTED	-	-	2 / 3	2.4 - 22.7	8.58	YES	22.7
SODIUM	3 / 3	26.6 - 116	115.27	3 / 3	18.1 - 39.45	27.02	NO	39.45
VANADIUM	3 / 3	5.9 - 42.7	36.93	3 / 3	19.1 - 37.9	25.67	NO	37.9
ZINC	3 / 3	14.2 - 26.9	37.33	3 / 3	8.75 - 54.7	31.32	NO	54.7

Note: Selected COPCs are indicated in boldface type.

TABLE 15-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 13
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'-DDE	1 / 3	1.7	1.7	1 / 3	2.45	2.45
4,4'-DDT	1 / 3	19	19	1 / 3	6.4	6.4
ALPHA-CHLORDANE	NOT DETECTED	-	-	2 / 3	11 - 20	20
AROCLOR-1254	NOT DETECTED	-	-	3 / 3	58 - 3900	3900
AROCLOR-1260	NOT DETECTED	-	-	2 / 3	33 - 1200	1200
BENZO(B)FLUORANTHENE	2 / 3	150 - 490	490	1 / 1	48	48
CHRYSENE	2 / 3	250 - 940	940	1 / 1	56	56
DIETHYLPHTHALATE	1 / 3	44	44	1 / 1	51	51
ENDOSULFAN SULFATE	NOT DETECTED	-	-	1 / 3	0.3	0.3
ENDRIN ALDEHYDE	NOT DETECTED	-	-	2 / 3	31 - 90	90
FLUORANTHENE	2 / 3	300 - 1800	1800	1 / 1	81	81
GAMMA-CHLORDANE	1 / 3	0.095	0.095	1 / 3	0.16	0.16
PYRENE	2 / 3	350 - 1900	1900	1 / 1	67.5	67.5

TABLE 15-4a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13SD01	13SD02	13SD02-DUP	13SD03	---	---	---	ARARS & TBCs
LOCATION:	13SD01	13SD02	13SD02	13SD03	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI				
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**				**mg/kg**
aluminum	2170	1920	1810	1150				-
antimony	0.56	6.6 U	6.2 U	2.5 E				2.00 M
arsenic	4.1	1.1	3.5	4.2				8.20 L
barium	5.6	15.9	2.7	6.9				40.0 B
beryllium	0.32	0.22 U	0.21 U	0.12				-
cadmium	0.35	0.78 U	0.73 U	0.47				1.20 L
calcium	176	610	84.5	81.1				-
chromium, total	72.5 J	6.6 J	59.8 J	23.2 J				81.0 L
cobalt	0.43	1.5 U	1.4 U	0.57				50.0 T
copper	7.6	2.9	2.9	32.7				34.0 L
iron	7230	2330	6380	9180				-
lead	32.3	6.4 J	13.8 J	94.3 E				47.0 L
magnesium	441	185	139	156				-
manganese	10.9	9.0 J	14.1 J	21.9				460 O
mercury	0.092	0.037	0.022	0.19 E				0.150 L
nickel	2.4	2.5 U	2.3 U	3.0				21.0 L
potassium	1530	264	352	451				-
silver	2.4 E	1.3 U	1.2 U	22.7 E				1.00 M
sodium	23.5	36.3	42.6	18.1				-
vanadium	37.9	5.8	32.4	20.0				-
zinc	30.5 J	10.8 J	6.7 J	54.7 J				150 L
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
benzo(b)fluoranthene	n/a	520 U	48.0 J	n/a				330 F
chrysene	n/a	520 U	56.0 J	n/a				330 F
diethylphthalate	n/a	520 U	51.0 J	n/a				630000 P
fluoranthene	n/a	520 U	81.0 J	n/a				2900 Q
pyrene	n/a	53.0 J	82.0 J	n/a				660 L

TABLE 15-4a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13SD01	13SD02	13SD02-DUP	13SD03	---	---	---	ARARS & TBCs
LOCATION:	13SD01	13SD02	13SD02	13SD03	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI				
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**				**ug/kg**
4,4'-DDE	3.8 E R	2.3 E JN	2.6 E J	1.9 R				2.20 L
4,4'-DDT	16.0 E R	6.2 E	6.6 E	25.0 E R				1.60 L
Aroclor-1254	2200	60.0	56.0	3900				-
Aroclor-1260	34.0 U	35.0 J	31.0 J	1200				-
alpha-chlordane	11.0 E	2.6 U	2.5 U	20.0 E J				7.00 O
endosulfan sulfate	3.4 U	5.1 U	0.30 J	3.4 U				5.40 P
endrin aldehyde	31.0 E J	5.1 U	4.8 U	90.0 E J				20.0 Q
gamma-chlordane	1.7 U	0.11 R	0.16 J	1.8 U				7.00 O

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

TABLE 15-4b

COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		13SD01	13SD02	13SD02-DUP	13SD03	---	---	---	ARARS & TBCs
LOCATION:		13SD01	13SD02	13SD02	13SD03	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI				
MISCELLANEOUS									
moisture	%	2.1	35.6	31.4	2.7				-
pH		n/a	4.2	4.4	4.7				-
petroleum hydrocarbons	mg/kg	80.0	n/a	n/a	90.0				-
total organic carbon	mg/kg	1100	2700	3600	800				-

TABLE 15-4b
COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - *Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.*

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to *sediment ecological toxicity criteria*:

- No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

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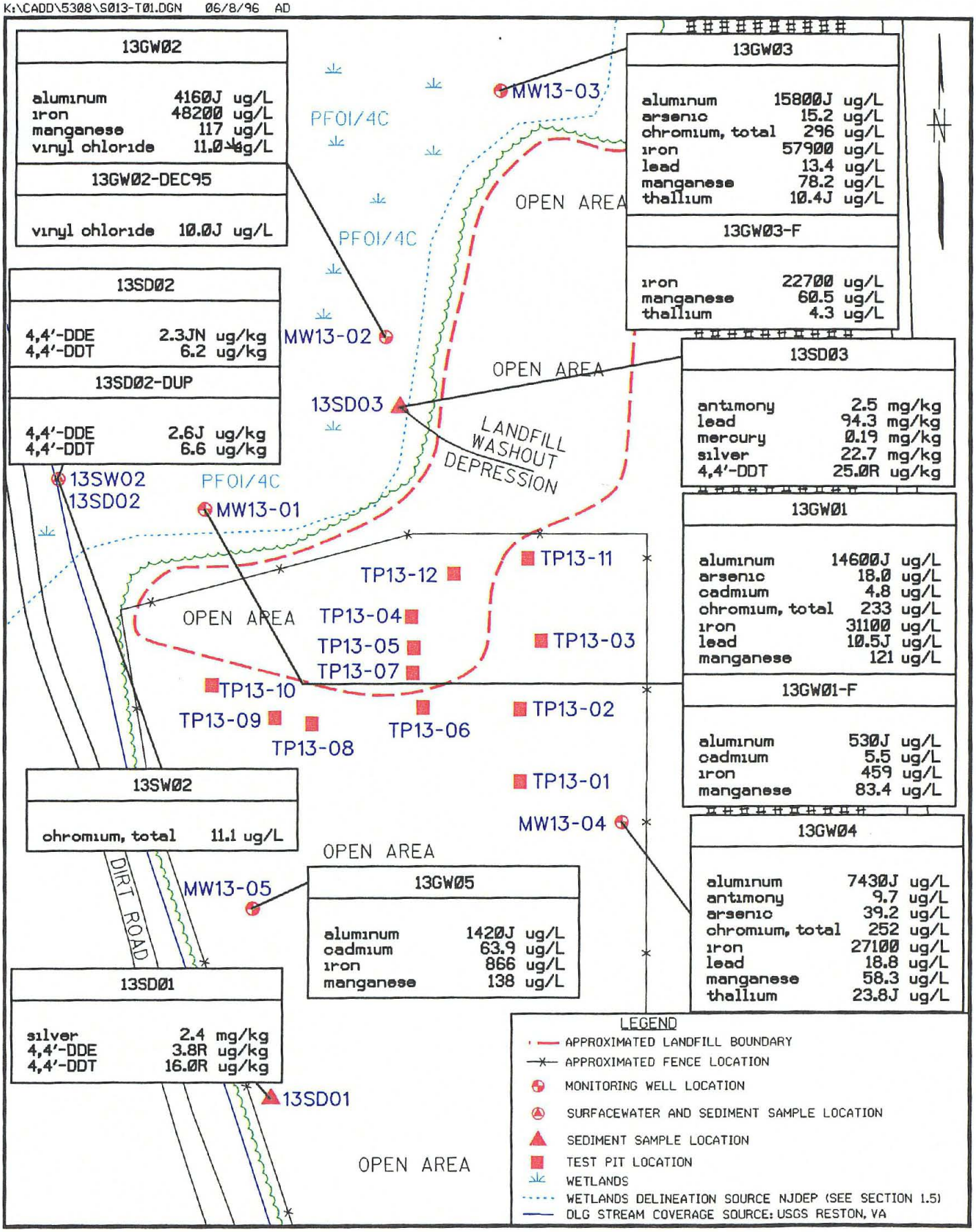

CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 13 - DRMO YARD

0 100 200

SCALE IN FEET

FIGURE 15-4

Brown & Root Environmental

samples and Aroclor 1260 (33 ug/kg to 1,200 ug/kg) was detected in two sediment samples. Alpha-chlordane (11 ug/kg to 20 ug/kg) and endrin aldehyde (31 ug/kg to 90 ug/kg) were each detected in two site-related sediment samples, and endosulfan sulfate (0.3 ug/kg) was detected in one site-related sediment sample.

15.5.1.3 Miscellaneous Parameters

Miscellaneous parameter analyses of five groundwater samples at Site 13 consisted of ammonia, BOD, COD, chloride, nitrates, sulfates, TOC, phosphates, and turbidity. Results are presented in Appendix A. Most indicator parameters revealed lower concentrations in upgradient wells than in downgradient wells (MW13-01 thru MW13-03). TOC levels (MW13-04 and MW13-05) were greater than maximum background levels in all samples. MW13-02 and MW13-03 exhibited ammonia and BOD concentrations above maximum background ranges. COD concentrations were greater than maximum background ranges. COD concentrations were greater than maximum background levels in all wells except MW13-05. Downgradient

15.5.2 Groundwater

Five groundwater samples were collected in Site 13: 13 GW 01 through 13 GW 05 (Figure 15-1). Tables 15-6 and 15-7 present the occurrence and distribution of inorganic and organic chemicals in site-related groundwater samples and compare them to background. Explosives were analyzed for but were not detected in Site 13 groundwater. Tables 15-6a and 15-6b present a comparison of detected compounds to ARARs and TBCs. Figure 15-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

15.5.2.1 Inorganics

Metals that significantly exceeded background levels were aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver, thallium, vanadium, and zinc. Filtered and unfiltered samples were collected from two monitoring wells where the turbidity endpoint goal could not be achieved (13 GW 03, 13 GW 03F and 13 GW 01, 13 GW 01F).

15.5.2.2 Organics

4,4'-DDT (0.029 ug/L to 0.051 ug/L) and heptachlor (0.0052 ug/L to 0.011 ug/L) were each detected in two groundwater samples (13 GW 01 and 13 GW 02). Compounds detected in only one groundwater sample at Site 13 include 1,1,1-TCA (5 ug/L in 13 GW 01), 1,2-DCE (7 ug/L in 13 GW 02), 4-methylphenol (2 ug/L

TABLE 15-6
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	11 / 11	287 - 7870	5097.82	5 / 5	1420 - 15800	8682.00	YES	15800.00
ANTIMONY	NOT DETECTED	-	-	1 / 5	9.7	3.02	YES	9.70
ARSENIC	1 / 11	5.8 - 5.8	4.05	3 / 5	15.2 - 39.2	15.14	YES	39.20
BARIUM*	11 / 11	2.6 - 518	229.60	5 / 5	10 - 285	102.84	NO	285.00
BERYLLIUM	4 / 11	0.21 - 1.6	0.49	4 / 5	0.67 - 1.6	0.865	YES	1.60
CADMIUM	5 / 11	0.6 - 1.9	1.21	5 / 5	1 - 63.9	14.5	YES	40.87
CALCIUM	11 / 11	506 - 17200	8306.55	5 / 5	3170 - 11900	6570	NO	11900.00
CHROMIUM	NOT DETECTED	-	-	5 / 5	26.3 - 296	176.34	YES	296.00
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 5	2.1 - 8.4	4.96	YES	8.40
COPPER*	9 / 11	0.79 - 13.5	6.53	5 / 5	2.6 - 14.2	6.32	NO	14.20
IRON	11 / 11	153 - 7690	4197.09	5 / 5	866 - 57900	33033.2	YES	57900.00
LEAD	3 / 11	2.1 - 3	2.44	5 / 5	3.4 - 18.8	10.58	YES	18.80
MAGNESIUM	11 / 11	273 - 27400	8449.64	5 / 5	2120 - 4040	2888	NO	3950.12
MANGANESE	11 / 11	3.3 - 65	46.18	5 / 5	58.3 - 138	102.5	YES	138.00
MERCURY*	11 / 11	0.005 - 0.12	0.12	5 / 5	0.047 - 0.11	0.0642	NO	0.09
NICKEL	10 / 11	0.81 - 25.5	11.98	4 / 5	11.5 - 35.7	14.895	YES	35.70
POTASSIUM	11 / 11	350 - 3245	2810.55	5 / 5	2620 - 9330	6288	YES	9330.00
SILVER	NOT DETECTED	-	-	1 / 5	1	0.576	YES	0.88
SODIUM	11 / 11	1850 - 11650	8449.09	5 / 5	3520 - 9780	6966	NO	9780.00
THALLIUM	3 / 11	4 - 5.1	5.15	2 / 5	10.4 - 23.8	7.92	YES	17.10
VANADIUM	10 / 11	0.69 - 42.25	16.48	5 / 5	2.6 - 152	89.44	YES	152.00
ZINC	6 / 9	3.7 - 348	178.61	5 / 5	34.9 - 1950	479.48	YES	1268.00

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

TABLE 15-7
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 13
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
1,1,1-TRICHLOROETHANE	NOT DETECTED	-	-	1 / 5	5	5
1,2-DICHLOROETHENE (TOTAL)	NOT DETECTED	-	-	1 / 5	7	6.34
4,4'-DDT	NOT DETECTED	-	-	2 / 5	0.029 - 0.051	0.051
4-METHYLPHENOL	NOT DETECTED	-	-	1 / 5	2	2
CARBON DISULFIDE	NOT DETECTED	-	-	1 / 5	1	1
DIELDRIN	NOT DETECTED	-	-	1 / 5	0.022	0.022
ENDOSULFAN I	NOT DETECTED	-	-	1 / 5	0.028	0.03
HEPTACHLOR	NOT DETECTED	-	-	2 / 5	0.0052 - 0.011	0.011
VINYL CHLORIDE	NOT DETECTED	-	-	1 / 5	11	9.73

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TABLE 15-6a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13GW01	13GW01-F	13GW02	13GW02-DEC95	13GW03	13GW03-F	ARARS & TBCs		
LOCATION:	13GW01	13GW01	13GW02	13GW02	13GW03	13GW03	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI, Dec.	1995 RI	1995 RI			
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	14600 E J	530 E J	4160 E J	n/a	15800 E J	13.4	-	-	200
antimony	2.7 U	2.7 U	2.7 U	n/a	2.7 U	2.7 U	6.00	3.00 a	20.0
arsenic	18.0 E	3.3 U	3.3 U	n/a	15.2 E	3.3 U	50.0	-	8.00
barium	70.1	54.7	285	n/a	10.0	2.0	2000	2000 a	2000
beryllium	1.1	0.21	0.11 U	n/a	0.90	0.11 U	4.00	4000 e	20.0
cadmium	4.8 E	5.5 E	1.0	n/a	1.6	0.56	5.00	5.00 e	4.00
calcium	8900	7850	11900	n/a	3890	3150	-	-	-
chromium, total	233 E	2.3	74.4	n/a	296 E	1.0 U	100 *	100 a	100
cobalt	4.4	2.6	2.1	n/a	3.8	1.4	-	-	-
copper	3.2	2.7	14.2	n/a	3.5	0.90	1300	-	1000
iron	31100 E	459 E	48200 E	n/a	57900 E	22700 E	-	-	300
lead	10.5 E J	1.5 UJ	6.8	n/a	13.4 E	1.5 UJ	15.0	-	10.0
magnesium	4040	1630	2340	n/a	3330	982	-	-	-
manganese	121 E	83.4 E	117 E	n/a	78.2 E	60.5 E	-	-	50.0
mercury	0.049	0.038	0.11	n/a	0.056	0.017	2.00	2.00 b	2.00
nickel	13.9	7.6	0.75 U	n/a	11.5	2.0	100	100 a	100
potassium	9330 J	3000	3920	n/a	7300 J	739	-	-	-
selenium	5.3 J	4.4 U	4.4 U	n/a	4.6 J	4.4 U	50.0	-	50.0
silver	0.94 U	0.94 U	1.0	n/a	0.94 U	0.94 U	-	100 a	-
sodium	8810	3590	6860	n/a	9780	7880	-	-	50000
thallium	3.6 UJ	3.6 U	3.6 U	n/a	10.4 E J	4.3 E	2.00	0.400 a	10.0
vanadium	111	0.61 U	35.6	n/a	146	0.61 U	-	-	-
zinc	94.6	72.8	265	n/a	34.9	7.7	-	2000 a	5000
SEMIVOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
4-methylphenol	10.0 U	n/a	10.0 U	n/a	2.0 J	n/a	-	100 a	-
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1,1,1-trichloroethane	5.0 J	n/a	10.0 U	10.0 U	10.0 U	n/a	200	200 a	30.0
1,2-dichloroethene (total)	10.0 U	n/a	7.0 J	2.0 J	10.0 U	n/a	70.0 a	70.0 a	10.0

TABLE 15-6a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13GW01		13GW01-F	13GW02		13GW02-DEC95		13GW03		13GW03-F	ARARS & TBCs		
LOCATION:	13GW01		13GW01	13GW02		13GW02		13GW03		13GW03	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI	1995 RI		1995 RI, Dec.		1995 RI		1995 RI			
VOLATILES	**ug/L**		**ug/L**	**ug/L**		**ug/L**		**ug/L**		**ug/L**	**ug/L**	**ug/L**	**ug/L**
carbon disulfide	10.0	UJ	n/a	10.0	U	10.0	U	10.0	UJ	n/a	-	-	-
vinyl chloride	10.0	U	n/a	11.0	E	10.0	E J	10.0	U	n/a	2.00	10.0 e	5.00
PESTICIDES	**ug/L**		**ug/L**	**ug/L**		**ug/L**		**ug/L**		**ug/L**	**ug/L**	**ug/L**	**ug/L**
4,4'-DDT	0.051	J	n/a	0.029	J	n/a		0.10	U	n/a	-	-	0.100
alpha-BHC	0.0010	R	n/a	0.050	U	n/a		0.050	U	n/a	-	-	0.0200
delta-BHC	0.025	R	n/a	0.050	U	n/a		0.050	U	n/a	-	-	-
dieldrin	0.022	J	n/a	0.10	U	n/a		0.10	U	n/a	-	0.500 e	0.0300
endosulfan I	0.028	JN	n/a	0.050	U	n/a		0.050	U	n/a	-	-	0.400
heptachlor	0.011	J	n/a	0.0052	JN	n/a		0.050	U	n/a	0.400	5.00 e	0.400
heptachlor epoxide	0.044	R	n/a	0.013	R	n/a		0.050	U	n/a	0.200	0.100 e	0.200

TABLE 15-6a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13GW04	13GW05	---	---	---	---	ARARS & TBCs		
LOCATION:	13GW04	13GW05	---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
aluminum	7430 E J	1420 E J					-	-	200
antimony	9.7 E	2.7 U					6.00	3.00 a	20.0
arsenic	39.2 E	3.3 U					50.0	-	8.00
barium	57.8	91.3					2000	2000 a	2000
beryllium	1.6	0.67					4.00	4000 e	20.0
cadmium	1.2	63.9 E					5.00	5.00 e	4.00
calcium	3170	4990					-	-	-
chromium, total	252 E	26.3					100 *	100 a	100
cobalt	8.4	6.1					-	-	-
copper	8.1	2.6					1300	-	1000
iron	27100 E	866 E					-	-	300
lead	18.8 E	3.4 J					15.0	-	10.0
magnesium	2610	2120					-	-	-
manganese	58.3 E	138 E					-	-	50.0
mercury	0.059	0.047					2.00	2.00 b	2.00
nickel	13.0	35.7					100	100 a	100
potassium	8270 J	2620					-	-	-
selenium	39.9	4.4 U					50.0	-	50.0
silver	0.94 U	0.94 U					-	100 a	-
sodium	3520	5860					-	-	50000
thallium	23.8 E J	3.6 UJ					2.00	0.400 a	10.0
vanadium	152	2.6					-	-	-
zinc	52.9	1950					-	2000 a	5000
SEMIVOLATILES	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
4-methylphenol	10.0 U	10.0 U					-	100 a	-
VOLATILES	**ug/L**	**ug/L**					**ug/L**	**ug/L**	**ug/L**
1,1,1-trichloroethane	10.0 U	10.0 U					200	200 a	30.0
1,2-dichloroethene (total)	10.0 U	10.0 U					70.0 a	70.0 a	10.0

TABLE 15-6a

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13GW04		13GW05		---	---	---	---	ARARS & TBCs		
LOCATION:	13GW04		13GW05		---	---	---	---	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:	1995 RI		1995 RI								
VOLATILES	**ug/L**		**ug/L**						**ug/L**	**ug/L**	**ug/L**
carbon disulfide	1.0	J	10.0	UJ					-	-	-
vinyl chloride	10.0	U	10.0	U					2.00	10.0 e	5.00
PESTICIDES	**ug/L**		**ug/L**						**ug/L**	**ug/L**	**ug/L**
4,4'-DDT	0.10	U	0.10	U					-	-	0.100
alpha-BHC	0.050	U	0.050	U					-	-	0.0200
delta-BHC	0.050	U	0.050	U					-	-	-
dieldrin	0.10	U	0.10	U					-	0.500 e	0.0300
endosulfan I	0.050	U	0.050	U					-	-	0.400
heptachlor	0.050	U	0.050	U					0.400	5.00 e	0.400
heptachlor epoxide	0.050	U	0.050	U					0.200	0.100 e	0.200

TABLE 15-6a
COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

- - No standard is available for this chemical in this classification.

a - Where applicable, value(s) represent the more stringent of criteria for total, cis-, and trans- isomers.

• - Criteria are for total chromium.

** - Action level 1300 ug/L for water treatment technology for public water supply systems.

*** - Action level 15 ug/L for water treatment technology for public water supply systems.

Footnotes to Health Advisories:

- - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TABLE 15-6b

COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		13GW01	13GW02	13GW03	13GW04	13GW05	ARARS & TBCs		
LOCATION:		13GW01	13GW02	13GW03	13GW04	13GW05	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
ammonia nitrogen	mg/L	1.0 U	0.70 E J	0.90 E J	1.0 U	1.0 U	-	30.0	0.500
biochemical oxygen demand	mg/L	3.0	6.0	5.0	3.0	0.80 J	-	-	-
chemical oxygen demand	mg/L	12.0	24.0	39.0	22.0	4.0 J	-	-	-
chloride	mg/L	6.0	5.0	5.0	5.0	6.0	-	-	250
nitrate nitrogen	mg/L	0.24 J	0.50 U	0.50 U	0.50 U	2.3	10.0	10.0	-
sulfate	mg/L	33.0	33.0	22.0	19.0	24.0	500	-	250
total organic carbon	mg/L	1.0	4.0	4.0	5.0	1.0	-	-	-
total phosphorus as PO4	mg/L	0.40	0.20 U	0.30	0.40	0.20 U	-	-	-
turbidity	ntu	n/a	n/a	n/a	290 J	n/a	-	-	-

TABLE 15-6b
COMPARISON OF GROUNDWATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to MCLs, MCLGs, or SMCLs:

. - No standard is available for this chemical in this classification.

Footnotes to Health Advisories:

. - No standard is available for this chemical in this classification.

a - The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.

b - The listed health advisory criterion, long-term adult, is equal to the most stringent of the EPA health advisories for this chemical.

c - The listed health advisory criterion, one-day child, is equal to the most stringent of the EPA health advisories for this chemical.

d - The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.

e - The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

in 13 GW 03), carbon disulfide (1 ug/L in 13 GW 04), dieldrin (0.022 ug/L in 13 GW 01), endosulfan I (0.028 ug/L in 13 GW 01), and vinyl chloride (11 ug/L in 13 GW 02). None of these compounds were detected in background groundwater samples.

15.5.2.3 Miscellaneous Parameters

Miscellaneous parameter analyses of groundwater samples at Site 13 consisted of ammonia, BOD, COD, chlorides, nitrates, sulfates, TOC, phosphates, and turbidity. Results are presented in Appendix A. Most indicator parameters revealed lower concentrations in upgradient wells than in downgradient wells (MW13-01 thru MW13-03). TOC levels were greater than maximum background groundwater levels in all samples. MW13-02 and MW13-03 exhibited ammonia and BOD concentrations above maximum background levels in all wells except MW13-05. Downgradient concentrations were greater than upgradient levels and above background ranges for sulfate in MW13-01 and MW13-02. MW13-05 exhibited levels exceeding background levels for nitrate nitrogen. Concentrations of phosphate exceeding ranges for sulfate in MW13-01 and MW13-02. MW13-05 exhibited levels exceeding background were detected in MW13-01, MW13-03, and MW13-04. 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).

15.5.3 Surface Water

One surface water sample, 13 SW 02, was collected (Figure 15-1). Table 15-8 presents the occurrence and distribution of inorganic chemicals in the site-related surface water sample and compares them to background. No organic compounds were detected in the site-related surface water sample. Explosives were analyzed for but were not detected in surface water. Tables 15-8a and 15-8b present a comparison of detected compounds to ARARs and TBCs. Figure 15-4 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

15.5.3.1 Inorganics

Concentrations of most metals in the site-related sample were similar to background ranges. Cadmium was detected at levels near the detection limit and slightly greater than the range of background samples.

TABLE 15-8
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 13
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	1 / 1	932	932	YES	932
BARIUM	3 / 3	16.3 - 34	53.73	1 / 1	28.45	28.45	NO	28.45
BERYLLIUM	2 / 3	0.22 - 0.33	0.41	1 / 1	0.28	0.28	NO	0.28
CADMIUM	1 / 3	0.18	0.23	1 / 1	0.555	0.555	YES	0.555
CALCIUM	3 / 3	462 - 10100	9128.00	1 / 1	3010	3010	NO	3010
CHROMIUM	3 / 3	0.72 - 2.6	2.71	1 / 1	11	11	YES	11
COBALT	3 / 3	0.81 - 1.9	2.54	1 / 1	2.55	2.55	YES	2.55
COPPER	2 / 3	1.1 - 9.8	7.40	1 / 1	1.2	1.2	NO	1.2
IRON	3 / 3	160 - 702	1040.00	1 / 1	1695	1695	YES	1695
LEAD	1 / 3	4.4	3.43	1 / 1	1.85	1.85	NO	1.85
MAGNESIUM	3 / 3	369 - 2770	2525.33	1 / 1	1940	1940	NO	1940
MANGANESE	3 / 3	14 - 55.5	59.93	1 / 1	41.3	41.3	NO	41.3
NICKEL	3 / 3	2.1 - 7.1	8.60	1 / 1	8.95	8.95	YES	8.95
POTASSIUM	2 / 3	251 - 1850	1482.33	1 / 1	1720	1720	YES	1720
SILVER	1 / 3	0.86	0.99	1 / 1	1.4	1.4	YES	1.4
SODIUM	NOT DETECTED	-	-	1 / 1	4405	4405	YES	4405
VANADIUM	2 / 3	0.89 - 0.9	1.32	1 / 1	0.405	0.405	NO	0.405

Note: Selected COPCs are indicated in boldface type.

TABLE 15-8a

COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	13SW02	13SW02-DUP	---	---	ARARS & TBCs				
LOCATION:	13SW02	13SW02	---	---	AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Criteria Freshwater Chronic Aquatic Life	NJDEP Surface Water Criteria for Protection of Human Health
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
aluminum	927 J	937 J			-	-	-	-	-
barium	28.3	28.6			-	-	-	-	2000
beryllium	0.28	0.28			-	-	-	-	-
cadmium	0.49	0.62			1.10 +	-	-	-	-
calcium	3000	3020			-	-	-	-	-
chromium, total	11.1	10.9			209 +	-	-	-	160
cobalt	2.5	2.6			-	-	-	-	-
copper	1.3	1.1			11.0 +	-	-	-	-
iron	1680	1710			-	-	-	-	-
lead	1.6	2.1			3.20 +	-	-	-	5.00
magnesium	1930	1950			-	-	-	-	-
manganese	41.0	41.6			-	-	-	-	-
nickel	8.6 J	9.3 J			160 +	610	4600	-	516
potassium	1640	1800			-	-	-	-	-
selenium	2.5 U	2.5			5.00	-	-	-	10.0
silver	0.63 U	1.4			1.90	-	-	-	164
sodium	4390 J	4420 J			-	-	-	-	-
vanadium	0.42	0.39			-	-	-	-	-
zinc	14.6 R	21.0 R			101 +	-	-	-	-
SEMIVOLATILES	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
phenol	2.0 J	10.0 U			-	21000	4600000	-	20900

TABLE 15-8a
COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L.

TABLE 15-8b

COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 13

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		13SW02		13SW02-DUP		---	ARARS & TBCs				
LOCATION:		13SW02		13SW02		---	AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Freshwater Chronic Aquatic Life	NJDEP Surface Water Protection of Human Health
DATA SOURCE:		1995 RI		1995 RI							
MISCELLANEOUS											
biochemical oxygen demand	mg/L	2.0	R	4.0	R		-	-	-	-	-
chemical oxygen demand	mg/L	7.0		8.0			-	-	-	-	-
chloride	mg/L	9.0		10.0			-	-	-	230	230
nitrate nitrogen	mg/L	0.18	J	0.21	J		-	10.0	-	-	10.0
petroleum hydrocarbons	mg/L	0.10	J	0.10	J		-	-	-	-	-
total organic carbon	mg/L	2.0		2.0			-	-	-	-	-
total phosphorus as PO4	mg/L	0.40	R	0.40	R		-	-	-	-	-
turbidity	ntu	1.6		1.7			-	-	-	-	-

TABLE 15-8b
COMPARISON OF SURFACE WATER MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

- - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L

& - Value represents the more stringent of criteria for freshwaters classified as FW2-NT, FW2-TP, and FW2-TM

15.5.3.2 Miscellaneous Parameters

Miscellaneous parameter analyses consisted of BOD, COD, chlorides, nitrates, TOC, phosphates, and turbidity. A low level of TPH (0.100 mg/L) was detected in sample 13 SW 02. No TPH result greater than the detection limit (0.300 mg/L) was reported in the associated background surface water samples.

Concentrations of chloride, nitrate nitrogen, and phosphate were detected above maximum surface water background levels. Results are presented in Appendix A.

15.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 13 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 15.6.1.

Persistence of detected chemicals in the environment is discussed in Section 15.6.2. Section 15.6.3 presents a brief discussion of contaminant trends.

15.6.1 Detected Chemicals and Transport Potential

A wide variety of metals, volatile, semivolatile, and pesticide compounds were detected in Site 13 groundwater. PCBs, metals, semivolatiles, and pesticides were found in sediment, and limited metals were detected in surface water. The physical transport data for the detected compounds are presented in Table 2-10. Additional discussion with respect to chemical and physical properties, contaminant persistence, and contaminant migration pathways is presented in Section 2.3.

Groundwater samples revealed several halogenated volatile organics, carbon disulfide, a substituted phenol, and certain pesticides (4,4'-DDT, heptachlor, dieldrin, and endosulfan I). The VOCs and phenol are typically considered highly mobile; the mobility of pesticides is considered compound specific and moderate to low compared to other compounds.

Concentrations of metals in unfiltered groundwater samples from wells MW13-01 and MW13-03 were generally greater than levels in the corresponding filtered samples collected at the same locations. With the exception of cadmium and zinc, elevated levels of metals were not present in the filtered samples. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution. Given a geologic formation that does not include conditions conducive to solution channeling or fracture-based flow, samples from wells with high turbidity sent for analysis would show higher metals concentrations than are actually mobile in the NWS Earle aquifer. Despite efforts such as

installation of dedicated low-flow bladder pumps and adherence to the EPA low-flow sampling procedure, at most wells, low-turbidity samples could not be collected.

PCBs, which were detected in site-related sediments, 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 adsorbed onto high-carbon content substrates.

Antimony, cadmium, lead, and silver, which were detected in site-related sediments, are adsorbed onto soil and sediment easily but may also exist in dissolved or suspended forms. Of these metals, only cadmium was detected at levels slightly above background in the surface water sample.

Sorption processes appear to exert a dominant effect on the distribution of lead in the environment. Adsorption to inorganic solids, organic materials, and hydrous iron and manganese oxides usually controls the mobility of lead and results in a strong partitioning of lead to the bed sediments in aquatic systems. The sorption mechanism most important in a particular system varies with geological setting, pH, Eh, availability of liquids, dissolved and particulate concentrations, and chemical composition. Lead is strongly complexed to organic materials present in aquatic systems and soil (Clement Associates, 1985). Activities at the site have included on-site battery reclamation by splitting open batteries and draining acid onto the ground, which is supported by the fact that both sediment samples (in the drainage ditch at the toe of the landfill and in the ditch to the west of the landfill) revealed unusually low pH (4.22 to 4.67) values. Low pH in soil and sediment leads to the solubilization of lead in these media, which facilitates contaminant migration. Transport of lead over distances is also controlled by other factors, including soil cation exchange and buffering capacities.

15.6.2 Contaminant Persistence

For the classes of detected chemicals, environmental persistence varies widely. Transformation of a chemical to its degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The by-product chemical(s) may or may not be significantly different toxicologically or from a physical transport perspective.

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

sediment) are most likely to be transformed in the environment. Higher molecular weight contaminants tend to be less mobile and less prone to chemical transformation.

All detected volatile organic groundwater contaminants are characteristically mobile in the environment (either through soil gas migration or groundwater transport) and may have originated either at source locations not identified in this investigation or from source locations that have since been depleted of these contaminants. 1,2-DCE and vinyl chloride, which were detected in groundwater, are associated with degradation of PCE and TCE (Cline and Viste, 1983). PCBs are considered highly persistent, typically exhibiting biodegradation patterns that proceed slowly and to varying degrees, depending upon the individual isomer chlorination pattern of the PCB congeners that make up the Aroclor mixtures.

15.6.3 Observed Chemical Contaminant Trends

The presence of suspended solids in samples 13 GW 01, 13 GW 02, 13 GW 03, and 13 GW 04 is indicated by very high turbidity readings and elevated levels of metals such as aluminum, whose common forms are relatively insoluble. Although only unfiltered sample results were used in calculations for the groundwater risk assessment, in accordance with the recommended conservative approach to this evaluation, an important caveat is that the filtered sample results of two wells at Site 13 appear to be more representative of dissolved-phase contamination. Elevated levels of most metals were not generally found in the filtered aliquots, with the exception of cadmium and zinc in the filtered aliquot of downgradient sample 13 GW 01 and thallium in the filtered aliquot of downgradient sample 13 GW 03. One upgradient groundwater sample (13 GW 04) displayed elevated levels of aluminum and exhibited cadmium at notable levels. Upgradient sample 13 GW 05 did not reveal high turbidity readings or aluminum at elevated levels but exhibited a notable concentration of zinc. No previous monitoring well metals data are available for comparison because no monitoring wells existed at Site 13 prior to this RI effort.

Low levels of pesticides were noted in downgradient groundwater sample 13 GW 01. One farther downgradient well revealed fewer pesticide detections and lower concentrations. This indicates that the landfill may be the source of the pesticide compounds in groundwater.

Surface water samples at Site 13 do not demonstrate dissolved-phase inorganic chemical migration impacts from the landfill. The detected sediment contamination is likely the result of runoff and erosional dispersion. Notable contaminants in sediment fall into three classes: PCBs (which are considered relatively immobile), pesticides (which have varying degrees of mobility), and certain metals.

Aroclor 1254 was detected in sediment sample 13 SD 01 at a level of 2,200 ug/kg, which is approximately 30 times greater than that observed in the corresponding downstream sample, 13 SD 02. Sample 13 SD

03, which was collected in the drainage ditch leading from the toe of the landfill, revealed both Aroclor 1254 (3,900 ug/kg) and 1260 (1,200 ug/kg). Since Aroclor 1260 was also detected in several landfill area soil samples during a 1992 investigation, this suggests erosional dispersion impacts from Aroclor 1260 in the drainage ditch from the landfill. Lead and silver, which were both detected in landfill soil samples in the 1992 investigation, were also detected in the current investigation in the drainage ditch sample, which suggests migration of these contaminants. Antimony and cadmium were also detected at low levels in site-related sediment samples (the highest levels were in 13 SD 03) but were not found in background sediments. Low pH of sediments may facilitate additional contaminant migration, although the levels detected in the drainage ditch sample were generally low and these constituents were not present in downgradient filtered groundwater samples at elevated levels.

Low concentrations of VOCs and a soluble semivolatile were observed in three downgradient groundwater monitoring wells but were not detected at two upgradient locations, which suggests groundwater impacts from the landfill. 1,1,1-TCA was detected in 13 GW 01, 1,2-DCE and vinyl chloride were detected in 13 GW 02, and 4-methylphenol was detected in 13 GW 03. The dichloroethenes are degradation products of PCE and TCE, which were not detected in groundwater. The degradation products may have originated at source locations (e.g., the landfill) that have since been depleted or from locations that were not sampled during the current investigation.

15.6.4 Conclusions

Migration of impacted sediments from the landfill through runoff and erosional dispersion may be the cause of the detected PCBs and metals in sediments downstream of the landfill. The landfill appears to be the source of the elevated levels of Aroclor 1260, lead, and silver in the drainage ditch leading from the toe of the landfill. Aroclor 1260, lead, and silver were detected in the landfill during a previous investigation (1992), and historical information indicates that PCB transformers and batteries were stored on site.

Chemical constituents detected in the sediment at Site 13 have low potential for impacts to groundwater. Detected chemicals in the groundwater indicate the possibility of limited groundwater impacts by certain VOCs, metals, and pesticides. VOCs and one semivolatile were detected in downgradient monitoring wells but were not found in upgradient wells, which suggests impacts from the landfill. Cadmium was detected at an elevated level in upgradient sample 13 GW 04 and zinc was detected at an elevated level in upgradient sample 13 GW 05, which suggests that the lower levels of these metals detected in a downgradient sample might not be site related.

15.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 13. The risk assessment was performed using the approach outlined in Section 2.4. Tables 15-9 through 15-11 provide the selected COPCs and representative concentrations of inorganics and organics in site-related sediment, groundwater, and surface water (inorganics only), respectively. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than a value of 1.0 for non-cancer risk and greater than 1E-04 for cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 15.7.1.5 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation alternatives are identified for a site.

15.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of hypothetical future land use (residential, recreational, and industrial receptors).

15.7.1.1 Future Industrial Employee

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 and an estimated noncarcinogenic HI with a value greater than 1.0 for the future industrial employee assuming exposure to COPCs in groundwater at Site 13. (Ingestion exposures contributed the significant portion of cancer and non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for industrial exposure to groundwater are discussed in Section 15.7.1.5 and presented in Tables 15-12, 15-12a, 15-13, and 15-13a, respectively.

TABLE 15-9
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	REPRESENTATIVE CONCENTRATION
ANTIMONY	2.5	NONPARAMETRIC
ARSENIC	4.2	NONPARAMETRIC
BERYLLIUM	0.32	NONPARAMETRIC
CADMIUM	0.47	NONPARAMETRIC
CHROMIUM	72.5	NONPARAMETRIC
COPPER	32.7	NONPARAMETRIC
IRON	9180	NONPARAMETRIC
LEAD	94.3	NONPARAMETRIC
MANGANESE	21.9	NONPARAMETRIC
MERCURY	0.19	NONPARAMETRIC
SILVER	22.7	NONPARAMETRIC
ZINC	54.7	NONPARAMETRIC
4,4'-DDE*	2.45	NONPARAMETRIC
4,4'-DDT*	6.4	NONPARAMETRIC
ALPHA-CHLORDANE*	20	NONPARAMETRIC
AROCLOR-1254*	3900	NONPARAMETRIC
AROCLOR-1260*	1200	NORMAL
BENZO(B)FLUORANTHENE*	48	NONPARAMETRIC
CHRYSENE*	56	NONPARAMETRIC
DIETHYLPHTHALATE*	51	NONPARAMETRIC
ENDOSULFAN SULFATE*	0.3	LOGNORMAL
ENDRIN ALDEHYDE*	90	NONPARAMETRIC
FLUORANTHENE*	81	NONPARAMETRIC
GAMMA-CHLORDANE*	0.16	NONPARAMETRIC
PYRENE*	67.5	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

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TABLE 15-10
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
GROUNDWATER - SITE 13 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	15800	NONPARAMETRIC
ANTIMONY	9.7	LOGNORMAL
ARSENIC	39.2	NONPARAMETRIC
BARIUM	285	NONPARAMETRIC
BERYLLIUM	1.6	NONPARAMETRIC
CADMIUM	40.87	NORMAL
CHROMIUM	296	NONPARAMETRIC
COPPER	14.2	NONPARAMETRIC
IRON	57900	LOGNORMAL
LEAD	18.8	NONPARAMETRIC
MERCURY	0.09	NORMAL
NICKEL	35.7	NONPARAMETRIC
SILVER	0.88	LOGNORMAL
THALLIUM	17.10	NORMAL
VANADIUM	152	NONPARAMETRIC
ZINC	1268.00	NORMAL
1,1,1-TRICHLOROETHANE	5	LOGNORMAL
1,2-DICHLOROETHENE (TOTAL)	6.34	LOGNORMAL
4,4'-DDT	0.051	LOGNORMAL
4-METHYLPHENOL	2	LOGNORMAL
CARBON DISULFIDE	1	LOGNORMAL
DIELDRIN	0.022	LOGNORMAL
ENDOSULFAN I	0.03	LOGNORMAL
HEPTACHLOR	0.011	NORMAL
VINYL CHLORIDE	9.73	LOGNORMAL

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TABLE 15-11
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE WATER - SITE 13 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
ALUMINUM	932	NONPARAMETRIC
BERYLLIUM	0.28	NONPARAMETRIC
CADMIUM	0.555	NONPARAMETRIC
CHROMIUM	11	NONPARAMETRIC
COBALT	2.55	NONPARAMETRIC
IRON	1695	NONPARAMETRIC
LEAD	1.85	NONPARAMETRIC
NICKEL	8.95	NONPARAMETRIC
SILVER	1.4	NONPARAMETRIC

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TABLE 15-12
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,1,1-TRICHLOROETHANE	N/A	N/A
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A
4,4'-DDT	6.1E-08	1.9E-07
4-METHYLPHENOL	N/A	N/A
CARBON DISULFIDE	N/A	N/A
DIELDRIN	1.2E-06	2.7E-07
ENDOSULFAN I	N/A	N/A
HEPTACHLOR	1.7E-07	3.1E-08
VINYL CHLORIDE	6.5E-05	3.5E-07
ALUMINUM	N/A	N/A
ANTIMONY	N/A	N/A
ARSENIC	2.1E-04	8.9E-08
BERYLLIUM	2.4E-05	9.9E-07
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
NICKEL	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	3.0E-04	1.9E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-12a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION	GROUNDWATER DERMAL CONTACT
1,1,1-TRICHLOROETHANE	N/A	N/A
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A
4,4'-DDT	6.0E-09	2.7E-08
4-METHYLPHENOL	N/A	N/A
CARBON DISULFIDE	N/A	N/A
DIELDRIN	1.4E-07	4.2E-08
ENDOSULFAN I	N/A	N/A
HEPTACHLOR	1.9E-08	5.0E-09
VINYL CHLORIDE	7.1E-06	5.5E-08
ALUMINUM	N/A	N/A
ANTIMONY	N/A	N/A
ARSENIC	8.8E-06	5.4E-09
BERYLLIUM	1.4E-06	8.4E-08
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
NICKEL	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	1.7E-05	2.2E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-13
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN										
SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT
1,1,1-TRICHLOROETHANE	5.4E-04											2.2E-05
1,2-DICHLOROETHENE (TOTAL)	6.9E-03	6.9E-03				6.9E-03						6.4E-05
4,4'-DDT	1.0E-03					1.0E-03						3.1E-03
4-METHYLPHENOL	3.9E-03			3.9E-03	3.9E-03	3.9E-03		3.9E-03				6.6E-05
CARBON DISULFIDE	9.8E-05	9.8E-05	9.8E-05	9.8E-05		9.8E-05		9.8E-05	9.8E-05	9.8E-05	9.8E-05	3.9E-06
DIELDRIN	4.3E-03					4.3E-03		4.3E-03			4.3E-03	9.4E-04
ENDOSULFAN I	4.4E-05	4.4E-05		4.4E-05								3.7E-06
HEPTACHLOR	2.2E-04					2.2E-04						3.9E-05
VINYL CHLORIDE	N/A					N/A		N/A				N/A
ALUMINUM	1.5E-01											1.3E-03
ANTIMONY	2.4E-01	2.4E-01										1.9E-03
ARSENIC	1.3E+00		1.3E+00									5.5E-04
BERYLLIUM	3.1E-03											1.3E-04
CADMIUM	8.0E-01			8.0E-01								3.3E-03
CHROMIUM	5.8E-01			5.8E-01								1.2E-02
IRON	1.9E+00					1.9E+00	1.9E+00					1.5E-02
LEAD	N/A	N/A						N/A				N/A
NICKEL	1.7E-02							1.7E-02				4.8E-05
SILVER	1.7E-03		1.7E-03									3.5E-06
THALLIUM	2.1E+00		2.1E+00	2.1E+00		2.1E+00		2.1E+00				1.7E-02
VANADIUM	2.1E-01											8.7E-03
ZINC	4.1E-02	4.1E-02										6.8E-05
	HI BY TARGET ORGAN	2.9E-01	3.4E+00	3.5E+00	3.9E-03	4.0E+00	1.9E+00	2.1E+00	9.8E-05	9.8E-05	4.4E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-13a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN										
SUBSTANCE	GROUNDWATER INGESTION	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM	GROUNDWATER DERMAL CONTACT
1,1,1-TRICHLOROETHANE	3.3E-04											2.0E-05
1,2-DICHLOROETHENE (TOTAL)	4.2E-03	4.2E-03				4.2E-03						5.6E-05
4,4'-DDT	5.5E-04					5.5E-04						2.4E-03
4-METHYLPHENOL	2.4E-03			2.4E-03	2.4E-03	2.4E-03		2.4E-03				5.8E-05
CARBON DISULFIDE	6.0E-05	6.0E-05	6.0E-05	6.0E-05		6.0E-05		6.0E-05	6.0E-05	6.0E-05	6.0E-05	3.4E-06
DIELDRIN	2.6E-03					2.6E-03		2.6E-03			2.6E-03	8.2E-04
ENDOSULFAN I	2.7E-05	2.7E-05		2.7E-05								3.3E-06
HEPTACHLOR	1.3E-04					1.3E-04						3.4E-05
VINYL CHLORIDE	N/A					N/A		N/A				N/A
ALUMINUM	5.2E-02											6.1E-04
ANTIMONY	4.5E-02	4.5E-02										5.3E-04
ARSENIC	3.0E-01		3.0E-01									1.9E-04
BERYLLIUM	1.0E-03											6.1E-05
CADMIUM	4.9E-01			4.9E-01								2.9E-03
CHROMIUM	2.1E-01			2.1E-01								6.2E-03
IRON	6.6E-01					6.6E-01	6.6E-01					7.7E-03
LEAD	N/A	N/A						N/A				N/A
NICKEL	4.5E-03							4.5E-03				1.7E-05
SILVER	1.1E-03		1.1E-03									3.1E-06
THALLIUM	1.3E+00		1.3E+00	1.3E+00		1.3E+00		1.3E+00				1.5E-02
VANADIUM	7.7E-02											4.5E-03
ZINC	2.5E-02	2.5E-02										5.9E-05
	HI BY TARGET ORGAN	7.5E-02	1.6E+00	2.0E+00	2.4E-03	2.0E+00	6.6E-01	1.3E+00	6.0E-05	6.0E-05	2.7E-03	

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

15.7.1.2 Future Residential Receptor

The conservative preliminary baseline risk assessment yielded estimated total cancer risks greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in groundwater at Site 13. In addition, this risk assessment yielded estimated noncarcinogenic HIs with values greater than 1.0 for the future child resident for exposures to groundwater. (Ingestion exposures contributed to the significant portion of cancer and non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. The amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 15.7.1.5 and presented in Tables 15-14, 15-14a, 15-15, and 15-15a, respectively.

15.7.1.3 Future Recreational Receptor

The estimated total RME cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 13 are 5.2E-07 (ingestion) and 1.8E-07 (dermal contact). The RME cancer risks for exposure to COPCs in surface water during wading at Site 13 are 1.3E-08 (ingestion) and 6.1E-08 (dermal contact). This sediment and surface water cancer risk are below the 1E-04 to 1E-06 target acceptable risk range.

The estimated RME HIs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 13 are less than 1.0 for ingestion and dermal contact exposure pathways. The estimated RME HIs for the future recreational child assuming exposure to COPCs in surface water during wading at Site 13 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic effects are not expected because the sum of these HIs is below 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to sediment at Site 13 in Tables 15-16 and 15-17, respectively. Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to surface water at Site 13 in Tables 15-18 and 15-19, respectively.

15.7.1.4 Lead Results

Lead was found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken during the 1995 RI. Lead was not found at levels in excess of the screening value for soils (400 mg/kg) in previous sampling events.

TABLE 15-14
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,1,1-TRICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
4,4'-DDT	2.6E-07	6.0E-06	4.7E-07
4-METHYLPHENOL	N/A	N/A	N/A
CARBON DISULFIDE	N/A	N/A	N/A
DIELDRIN	5.2E-06	8.5E-06	9.6E-06
ENDOSULFAN I	N/A	N/A	N/A
HEPTACHLOR	7.4E-07	1.0E-06	4.6E-07
VINYL CHLORIDE	2.7E-04	1.1E-05	5.7E-05
ALUMINUM	N/A	N/A	N/A
ANTIMONY	N/A	N/A	N/A
ARSENIC	8.7E-04	2.1E-06	N/A
BERYLLIUM	1.0E-04	2.3E-05	N/A
CADMIUM	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
THALLIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	1.3E-03	5.1E-05	6.7E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-14a
CENTRAL TENDENCY CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	GROUNDWATER INGESTION - LIFETIME	GROUNDWATER DERMAL CONTACT - LIFETIME	INHALATION OF VOAS IN GW - ADULT
1,1,1-TRICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOROETHENE (TOTAL)	N/A	N/A	N/A
4,4'-DDT	3.3E-08	8.6E-07	2.4E-08
4-METHYLPHENOL	N/A	N/A	N/A
CARBON DISULFIDE	N/A	N/A	N/A
DIELDRIN	7.5E-07	1.4E-06	5.5E-07
ENDOSULFAN I	N/A	N/A	N/A
HEPTACHLOR	1.1E-07	1.6E-07	2.7E-08
VINYL CHLORIDE	3.9E-05	1.7E-06	3.2E-06
ALUMINUM	N/A	N/A	N/A
ANTIMONY	N/A	N/A	N/A
ARSENIC	4.9E-05	1.1E-07	N/A
BERYLLIUM	7.9E-06	1.7E-06	N/A
CADMIUM	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
IRON	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
SILVER	N/A	N/A	N/A
THALLIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	9.7E-05	5.9E-06	3.8E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-15
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM
1,1,1-TRICHLOROETHANE	3.6E-03										
1,2-DICHLOROETHENE (TOTAL)	4.5E-02	4.5E-02				4.5E-02					
4,4'-DDT	6.5E-03					6.5E-03					
4-METHYLPHENOL	2.6E-02			2.6E-02	2.6E-02	2.6E-02		2.6E-02			
CARBON DISULFIDE	6.4E-04	6.4E-04	6.4E-04	6.4E-04		6.4E-04		6.4E-04	6.4E-04	6.4E-04	6.4E-04
DIELDRIN	2.8E-02					2.8E-02		2.8E-02			2.8E-02
ENDOSULFAN I	2.9E-04	2.9E-04		2.9E-04							
HEPTACHLOR	1.4E-03					1.4E-03					
VINYL CHLORIDE	N/A					N/A		N/A			
ALUMINUM	1.0E+00										
ANTIMONY	1.6E+00	1.6E+00									
ARSENIC	8.4E+00		8.4E+00								
BERYLLIUM	2.0E-02										
CADMIUM	5.2E+00			5.2E+00							
CHROMIUM	3.8E+00			3.8E+00							
IRON	1.2E+01					1.2E+01	1.2E+01				
LEAD	N/A	N/A						N/A			
NICKEL	1.1E-01							1.1E-01			
SILVER	1.1E-02		1.1E-02								
THALLIUM	1.4E+01		1.4E+01	1.4E+01		1.4E+01		1.4E+01			
VANADIUM	1.4E+00										
ZINC	2.7E-01	2.7E-01									
	HI BY TARGET ORGAN	1.9E+00	2.2E+01	2.3E+01	2.6E-02	2.6E+01	1.2E+01	1.4E+01	6.4E-04	6.4E-04	2.9E-02

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-15
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER DERMAL CONTACT BY TARGET ORGAN										
SUBSTANCE	GROUNDWATER DERMAL CONTACT - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM	INHALATION OF VOAS IN GW - ADULT
1,1,1-TRICHLOROETHANE	8.6E-04											7.5E-04
1,2-DICHLOROETHENE (TOTAL)	2.5E-03	2.5E-03				2.5E-03						N/A
4,4'-DDT	1.2E-01					1.2E-01						N/A
4-METHYLPHENOL	2.5E-03			2.5E-03	2.5E-03	2.5E-03		2.5E-03				N/A
CARBON DISULFIDE	1.5E-04	1.5E-04	1.5E-04	1.5E-04		1.5E-04		1.5E-04	1.5E-04	1.5E-04	1.5E-04	2.6E-04
DIELDRIN	3.6E-02					3.6E-02		3.6E-02			3.6E-02	N/A
ENDOSULFAN I	1.4E-04	1.4E-04		1.4E-04								N/A
HEPTACHLOR	1.5E-03					1.5E-03						N/A
VINYL CHLORIDE	N/A					N/A		N/A				N/A
ALUMINUM	3.9E-02											N/A
ANTIMONY	6.0E-02	6.0E-02	6.0E-02									N/A
ARSENIC	1.7E-02		1.7E-02									N/A
BERYLLIUM	4.0E-03											N/A
CADMIUM	1.0E-01			1.0E-01								N/A
CHROMIUM	3.7E-01		3.7E-01	3.7E-01								N/A
IRON	4.8E-01					4.8E-01	4.8E-01					N/A
LEAD	N/A	N/A						N/A				N/A
NICKEL	1.5E-03							1.5E-03				N/A
SILVER	1.1E-04		1.1E-04									N/A
THALLIUM	5.3E-01		5.3E-01	5.3E-01		5.3E-01		5.3E-01				N/A
VANADIUM	2.7E-01											N/A
ZINC	2.1E-03	2.1E-03										N/A
	HI BY TARGET ORGAN	6.5E-02	9.8E-01	1.0E+00	2.5E-03	1.2E+00	4.8E-01	5.7E-01	1.5E-04	1.5E-04	3.6E-02	

N/A = NOT APPLICABLE, NO T N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-15a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER INGESTION BY TARGET ORGAN									
SUBSTANCE	GROUNDWATER INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM
1,1,1-TRICHLOROETHANE	1.7E-03										
1,2-DICHLOROETHENE (TOTAL)	2.1E-02	2.1E-02				2.1E-02					
4,4'-DDT	2.8E-03					2.8E-03					
4-METHYLPHENOL	1.2E-02			1.2E-02	1.2E-02	1.2E-02		1.2E-02			
CARBON DISULFIDE	3.0E-04	3.0E-04	3.0E-04	3.0E-04		3.0E-04		3.0E-04	3.0E-04	3.0E-04	3.0E-04
DIELDRIN	1.3E-02					1.3E-02		1.3E-02			1.3E-02
ENDOSULFAN I	1.3E-04	1.3E-04		1.3E-04							
HEPTACHLOR	6.6E-04					6.6E-04					
VINYL CHLORIDE	N/A					N/A		N/A			
ALUMINUM	2.6E-01										
ANTIMONY	2.3E-01	2.3E-01									
ARSENIC	1.5E+00		1.5E+00								
BERYLLIUM	5.2E-03										
CADMIUM	2.4E+00			2.4E+00							
CHROMIUM	1.1E+00			1.1E+00							
IRON	3.3E+00					3.3E+00	3.3E+00				
LEAD	N/A	N/A						N/A			
NICKEL	2.2E-02							2.2E-02			
SILVER	5.3E-03		5.3E-03								
THALLIUM	6.4E+00		6.4E+00	6.4E+00		6.4E+00		6.4E+00			
VANADIUM	3.8E-01										
ZINC	1.3E-01	1.3E-01									
	HI BY TARGET ORGAN	3.7E-01	7.9E+00	9.9E+00	1.2E-02	9.7E+00	3.3E+00	6.4E+00	3.0E-04	3.0E-04	1.3E-02

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-15a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 13
GROUNDWATER, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		GROUNDWATER DERMAL CONTACT BY TARGET ORGAN										
SUBSTANCE	GROUNDWATER DERMAL CONTACT - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	RESPIRA-TORY SYSTEM	LIVER	DIGESTIVE SYSTEM	CENTRAL NERVOUS SYSTEM	PERIPHERAL NERVOUS SYSTEM	EYES	REPRO-DUCTIVE SYSTEM	INHALATION OF VOAS IN GW - ADULT
1,1,1-TRICHLOROETHANE	5.7E-04											1.5E-04
1,2-DICHLOROETHENE (TOTAL)	1.6E-03	1.6E-03				1.6E-03						N/A
4,4'-DDT	7.2E-02					7.2E-02						N/A
4-METHYLPHENOL	1.7E-03			1.7E-03	1.7E-03	1.7E-03		1.7E-03				N/A
CARBON DISULFIDE	1.0E-04	1.0E-04	1.0E-04	1.0E-04		1.0E-04		1.0E-04	1.0E-04	1.0E-04	1.0E-04	5.1E-05
DIELDRIN	2.4E-02					2.4E-02		2.4E-02			2.4E-02	N/A
ENDOSULFAN I	9.6E-05	9.6E-05		9.6E-05								N/A
HEPTACHLOR	1.0E-03					1.0E-03						N/A
VINYL CHLORIDE	N/A					N/A		N/A				N/A
ALUMINUM	1.4E-02											N/A
ANTIMONY	1.3E-02	1.3E-02	1.3E-02									N/A
ARSENIC	4.4E-03		4.4E-03									N/A
BERYLLIUM	1.4E-03											N/A
CADMIUM	6.8E-02			6.8E-02								N/A
CHROMIUM	1.5E-01		1.5E-01	1.5E-01								N/A
IRON	1.8E-01					1.8E-01	1.8E-01					N/A
LEAD	N/A	N/A						N/A				N/A
NICKEL	4.1E-04							4.1E-04				N/A
SILVER	7.3E-05		7.3E-05									N/A
THALLIUM	3.6E-01		3.6E-01	3.6E-01		3.6E-01		3.6E-01				N/A
VANADIUM	1.1E-01											N/A
ZINC	1.4E-03	1.4E-03										N/A
	HI BY TARGET ORGAN	1.6E-02	5.2E-01	5.7E-01	1.7E-03	6.4E-01	1.8E-01	3.8E-01	1.0E-04	1.0E-04	2.4E-02	

N/A = NOT APPLICABLE, NO T N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 15-16
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 13
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDE	9.1E-12	2.3E-12
4,4'-DDT	2.4E-11	5.9E-12
ALPHA-CHLORDANE	2.8E-10	7.1E-11
AROCLOR-1254	3.3E-07	9.2E-08
AROCLOR-1260	1.0E-07	2.8E-08
BENZO(B)FLUORANTHENE	3.8E-10	*
CHRYSENE	4.5E-12	*
DIETHYLPHTHALATE	N/A	N/A
ENDOSULFAN SULFATE	N/A	N/A
ENDRIN ALDEHYDE	N/A	N/A
FLUORANTHENE	N/A	N/A
GAMMA-CHLORDANE	2.3E-12	5.6E-13
PYRENE	N/A	N/A
ANTIMONY	N/A	N/A
ARSENIC	6.9E-08	2.9E-09
BERYLLIUM	1.5E-08	6.0E-08
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
SILVER	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	5.2E-07	1.8E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 15-17
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 13
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDE	NA	NA
4,4'-DDT	1.6E-06	4.1E-07
ALPHA-CHLORDANE	4.3E-05	1.1E-05
AROCLOR-1254	2.5E-02	7.0E-03
AROCLOR-1260	NA	NA
BENZO(B)FLUORANTHENE	NA	NA
CHRYSENE	NA	NA
DIETHYLPHTHALATE	8.2E-09	3.2E-09
ENDOSULFAN SULFATE	NA	NA
ENDRIN ALDEHYDE	NA	NA
FLUORANTHENE	2.6E-07	1.0E-07
GAMMA-CHLORDANE	3.4E-07	8.4E-08
PYRENE	2.9E-07	1.1E-07
ANTIMONY	8.0E-04	6.3E-04
ARSENIC	1.8E-03	7.5E-05
BERYLLIUM	8.2E-06	3.2E-05
CADMIUM	1.2E-04	9.5E-05
CHROMIUM	1.9E-03	3.7E-03
COPPER	1.0E-04	6.9E-06
IRON	3.9E-03	3.1E-03
LEAD	NA	NA
MANGANESE	5.6E-04	7.4E-04
MERCURY	8.1E-05	4.6E-05
SILVER	5.8E-04	1.1E-04
ZINC	2.3E-05	3.7E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE ESTABLISHED FOR THIS CHEMICAL

TABLE 15-18
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 13
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALUMINUM	N/A	N/A
BERYLLIUM	1.3E-08	6.1E-08
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COBALT	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
NICKEL	N/A	N/A
SILVER	N/A	N/A
TOTAL RISK	1.3E-08	6.1E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE IS ESTABLISHED FOR THIS CHEMICAL

TABLE 15-19
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 13
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
ALUMINUM	1.2E-04	1.1E-04
BERYLLIUM	7.2E-06	3.3E-05
CADMIUM	1.4E-04	1.3E-04
CHROMIUM	2.8E-04	6.5E-04
COBALT	5.4E-06	5.1E-06
IRON	7.2E-04	6.7E-04
LEAD	N/A	N/A
NICKEL	5.7E-05	3.8E-05
SILVER	3.6E-05	8.3E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE IS ESTABLISHED FOR THIS CHEMICAL

The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 13 exposures are presented in Appendix I.

15.7.1.5 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 13 for future industrial and future residential receptors assuming exposure to COPCs in groundwater.

Comparison to Background

Barium, copper, and mercury were eliminated from consideration as groundwater COPCs based on a comparison of average levels to twice the background level. Table 15-6 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Consideration of Modified Dermal Absorption and Target Organ Grouping

As discussed in Section 2.4.6.2, groundwater cancer and noncancer risks were recalculated using a modified gastrointestinal absorption factor for one chemical. After these steps, the final RME cancer risks are still above the 1E-04 to 1E-06 target acceptable range for the future residential receptor (1.4E-03, via groundwater ingestion) and the future industrial receptor (3.0E-04, also via groundwater ingestion). For the future residential receptor, the principal COPCs contributing to these groundwater RME cancer risks are arsenic (ingestion; 67 percent of the cancer risk for this pathway), vinyl chloride (ingestion; 21 percent of the cancer risk for this pathway), and beryllium (ingestion; 8 percent of the cancer risk for this pathway). As stated in the groundwater discussion for the Nature and Extent section, the calculated cancer risk may not be representative of dissolved-phase metals contamination receptor impacts because of use of unfiltered sample results.

The revised HIs are greater than 1.0 for exposure to groundwater by future residential and future industrial receptors; therefore, these risks were grouped according to target organ. The resulting final RME HIs are greater than 1.0 in several cases for the future industrial receptor and the future residential child. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: liver (26 - thallium and iron), kidney (23 - thallium, chromium, and cadmium), skin (22 - thallium and arsenic), central nervous system (14 - thallium), and digestive system (12 - iron). For groundwater dermal contact by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: liver (1.2 - thallium and iron), and kidney (1.0 -

thallium and chromium). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. As noted in the groundwater discussion for Nature and Extent, the estimated HQs may not be representative of dissolved phase metals contamination receptor impacts because only unfiltered sampling results were used to calculate HQs.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future industrial employees exposed to groundwater in Tables 15-12 and 15-13, respectively. Estimated RME carcinogenic risks and noncarcinogenic HQs are presented for future residential receptors exposed to groundwater in Tables 15-14 and 15-15, respectively.

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate groundwater cancer and non-cancer risks for exposure to COPCs in groundwater for future residential and future industrial receptors. 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. Based on this evaluation, the estimated total central tendency cancer risks are within the mid-range of the target acceptable risk range for the future industrial employee and approximately 1E-04 for the future residential receptor. Ingestion exposures contributed the major portion of these cancer risks.

Central tendency noncarcinogenic HIs for groundwater were greater than 1.0 for the future industrial employee and the future residential child. For groundwater ingestion by the future residential child, the target organs, corresponding RME HIs, and associated principal COPCs are as follows: kidney (9.9 - thallium, chromium, and cadmium), liver (9.7 - thallium and iron), skin (7.9 - thallium and arsenic), central nervous system (6.4 - thallium), and digestive system (3.3 - iron). For the future industrial employee, target organs were the kidney (HI of 2.0), liver (HI of 2.0), skin (HI of 1.6), and digestive system (HI of 1.3). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated central tendency carcinogenic risks are presented for exposure to groundwater for future industrial receptors in Table 5-12a and for future residential receptors in Table 5-14a. Estimated central tendency noncarcinogenic risks are presented for future industrial receptors in Table 5-13a and for the future residential child in Table 5-15a.

15.7.2 Conclusions

Sediment, groundwater, and surface water were sampled at Site 13. The potential receptors for this site were future industrial, residential, and recreational receptors. The RME cancer risks for groundwater ingestion for the future industrial and future residential exposure scenarios exceeded 1E-04; the upper end of the target risk range. Arsenic, vinyl chloride, and beryllium (via ingestion of groundwater) were the major COPCs that contributed to the cancer risk for these exposure scenarios. Howver, these RME estimates of cancer risk from exposure to groundwater are probably overconservative because associated central tendency cancer risks are less than 1E-04 for the future industrial receptor and approximately 1E-04 for residential exposure to groundwater.

RME estimates for noncarcinogenic HIs associated with future industrial and future residential (groundwater) exposure scenarios exceeded 1.0; the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Thallium, iron, and chromium (via ingestion of and dermal contact with groundwater) and arsenic and cadmium (via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for these exposure scenarios. Central tendency risk estimates for future industrial and future residential receptors also yielded HIs greater than 1.0 for groundwater ingestion (although dermal contact HIs were below the level of concern).

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

The amended risk assessment procedure did not result in the elimination of all cancer or non-cancer risks above guideline limits. However, the estimated risks may not be representative of dissolved phase metals contamination receptor impacts because only unfiltered sampling results were used to calculate risks.

Risk characterization results (total RME cancer risks and total RME noncarcinogenic HIs) are presented for all potential receptors at Site 13 in Table 15-20 for sediment, groundwater, and surface water. Table 15-20a presents the relevant central tendency risk estimates associated with potential receptors for groundwater.

TABLE 15-20
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 13
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	5.2E-07	N/A	N/A	N/A	N/A	3.5E-02
	Dermal Contact	N/A	N/A	N/A	1.8E-07	N/A	N/A	N/A	N/A	1.6E-02
Groundwater	Ingestion	N/A	3.0E-04^	1.3E-03^	N/A	N/A	4.0E+00@	2.6E+01@	N/A	N/A
	Dermal Contact	N/A	1.9E-06^	5.1E-05^	N/A	N/A	6.5E-02^	1.2E+00@	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	6.7E-05^	N/A	N/A	N/A	N/A	1.0E-03^	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	1.3E-08	N/A	N/A	N/A	N/A	1.4E-03
	Dermal Contact	N/A	N/A	N/A	6.1E-08	N/A	N/A	N/A	N/A	1.7E-03
TOTAL		-	3.0E-04	1.4E-03	7.7E-07	-	4.1E+00	2.7E+01	1.0E-03	5.3E-02

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.

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TABLE 15-20a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 13
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	1.7E-05^	9.7E-05^	N/A	N/A	2.0E+00@	9.9E+00@	N/A	N/A
	Dermal Contact	N/A	2.2E-07^	5.9E-06^	N/A	N/A	4.1E-02^	6.4E-01@	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.8E-06^	N/A	N/A	N/A	N/A	N/R	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		-	1.7E-05	1.1E-04	-	-	2.0E+00	1.1E+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.

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15.8 ECOLOGICAL RISK ASSESSMENT

15.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Most of the former landfill is covered by grasses and bare areas with exposed landfill debris. Several abandoned automobiles and various other equipment and machinery are stored on the southern portion of the landfill, inside the fenced area. A large railroad bed and Normandy Road are located east of the site. A channelized stream runs along the western boundary of the fenced area between the road and the fence, and drainage flows to the north. This drainageway eventually empties into Hockhockson Brook approximately 2,500 feet north of the site. Another branch of Hockhockson Brook is located approximately 800 feet east of the site. Thus, the site is located within the Hockhockson Brook watershed. Forested wetland areas are located to the north and west of the landfill, and are dominated by Atlantic white cedar, black gum, and red maple. The forested wetlands are a few feet lower in elevation than the landfill; the edge of the landfill slopes down into the forested area, and runoff from the landfill flows into the forested area and stream. Standing water in the wetlands is ephemeral and is present only after periods of heavy rainfall. As a result, an aquatic community is not present in these areas, except where the channelized stream runs through the forested area. Assorted debris is also present in the forested area adjacent to the landfill. RI site 11 is located 1,000 feet west of the site, and several other RI sites are located in an area between 2,000 and 3,000 feet southwest of Site 13.

The landfill provides marginal habitat, while the forested wetland areas to the north and west provide excellent habitat, primarily for terrestrial receptors. Most mammals found in the Mainside area, such as white-tailed deer, gray fox, and small mammals, and most species of birds found on the base that are attracted to forested areas are expected to utilize the forested wetlands. The stream is small and provides marginal habitat, although some small fish and amphibians may use the waterway. No sensitive habitats, other than the wetlands, and no threatened or endangered species are known to occur in the area.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major contaminant release pathways from the landfill are overland runoff and infiltration of contaminants. Overland runoff from precipitation may carry constituents to nearby surface waters, sediments, and soils, particularly to the channelized stream and forested area. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water in the forested wetlands and stream;

contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic and semi-aquatic organisms.

Exposure Routes

Terrestrial receptors at Site 13 may be exposed to surface soil contaminants via incidental ingestion of soil or by ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants in Site 13 surface water by drinking it, although this pathway is generally insignificant. Terrestrial vegetation may also be exposed to contaminants in soils at Site 13. However, since the wetlands provide substantially more habitat, and since habitat on the landfill is relatively poor, exposure routes of main concern are aquatic and semi-aquatic. As a result, assessment of potential risks to terrestrial receptors on the landfill was not applicable. Aquatic and terrestrial organisms inhabiting the nearby wetlands and stream may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1995 RI activities for this site. In particular, contaminants detected in Site 13 surface water and sediments were considered preliminary COPCs. Contaminants detected in surface water, sediment, and soil samples taken as part of the SI, and in groundwater samples taken as part of the 1995 RI, were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

15.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminated surface water and sediments. Surface water and sediment ET values are presented in Tables 2-26 and 2-27, respectively.

15.8.3 Preliminary Exposure Assessment

Contaminant concentrations in surface water and sediment used for this initial screening were obtained from data generated during initial RI activities. Data collected during the summer and fall of 1995 for surface water and sediment were evaluated. The maximum detected contaminant concentrations in surface water and sediment were used as conservative representative exposure point concentrations. Data from SI surface water, sediment, and surface soil samples, and from 1995 RI groundwater samples, are assessed qualitatively in Section 15.8.5. Background concentrations presented for comparative purposes were obtained from facility-wide background samples. Section 2.4.1.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

15.8.4 Risk Characterization

In Site 13 surface waters, aluminum (HQ = 10.7), barium (HQ = 7.29), chromium (HQ = 1.10), and silver (HQ = 140) exceeded ET values and were retained as final COPCs (Table 15-21). No organics were detected in Site 13 surface water. For inorganics in sediments, antimony (HQ = 1.25) exceeded the only ET value available and was retained as a final COPCs (Table 15-22). Silver exceeded both most and less conservative ET values. Lead and mercury exceeded less conservative ETs and were retained as final COPCs, but did not exceed less conservative ET values. Aluminum, beryllium and vanadium were conservatively retained as final COPCs since no suitable ETs were available. For organics in Site 13 sediments, 4,4'-DDE and 4,4'-DDT exceeded most conservative ET values and were retained as final COPCs, but did not exceed less conservative values. PCB (Aroclor 1254 and Aroclor 1260) exceeded most and less conservative ETs. Two organochlorine pesticides, alpha-chlordane (HQ = 2.86) and endrin aldehyde (HQ = 4.5) also exceeded the only ET values available.

The toxicological properties of final COPCs in surface water and sediment are summarized in Appendix M.

TABLE 15-21
SURFACE WATER CONTAMINANTS OF POTENTIAL CONCERN - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (µg/L)	Maximum Concentration (µg/L)	Ecotox Threshold (µg/L)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	1/1	409	932	87	10.7	Retained-HQ > 1
Barium	1/1	34	28.45	3.9	7.29	Retained-HQ > 1
Beryllium	1/1	0.33	0.28	5.1	0.05	Eliminated-Does not exceed threshold
Cadmium	1/1	0.18	0.56	1	0.56	Eliminated-Does not exceed threshold
Chromium	1/1	2.6	11	10	1.1	Retained-HQ > 1
Cobalt	1/1	1.9	2.55	3	0.85	Eliminated-Does not exceed threshold
Copper	1/1	9.8	1.2	11	0.11	Eliminated-Does not exceed threshold
Lead	1/1	4.4	1.85	2.5	0.74	Eliminated-Does not exceed threshold
Manganese	1/1	55.5	41.3	80	0.52	Eliminated-Does not exceed threshold
Nickel	1/1	7.1	8.95	160	0.06	Eliminated-Does not exceed threshold
Silver	1/1	0.86	1.4	0.01	140	Retained-HQ > 1
Vanadium	1/1	0.9	0.41	19	0.02	Eliminated-Does not exceed threshold

TABLE 15-22
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 13
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Inorganics						
Aluminum	3/3	3940	2170	NA		Retained-No suitable threshold available
Antimony	2/3	ND	2.5	2.0	1.25	Retained-HQ > 1
Arsenic	3/3	6.2	4.2	8.2	0.51	Eliminated-Does not exceed threshold
Barium	3/3	10.6	9.3	40	0.23	Eliminated-Does not exceed threshold
Beryllium	2/3	0.57	0.32	NA		Retained-No suitable threshold available
Cadmium	2/3	ND	0.47	1.2	0.39	Eliminated-Does not exceed threshold
Chromium	3/3	56	72.5	81	0.90	Eliminated-Does not exceed threshold
Cobalt	2/3	2.1	0.57	50	0.01	Eliminated-Does not exceed threshold
Copper	3/3	13	32.7	34	0.96	Eliminated-Does not exceed threshold
Lead	3/3	34.3	94.3	47/218	2.01/0.43	Retained-HQ > 1
Manganese	3/3	9.2	21.9	460	0.05	Eliminated-Does not exceed threshold
Mercury	3/3	0.068	0.19	0.15/0.71	1.27/0.27	Retained-HQ > 1
Nickel	2/3	6	3	21	0.14	Eliminated-Does not exceed threshold
Silver	2/3	ND	22.7	1/3.7	22.7/6.14	Retained-HQ > 1
Vanadium	3/3	42.7	37.9	NA		Retained-No suitable threshold available
Zinc	3/3	26.9	54.7	150	0.36	Eliminated-Does not exceed threshold
Organics[3]						
4,4'-DDE	1/3	1.7	2.45 ug/kg	2.2/27	1.11/0.09	Retained-HQ > 1
4,4'-DDT	1/3	19	6.4	1.6/46	4.0/0.14	Retained-HQ > 1
Alpha-Chlordane	2/3	ND	20	7	2.86	Retained-HQ > 1
Aroclor 1254	3/3	ND	3900 ug/kg	22.7/180	171.8/21.7	Retained-HQ > 1
Aroclor 1260	2/3	ND	1200 ug/kg	22.7/180	52.9/6.7	Retained-HQ > 1
Benzo(b)fluoranthene	1/1	490	48	330/1700	0.15/0.03	Eliminated-Does not exceed threshold
Chrysene	1/1	940	56	330/2800	0.17/0.02	Eliminated-Does not exceed threshold
Diethylphthalate	1/1	44	51	630	0.08	Eliminated-Does not exceed threshold
Endosulfan Sulfate	1/3	ND	0.3	5.4	0.06	Eliminated-Does not exceed threshold
Endrin aldehyde	2/3	ND	90	20	4.50	Retained-HQ > 1
Fluoranthene	1/1	1800	81	2900	0.03	Eliminated-Does not exceed threshold
Gamma-Chlordane	1/3	0.095	0.16	7	0.02	Eliminated-Does not exceed threshold
Pyrene	1/1	1900	67.5	660/2600	0.10/0.03	Eliminated-Does not exceed threshold

ND = None detected
NA = No suitable threshold was available
1 When two values are presented, the left value is the most conservative available and the right value is a less conservative value, if available. In these instances, two HQ values are presented.
2 Contaminants were retained as final COPCs if the most conservative ET value available was exceeded.
3 All organic values are in μg/kg.

15.8.5 Summary and Conclusions

Although habitat on the landfill is limited, the forested wetland areas north and west of the landfill provide excellent habitat, primarily for terrestrial receptors. The channelized stream contains marginal aquatic habitat, although it connects with Hockhockson Brook several hundred feet north of the site. Runoff from the landfill drains to the wetlands and stream, and groundwater at the site flows toward the stream and wetlands, indicating potential groundwater to surface water contaminant migration.

Surface water, sediment, and surface soil samples were taken as part of SI activities at Site 13. Low levels of several metals were detected in surface water, and no organics were detected. In sediments, SVOCs were detected (including low levels of phenanthrene, pyrene, and one phthalate). In addition, PCBs and one pesticide, 4,4'-DDE, were detected at low concentrations. In SI surface soil samples taken on the landfill, several PAHs were detected in low concentrations, some pesticides were detected in low concentrations, and some elevated metals concentrations were present. RI groundwater samples taken in 1995 indicated the presence of elevated concentrations of several inorganics and low levels of several organics, including some pesticides. No PCBs were detected in groundwater.

One surface water and three sediment samples were taken in the drainage ditch and forested wetlands as part of 1995 RI activities to investigate off-site migration, and were used for quantitative assessment. HQ values for inorganics in surface water were indicative of low potential risk, with the exception of silver, which had a relatively high HQ. Nonetheless, silver was only detected slightly above background, and the elevated HQ may be due to the only ET available for this inorganic, which may be excessively conservative. No organics were detected in the surface water sample. HQ values for inorganics in sediments were indicative of low potential risk, with the exception of silver, which slightly exceeded a less conservative ET value. Aluminum and vanadium were conservatively retained as final COPCs since no suitable ET values were available, but were less than background. HQs for organics were indicative of low potential risk, with the exception of the two PCB compounds detected, Aroclor 1254 and 1260. Both these mixtures exceeded less conservative ET values.

In summary, HQ values for metals in both surface water and sediment were indicative of low potential risk, with the exception of silver in both media. No organics were detected in surface waters and HQs for organics in sediments were indicative of low potential risk, except for PCBs. Silver was not detected in SI surface water samples. PCBs were detected in low levels in SI sediment samples, but silver was not analyzed for. Slightly elevated levels of silver were detected in three of six SI surface soil samples taken on the landfill, though this inorganic was detected in only one 1995 RI groundwater sample. In addition, low levels of PCBs were detected in five of six SI surface soils samples, but were not detected in RI groundwater samples. For these reasons, overland runoff appears to be the dominant migration pathway to the wetlands and stream. However, a Hockhockson Brook watershed surface water and sediment sample (WSSW/SD14) was taken north of Site 13 as part of 1995 RI activities. Silver was only detected

slightly above background in the surface water sample and was not detected in sediments. PCBs were not analyzed for in those samples. These compounds are highly lipophilic and tend to bioaccumulate and biomagnify. Nonetheless, all PCB congeners have strong affinities for organic carbon in surface soils and sediments, and do not migrate significantly. Both of the PCB compounds detected are characterized by higher-chlorinated PCB congeners, which have a greater affinity for organic carbon than lower-chlorinated PCB congeners. As a result, downstream migration of PCBs into Hockhockson Brook is highly unlikely. Although silver and two Aroclors may pose moderate potential risk to aquatic and semi-aquatic receptors near the landfill, aquatic habitat is limited in the area since the channelized stream is small and the wetlands are forested with ephemeral standing water. In addition, it does not appear that silver is migrating or PCBs have the potential to migrate to better habitats downstream in Hockhockson Brook. Additional sediment samples taken further downstream may further delineate the extent of potential downstream migration of silver and PCBs. However, no evidence suggests that downstream migration has occurred, and thus, these additional samples do not appear to be necessary. Some of the exposed debris on the landfill could be removed and additional soil could be placed on the bare areas on the landfill to promote plant growth and ecological succession.

15.9 EVALUATION AND RECOMMENDATIONS

15.9.1 Evaluation Summary

Metals in groundwater at levels above regulatory guidelines included aluminum, antimony, arsenic, cadmium, chromium, iron, lead, manganese and thallium. Final sample turbidities from well sampling were high , resulting in exaggerated metals results in groundwater samples.

Organic compounds found in groundwater at concentrations above regulatory guidelines include vinyl chloride, DDE and DDE.

Test pits confirmed the presence of waste in the southern extent of the site as delineated in Figure 15-1.

Results of human health risk assessment concluded that calculated cancer and non-cancer risks were above guideline limits for dermal absorption and ingestion of groundwater.

Ecological risk assessment concluded that no evidence suggests that downstream migration of PCBs and silver has occurred, and that additional sampling does not appear to be necessary. Sampling to date has been exhaustive, so it is a matter for discussion whether additional ecological risk oriented sampling should be carried out.

Concentrations of metals found in site surface soils were generally in the range of background.

The material in the landfill is not well covered. Material is protruding from the toe and at the surface.

15.9.2 Recommendations

Materials protruding from the landfill should be removed or covered. Structural fill could be placed if the area would be useful as a transient storage yard, or clean fill could be used as a basis for reforestation. Run-off control should also be evaluated.

EPA guidance "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 the disposition of this site.

Considering the presence of metals and organics in groundwater the establishment of a CEA according to State regulations may need to be considered. This would include future monitoring of groundwater quality.

16.0 SITE 14 - MERCURY SPILL

16.1 SITE BACKGROUND AND PHYSICAL SETTING

The Defense Property Disposal Office Warehouse, Building C-33, is a 16,000-square-foot storage building for items awaiting processing. On-site interviews indicated that a small amount of mercury (reportedly ranging in size from one to several ounces) was spilled inside the warehouse in 1970 (IAS, 1983). The location of the spill was not documented. However, on-site interviews confirmed that the spill was inside the building and that the mercury was removed by vacuuming.

The warehouse has solid concrete floors that would prevent the mercury spill from affecting the soil below the building. The floors of the warehouse have been coated with a concrete protective material since the spill, and it is unlikely that any residue from the spill remains. Materials are stored in a protected manner; thus, the likelihood of environmental contamination is low.

16.2 PREVIOUS INVESTIGATIONS

The IAS (1983) consisting of interviews, concluded minimal impact because clean-up action was taken at the time of the spill.

No sampling was conducted within the Defense Property Disposal Warehouse during the SI because the location of the spill was not documented and the impact was judged to be minimal.

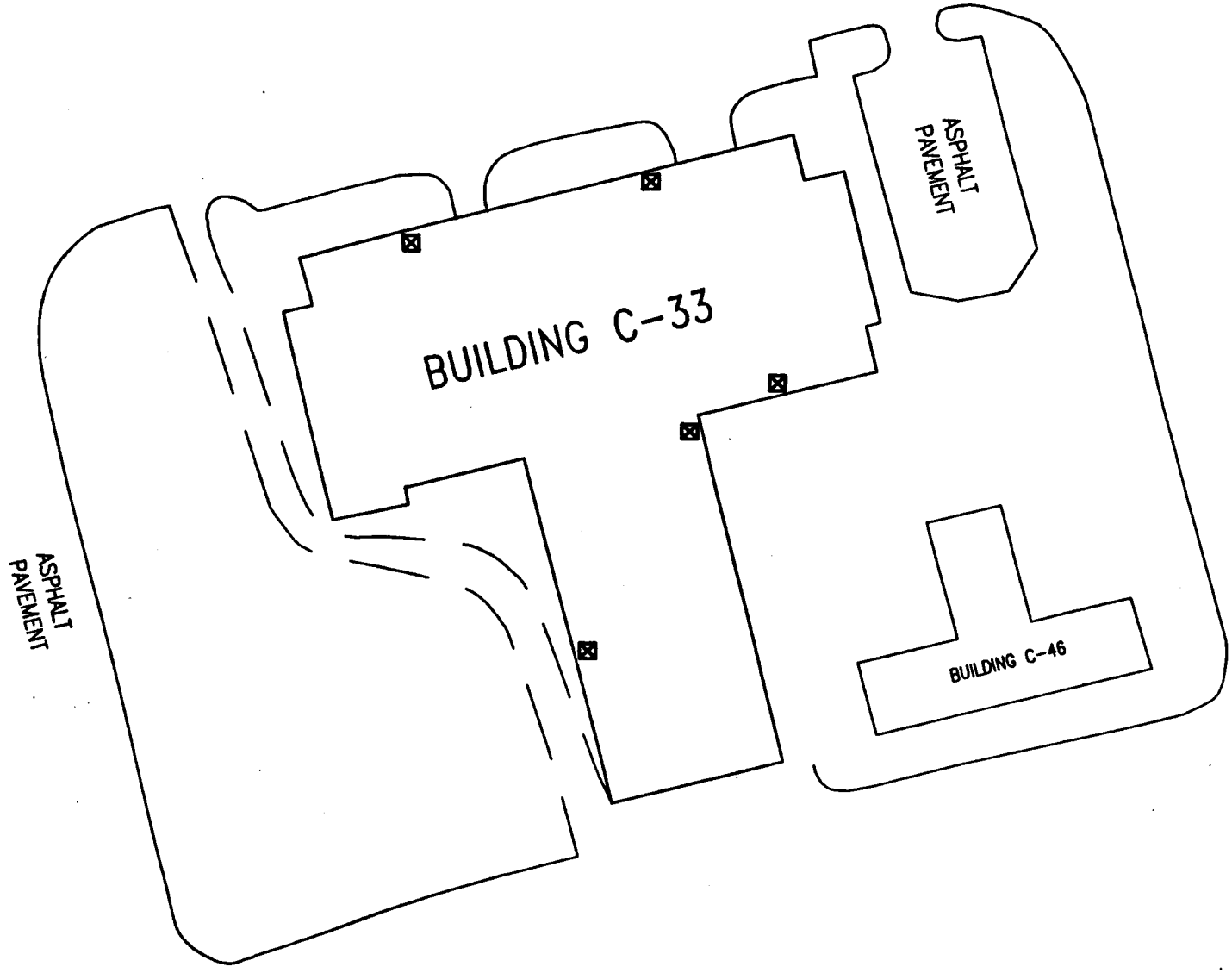
16.3 REMEDIAL INVESTIGATION SAMPLING ACTIVITIES

In December 1995, B&R Environmental conducted the following field investigation activity at Site 14:

- Sampling and analysis of warehouse floor sweepings (Section 16.3.1)

16.3.1 Floor Sweepings

Since the exact location of the spill is unknown, sweepings from different areas of the warehouse were collected to determine if any traces of mercury remained on the floor surface. Floor sweepings were collected from five grab sample points and composited into one floor sweepings sample. See Figure 16-1 for grab sample point locations in Building C-33.



LEGEND

⊠ FLOOR SWEEPINGS GRAB LOCATIONS

FIGURE 16-1

SAMPLE LOCATIONS
SITE 14 - BUILDING C-33
NWS EARLE, NEW JERSEY

Brown & Root Environmental

The warehouse floor sweepings were collected and submitted to Lancaster Laboratories for mercury analysis. Sample log sheets are provided in Appendix D.

16.4 SITE CHARACTERISTICS

16.4.1 Geology

Regional mapping places Site 14 within the outcrop area of the Kirkwood Formation; therefore, upper colluvium may be present at the site. The upper colluvium consists of massive sand and gravel and may contain quartz and ironstone pebbles. The Kirkwood Formation consists of gray and tan, very fine- to medium-grained quartz sand and dark-colored, micaceous, diatomaceous clay. The presence of upper colluvium or the Kirkwood Formation beneath the site cannot be confirmed because no soil borings were drilled at the site. The lithology of the sediments encountered in borings at Site 23 generally agrees with the published description of the upper colluvium and the Kirkwood and Vincentown Formations. Site 23 is located about 3,000 feet southeast of Site 14. In general, the borings at Site 23 encountered yellowish-brown, fine- to coarse-grained sand (possibly representative of the upper colluvium), brownish and olive, fine- to medium-grained sand (probably representative of the Kirkwood Formation), and greenish-gray, glauconitic, fine- to medium-grained sand (probably representative of the Vincentown Formation).

16.4.2 Hydrogeology

Groundwater conditions beneath the site cannot be confirmed because no wells were installed at the site. However, groundwater in the Kirkwood and Vincentown aquifer beneath Site 23, and presumably Site 14, occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. The direction of shallow groundwater flow in the aquifer beneath Site 23, as indicated by both the August and October groundwater contour maps for Site 23, is toward the north-northeast.

16.5 NATURE AND EXTENT OF CONTAMINATION

16.5.1 Floor Sweepings

One floor sweepings sample was composited from five grab sample points (Figure 16-1).

16.5.2 Inorganics

Mercury was detected at 8.6 mg/kg in sample 14 FS 01. The concentration of mercury is below New Jersey state standards for Residential Direct Contact Soil Cleanup Criteria for mercury of 14 mg/kg.

Methylmercury
RBC
Reg. III

Although this site is inside an industrial facility, it should be noted that the EPA value for residential levels of mercury in soil at an HI of 1 is 7.8 mg/kg.

16.5.3 Miscellaneous Parameters

The composite floor sweepings sample had a moisture content of 2.9 percent. Results for miscellaneous parameters are presented in Appendix A.

16.5.4 Conclusions

The spill reportedly occurred on a solid concrete floor in an enclosed building with solid walls. The building has been maintained against the weather continuously since the spill. The spill was reportedly cleaned up using a vacuum.

Investigation confirms the interview reports. It appears as if the spill was adequately cleaned up at the time, and no evidence of a wider environmental contamination or risk to human health was found.

16.6 EVALUATION AND RECOMMENDATIONS

16.6.1 Evaluation Summary

The mercury found in floor sweepings at Building C-33 represents no apparent health threat. The mercury concentration found in floor sweepings is lower than the concentration in soil (which could be tracked in on the shoes of workers or on the tires of handling equipment) and would be considered protective of non-residential or even lifetime residential exposure under NJDEP clean-up criteria. The corresponding EPA residential level at an HI of 1 is approximately equal to the concentration found and would be considered protective of human health.

There is no known evidence that the mercury spill may have affected the area around building C-33.

16.6.2 Recommendations

No further investigation or ecological risk assessment appears necessary.

17.0 SITE 15: SLUDGE DISPOSAL SITE

17.1 SITE BACKGROUND AND PHYSICAL SETTING

The sludge disposal site reportedly occupied a small area along the former railroad tracks near the main entrance to the Waterfront area. 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 a railroad grade that was built approximately 6 feet above the surrounding ground surface. It is unknown whether sludge disposal occurred along one or both sides of the railroad tracks. A small drainage swale runs parallel to the railroad bed on the north side, and surface water from the site and the adjacent paved parking area flows toward this swale. This swale contains water only after precipitation. Wetlands are present north and south of the site. Figure 17-1 is a map of the site.

17.2 PREVIOUS INVESTIGATIONS

17.2.1 Summary of Activities and Results

The 1983 IAS consisted of interviews and visual inspection. The site 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 the full scan of TCL compounds. Analysis indicated that elevated levels of metals were present in groundwater.

17.2.2 Summary of Conclusions

Low levels of semivolatile organic compounds were found in soil and sediment. Metals were present in the groundwater sample.

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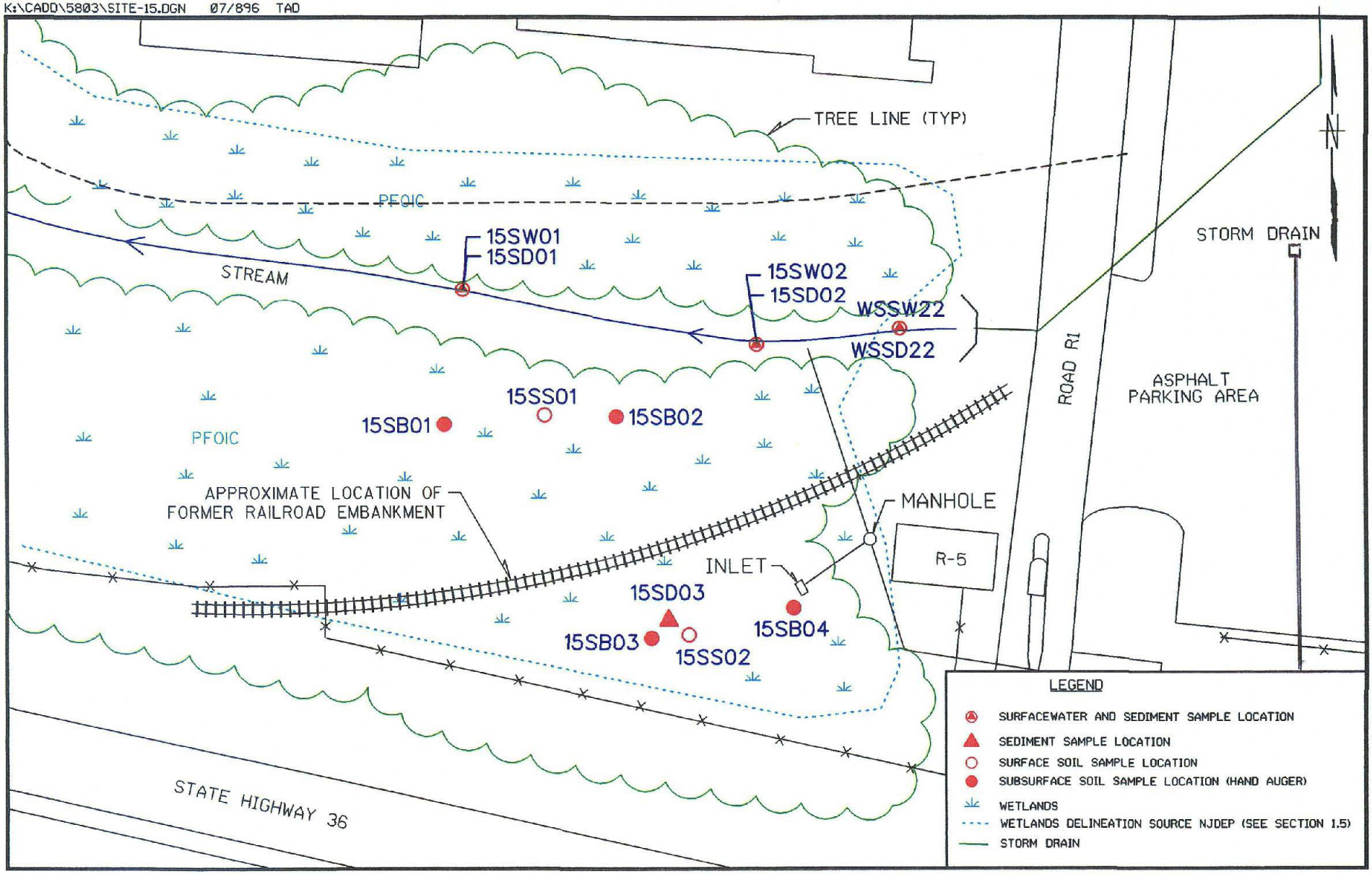

SAMPLE LOCATIONS

SITE 15 - SLUDGE DISPOSAL SITE

0 60 120

SCALE IN FEET

FIGURE 17-1

Brown & Root Environmental

17.2.3 Data Gaps (Objectives of Remedial Investigation)

Based on previous investigations, follow-up remedial investigation activities were developed to meet the following objective:

- Obtain additional soil, sediment, and surface water samples to determine the extent of the impacted area.

- Compare data to background levels and risk-based criteria.

17.3 RI FIELD INVESTIGATIONS

Between June and July 1995, B&R Environmental conducted the following field investigation activities at Site 15:

- Sampling and analysis of surface water (Section 17.3.1)
- Sampling and analysis of sediment (Section 17.3.2)
- Sampling and analysis of surface soil (Section 17.3.3)
- Sampling and analysis of subsurface soil (Section 17.3.4)

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the surface water and sediment samples and the surface soil and subsurface soil sample locations. Surveying notes are provided in Appendix F.

17.3.1 Surface Water Sampling

Two surface water samples (15 SW 01 and 15 SW 02) were collected in June 1995 from the stream located on the north side of the suspected disposal area to determine if surface water has been impacted by the site. Figure 17-1 shows sampling locations. B&R Environmental collected surface water samples by dipping the sample bottle directly into the water. Field measurements collected during sampling included pH, specific conductance, temperature, turbidity, dissolved oxygen, and salinity. The surface water samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, and TAL metals analyses. Sample 15 SW 01 was collected west and downstream of the suspected disposal area and sample 15 SW 02 was collected east and upstream of 15 SW 01 (Figure 17-1). Sample log sheets are presented in Appendix D.

17.3.2 Sediment Sampling

B&R Environmental collected two sediment samples (15 SD 01 and 15 SD 02) in June 1995 from the stream north of the suspected disposal area to determine if sediments have been impacted by the site. The sediment samples were collected from 0 to 6 inches below the sediment water interface or ground surface using a stainless-steel trowel. The sediment material was placed directly into the required bottleware via the stainless-steel trowel. The sediment samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TPH, and TAL metals analyses. Sample 15 SD 01 was collected west and downstream of the suspected disposal area. The sediment material consisted of rust-colored silt and organic matter. Sample 15 SD 02 was collected east and upstream of sample 15 SD 01 and consisted of dark brown to gray silty sand with trace amounts of organic material. One sediment sample (15 SD 03) was collected in the wetlands area south of the railroad tracks and the suspected disposal area to determine if these wetlands have been impacted by the site. This sediment sample consisted of dark brown silt with organic matter. Sample log sheets are presented in Appendix D.

17.3.3 Surface Soil Sampling

Two surface soil samples (15 SS 01 and 15 SS 02) were collected in July 1995 to determine if surface soil contamination is present as a result of the past activities on site (Figure 17-1). The samples were collected from 0 to 6 inches bgs using a stainless-steel trowel and were placed directly into the appropriate bottleware. The surface vegetation was removed before sampling. The surface soil samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals TPH, moisture, and pH analyses. Sample 15 SS 01 consisted of black silty sand with trace amounts of organic matter and sample 15 SS 02 consisted of tan silty sand with some roots. Sample log sheets are presented in Appendix D.

17.3.4 Subsurface Soil Sampling (Hand Augering)

The field team collected five subsurface soil samples (15 SB 01 through 15 SB 04), including one field duplicate (Dup 13), in July 1995 for comparison with the SI data results and to determine depth and extent of contamination, if any, at the site (Figure 17-1). Samples 15 SB 01 and 15 SB 02 were collected between 1 and 2 feet bgs, and samples 15 SB 03 and 15 SB 04 were collected between 2 and 3 feet bgs. A hand auger was used to auger down to the desired depth, and the soil sample was placed directly into the appropriate bottleware using a stainless-steel trowel. The auger holes were backfilled with the removed cuttings, and the hand auger was cleaned between sample locations. The samples were submitted to Lancaster Laboratories for TCL VOC, TCL SVOC, TCL pesticides/PCBs, TAL metals, TPH, moisture, and pH analyses. Sample 15 SB 01 consisted of brown to black silty sand. Sample 15 SB 02

consisted of gray to brown silty sand with trace amounts of clay. Sample 15 SB 03 consisted of tan to gray silty sand with organic matter. Sample 15 SB 04 consisted of gray to brown sandy clay. Sample log sheets are presented in Appendix D.

17.4 SITE CHARACTERISTICS

17.4.1 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 and no previous soil boring was more than 16 feet deep. 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 upon 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.

17.4.2 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 contour maps for Site 6, is toward the north and northwest. The direction of groundwater flow in the aquifer beneath Site 17, as indicated by both the August and October groundwater contour maps for Site 17, is toward the northwest.

17.5 NATURE AND EXTENT OF CONTAMINATION

17.5.1 Surface Soils

Two surface soil samples were collected at Site 15, 15 SS 01 and 15 SS 02 (Figure 17-1). Tables 17-1 and 17-2 present the occurrence and distribution of inorganic and organic chemicals in site-related

TABLE 17-1
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL AT SITE 15
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.

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TABLE 17-2
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOIL AT SITE 15
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'-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

samples and compare them to background as presented in Section 31. Tables 17-1a and 17-1b present a comparison of detected compounds to ARARs and TBCs. Figure 17-2 shows locations and concentrations of compounds that exceed ARARs and TBCs.

17.5.1.1 Inorganics

Concentrations of most metals in site-related samples were similar to background. Concentrations slightly greater than background were observed for cadmium in sample 15 SS 02 and lead in sample 15 SS 01. Antimony was detected in 15 SS 01 at a low level, near the instrument detection limit, but was not detected in background samples.

17.5.1.2 Organics

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

17.5.1.3 Miscellaneous Parameters

The two surface soil samples collected at Site 15 were analyzed for moisture, pH, and TPH (120 to 200 mg/kg). The TPH background surface soil results were 9.0 mg/kg to 110 mg/kg.

17.5.2 Subsurface Soils

Four subsurface soil samples were collected in Site 15: 15 SB 01 through 15 SB 04 (Figure 17-1). Tables 17-3 and 17-4 present the occurrence and distribution of inorganic and organic chemicals in site-related samples and compare them to background. Tables 17-3a and 17-3b present a comparison of detected compounds to ARARs and TBCs. Figure 17-2 shows sample locations and concentrations that exceed ARARs and TBCs.

17.5.2.1 Inorganics

Concentrations of most metals in site-related samples were similar to background. Cadmium was present at levels slightly greater than background in one sample (15 SB 04-02).

TABLE 17-1a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SS01	15SS02	---	---	---	---	ARARS & TBCs		
LOCATION:	15SS01	15SS02	---	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI							
INORGANICS	**mg/kg**	**mg/kg**					**mg/kg**	**mg/kg**	**mg/kg**
aluminum	897	9250					-	-	-
antimony	1.8	0.84 U					14.0	340	-
arsenic	10.1	19.2 J					20.0	20.0	-
barium	7.8	18.0					700	47000	-
beryllium	0.035 U	1.0					1.00	1.00	-
cadmium	0.85	3.4 E J					1.00	100	-
calcium	828	407					-	-	-
chromium, total	3.7	37.7					-	500	-
cobalt	1.1	2.8					-	-	-
copper	33.2	14.3					600	600	-
iron	10900	52300					-	-	-
lead	110	56.8					400	600	-
magnesium	118	2260					-	-	-
manganese	92.9	60.7					-	-	-
mercury	0.16	0.051					14.0	270	-
nickel	3.0	7.5					250	2400	-
potassium	122	6790 J					-	-	-
sodium	47.4	195					-	-	-
thallium	1.1 UJ	1.5 J					2.00	2.00	-
vanadium	14.9	36.0					370	7100	-
zinc	7.2 J	52.4					1500	1500	-
SEMIVOLATILES	**ug/kg**	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**
benzo(a)anthracene	71.0 J	510 U					900	4000	500000
benzo(a)pyrene	69.0 J	58.0 J					660	660	100000
benzo(b)fluoranthene	160 J	120 J					900	4000	50000
bis(2-ethylhexyl)phthalate	110 J	100 J					49000	210000	100000
chrysene	90.0 J	68.0 J					9000	40000	500000
fluoranthene	180 J	130 J					2300000	10000000	100000

TABLE 17-1a

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SS01		15SS02		---	---	---	---	---	ARARS & TBCs		
LOCATION:	15SS01		15SS02		---	---	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI		1995 RI									
SEMIVOLATILES	**ug/kg**		**ug/kg**							**ug/kg**	**ug/kg**	**ug/kg**
phenanthrene	100	J	69.0	J						-	-	-
pyrene	210	J	140	J						1700000	10000000	100000
PESTICIDES	**ug/kg**		**ug/kg**							**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDE	43.0		13.0							2000	9000	50000
4,4'-DDT	12.0		6.2	R						2000	9000	500000
alpha-BHC	2.7	U	0.13	J						-	-	-

TABLE 17-1a
COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

- No standard is available for this chemical in this classification.

TABLE 17-1b

COMPARISON OF SURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SS01	15SS02	---	---	---	ARARS & TBCs		
LOCATION:	15SS01	15SS02	---	---	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI						
MISCELLANEOUS								
moisture %	37.2	35.5				-	-	-
pH	4.0	3.4				-	-	-
petroleum hydrocarbons mg/kg	200 J	120 J				10000 @	10000 @	-

TABLE 17-1b
COMPARISON OF SURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

- - No standard is available for this chemical in this classification.

@ - Value is New Jersey guideline for maximum total concentration of all organic compounds in soil (including VOCs, SVOCs, and TPH).

TABLE 17-3
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SUBSURFACE SOIL AT SITE 15
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 17-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SUBSURFACE SOIL AT SITE 15
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
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	4 / 4	59 - 260	260

TABLE 17-3a

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SB01-01	15SB02-01	15SB03-02	15SB04-02	15SB04-02-DUP	---	ARARS & TBCs		
LOCATION:	15SB01	15SB02	15SB03	15SB04	15SB04	---	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:	1995 RI	1995 RI	1995 RI	1995 RI	1995 RI				
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**		**mg/kg**	**mg/kg**	**mg/kg**
aluminum	890	3600	1480	4470	9900		-	-	-
arsenic	0.88 U	20.5 E J	8.8 J	15.9 J	23.8 E J		20.0	20.0	-
barium	6.2	6.5	3.9	7.7	14.8		700	47000	-
beryllium	0.15	0.12	0.12	0.25	0.30		1.00	1.00	-
cadmium	0.10 U	1.2 E	1.9 E J	2.1 E J	3.5 E J		1.00	100	-
calcium	584	70.8	95.9	155	172		-	-	-
chromium, total	2.4	9.0	4.2	11.9 J	21.7 J		-	500	-
cobalt	0.16 U	0.39	0.16	0.40	1.0		-	-	-
copper	3.3	1.0	0.35	2.2	3.0		600	600	-
iron	1600	16400	28700	31000	55800		-	-	-
lead	3.1	6.3	1.9	5.2	8.1		400	600	-
magnesium	68.8	227	81.8	233	696		-	-	-
manganese	4.4	1.9	3.1	6.7	8.0		-	-	-
mercury	0.0027 U	0.0054	0.0025 U	0.0027 U	0.0029 U		14.0	270	-
nickel	1.7	1.2	0.48	0.39	2.0		250	2400	-
potassium	55.0	334	246	553	1710 J		-	-	-
selenium	1.6 J	1.3 J	1.1 U	1.2 U	1.3 U		63.0	3100	-
sodium	33.6	29.3	45.9	93.6	139		-	-	-
thallium	1.0 UJ	1.5 J	0.91 UJ	1.0 UJ	1.3 J		2.00	2.00	-
vanadium	4.5	31.6	8.3	31.7	47.1		370	7100	-
zinc	3.7 J	3.2 J	0.75 J	6.1 J	11.4		1500	1500	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**		**ug/kg**	**ug/kg**	**ug/kg**
bis(2-ethylhexyl)phthalate	260 J	240 J	59.0 J	85.0 J	110 J		49000	210000	100000

TABLE 17-3a
COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

- No standard is available for this chemical in this classification.

TABLE 17-3b

COMPARISON OF SUBSURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:		15SB01-01	15SB02-01	15SB03-02	15SB04-02	15SB04-02-DUP	ARARS & TBCs		
LOCATION:		15SB01	15SB02	15SB03	15SB04	15SB04	NJDEP Soil Residential Direct Contact Cleanup Criteria	NJDEP Soil Non-Residential Direct Contact Cleanup Criteria	NJDEP Soil Impact to Groundwater Cleanup Criteria
DATA SOURCE:		1995 RI	1995 RI	1995 RI	1995 RI	1995 RI			
MISCELLANEOUS									
moisture	%	25.2	25.3	20.9	25.6	32.1	-	-	-
pH		4.4	4.1	5.0	6.1	6.2	-	-	-
petroleum hydrocarbons	mg/kg	110 J	40.0 J	22.0 J	20.0 J	40.0 J	10000 @	10000 @	-

TABLE 17-3b
COMPARISON OF SUBSURFACE SOIL MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

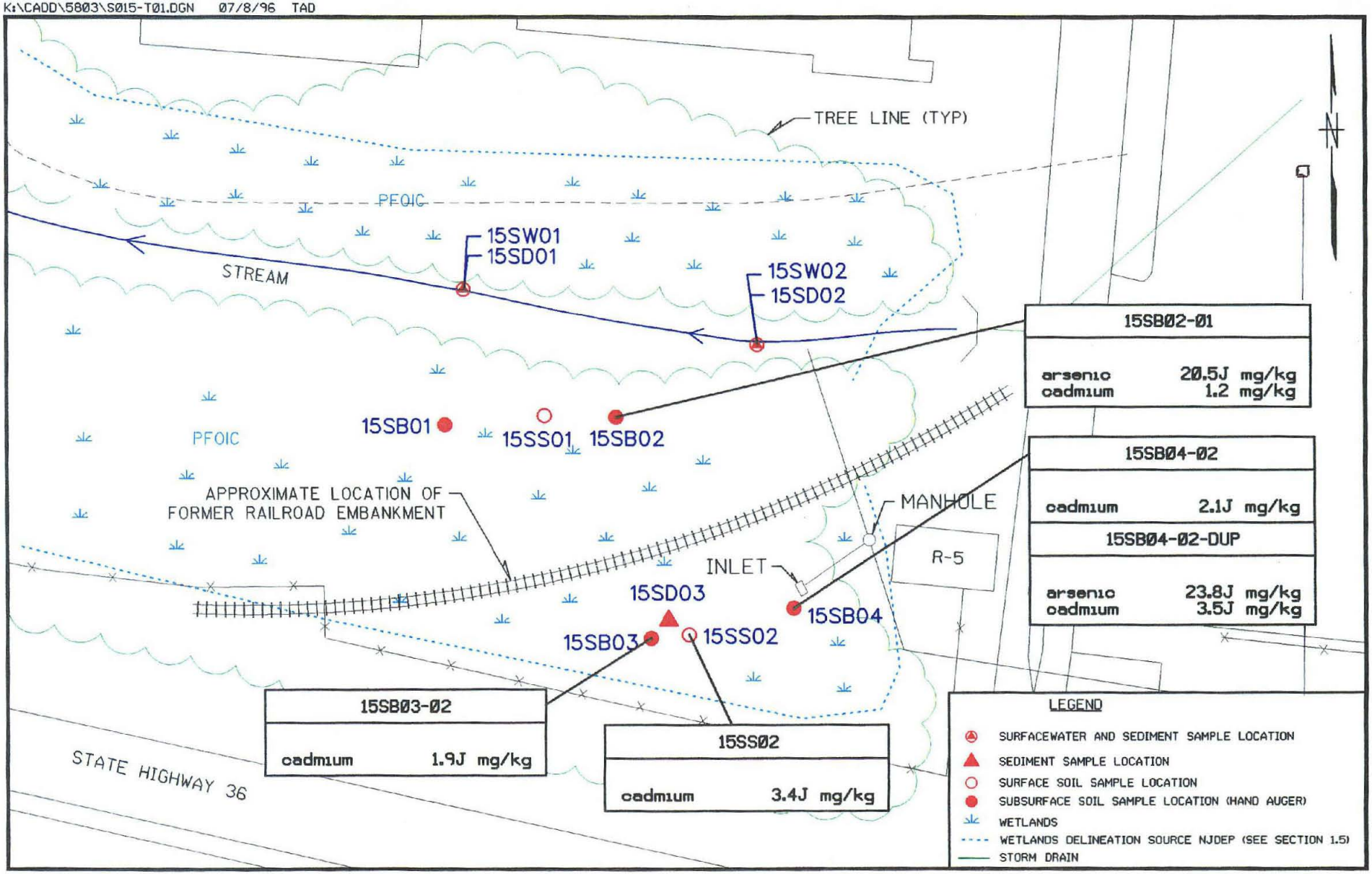
E - Result exceeds one or more of the selected ARARs.

Footnotes to soil criteria:

. - No standard is available for this chemical in this classification.

@ - Value is New Jersey guideline for maximum total concentration of all organic compounds in soil (including VOCs, SVOCs, and TPH).

K:\CADD\5803\S015-T01.DGN 07/8/96 TAD



CONCENTRATIONS ABOVE SUBSURFACE AND SURFACE SOILS SCREENING LEVELS

SITE 15 - SLUDGE DISPOSAL SITE

FIGURE 17-2

0 60 120

SCALE IN FEET

Brown & Root Environmental

17.5.2.2 Organics

Bis(2-ethylhexyl) phthalate (59 ug/kg 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.

17.5.2.3 Miscellaneous Parameters

The four subsurface soil samples collected at Site 15 were analyzed for moisture, pH, and TPH (20.0 mg/kg to 110 mg/kg). TPH in background subsurface soil samples ranged from 12.0 mg/kg to 220 mg/kg.

17.5.3 Sediment

Three sediment samples were collected at Site 15: 15 SD 01 through 15 SD 03 (Figure 17-1). Tables 17-5 and 17-6 present the occurrence and distribution of inorganic and organic chemicals in site-related sediment samples and compare them to background. Tables 17-5a and 17-5b present a comparison of detected compounds to ARARs and TBCs. Figure 17-3 shows sample locations and concentrations that exceed ARARs and TBCs.

17.5.3.1 Inorganics

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 15 SD 01. The highest concentration of copper (269 mg/kg) was seen in sample 15 SD 02, and zinc exhibited a maximum concentration (464 mg/kg) in sample 15 SD 03.

17.5.3.2 Organics

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 at a range from 110 ug/kg to 1,900 ug/kg. Similar PAHs were detected in sediment samples collected at Site 15. PAH levels in sample 15 SD 01 were generally two to five times higher than background ranges. Samples 15 SD 02 and 15 SD 03 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-related sediment sample but were not detected in background sediment samples.

Background sediment samples exhibited the presence of 4,4'-DDD (4.9 ug/kg - 21 ug/kg), 4,4'-DDE (1.7 ug/kg), and 4,4'-DDT (19 ug/kg).

TABLE 17-5
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 15
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 17-6
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED		
SUBSTANCE	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 17-5a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SD01	15SD02	15SD03	---	---	---	---	ARARS & TBCs
LOCATION:	15SD01	15SD02	15SD03	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI					
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**					**mg/kg**
aluminum	10600 J	5110	2550 J					-
arsenic	25.5 E J	10.5 E	17.2 E J					8.20 L
barium	43.2 E J	28.9	45.4 E J					40.0 B
beryllium	1.7 J	0.32 J	0.072 UJ					-
cadmium	1.9 E J	0.62 U	1.1 UJ					1.20 L
calcium	1050 J	5100	282 J					-
chromium, total	32.5 J	58.7	8.6 J					81.0 L
cobalt	5.6 J	7.1	1.4 UJ					50.0 T
copper	85.8 E J	269 E	11.3 J					34.0 L
iron	84000 J	20800	44700 J					-
lead	187 E J	62.5 E	42.5 J					47.0 L
magnesium	1130 J	1530	251 J					-
manganese	72.8 J	52.9 J	12.0 J					460 O
mercury	0.67 E J	0.11 J	0.16 E J					0.150 L
nickel	15.5 J	11.1	3.3 UJ					21.0 L
potassium	576 J	395	458 J					-
selenium	2.2 J	0.71 U	1.5 J					-
silver	3.1 E J	0.52	0.77 UJ					1.00 M
sodium	317 J	222	291 J					-
thallium	2.4 J	1.0	2.8 J					-
vanadium	48.7 J	35.2	20.1 J					-
zinc	176 E J	136	464 E J					150 L
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**					**ug/kg**
2-methylnaphthalene	300 J	470 U	850 U					330 F
acenaphthene	140 J	470 U	850 U					620 Q
anthracene	240 J	52.0 J	850 U					330 F
benzo(a)anthracene	1400 E	270	850 U					330 F
benzo(a)pyrene	1500 E	260	850 U					430 L

TABLE 17-5a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SD01		15SD02		15SD03		---		---		---		---		ARARS & TBCs
LOCATION:	15SD01		15SD02		15SD03		---		---		---		---		Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI		1995 RI		1995 RI										
SEMIVOLATILES	**ug/kg**		**ug/kg**		**ug/kg**										**ug/kg**
benzo(b)fluoranthene	2700	E	400	E	130	J									330 F
benzo(g,h,i)perylene	1200	E	170	J	850	U									330 F
benzo(k)fluoranthene	930	E	140	J	850	U									330 F
butylbenzylphthalate	910		470	U	850	U									11000 Q
carbazole	250	J	470	U	850	U									330 F
chrysene	2200	E	330		120	J									330 F
di-n-butylphthalate	160	J	470	U	850	U									11000 P
dibenz(a,h)anthracene	340	E J	470	U	850	U									330 F
dibenzofuran	130	J	470	U	850	U									2000 P
fluoranthene	3600	E	630		200	J									2900 Q
fluorene	180	J	470	U	850	U									540 P
indeno(1,2,3-cd)pyrene	1100	E	150	J	850	U									330 F
naphthalene	140	J	470	U	850	U									480 P
phenanthrene	1800	E	320		120	J									850 Q
pyrene	3400	E	560		180	J									660 L
VOLATILES	**ug/kg**		**ug/kg**		**ug/kg**										**ug/kg**
2-butanone	36.0	UJ	14.0	U	86.0	J									-
styrene	32.0	UJ	14.0	U	11.0	J									-
PESTICIDES	**ug/kg**		**ug/kg**		**ug/kg**										**ug/kg**
4,4'-DDD	43.0	E	13.0	E	45.0	E									1.60 L
4,4'-DDE	31.0	E	2.1	NJ	59.0	E									2.20 L
4,4'-DDT	46.0	E NJ	7.2	E NJ	8.4	U									1.60 L
Aroclor-1260	100	J	16.0	J	84.0	U									-
alpha-chlordane	31.0	E J	3.8	NJ	2.0	R									7.00 O
beta-BHC	0.35	R	0.072	R	0.39	R									-
dieldrin	11.0	U	4.6	U	5.0	R									52.0 Q
endrin	11.0	U	4.6	U	10.0	J									20.0 Q
gamma-chlordane	29.0	E J	5.1	NJ	4.3	U									7.00 O

TABLE 17-5a

COMPARISON OF SEDIMENT ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SD01	15SD02	15SD03	---	---	---	---	ARARS & TBCs
LOCATION:	15SD01	15SD02	15SD03	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI					
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**					**ug/kg**
heptachlor epoxide	3.2 J	0.47 J	4.3 U					5.00 O

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

TABLE 17-5b

COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SD01	15SD02	15SD03	---	---	---	---	ARARS & TBCs
LOCATION:	15SD01	15SD02	15SD03	---	---	---	---	Sediment Ecological Toxicity Threshold Values
DATA SOURCE:	1995 RI	1995 RI	1995 RI					
MISCELLANEOUS								
moisture %	69.1	29.1	61.1					-
pH	6.1 J	5.7	3.7 J					-
petroleum hydrocarbons mg/kg	3100 J	1200	370 J					-

TABLE 17-5b
COMPARISON OF SEDIMENT MISCELLANEOUS PARAMETERS DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to sediment ecological toxicity criteria:

. - No standard is available for this chemical in this classification.

B - Source: Baudo, R., J. Geisy and H. Muntau. eds. 1990. Sediments: Chemistry and Toxicity of In-Place Pollutants. Lewis Publishers, Inc. Ann Arbor, MI.

F - Source: USEPA. 1994c. Draft Region IV Waste Management Division Sediment Screeing Values for Hazardous Waste Sites. 2/16/94 Revision.

L - Effects Range-Low. Source: Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. 19:81-97.

M - Effects Range-Low. Source: Long, E. R. and L. G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA.

O - Ontario screening level. Source: Ontario Ministry of the Environment (OME). 1992. Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario. Log 92-2309-067, PIBS 1962.

P - Sediment quality benchmark using equipartition. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

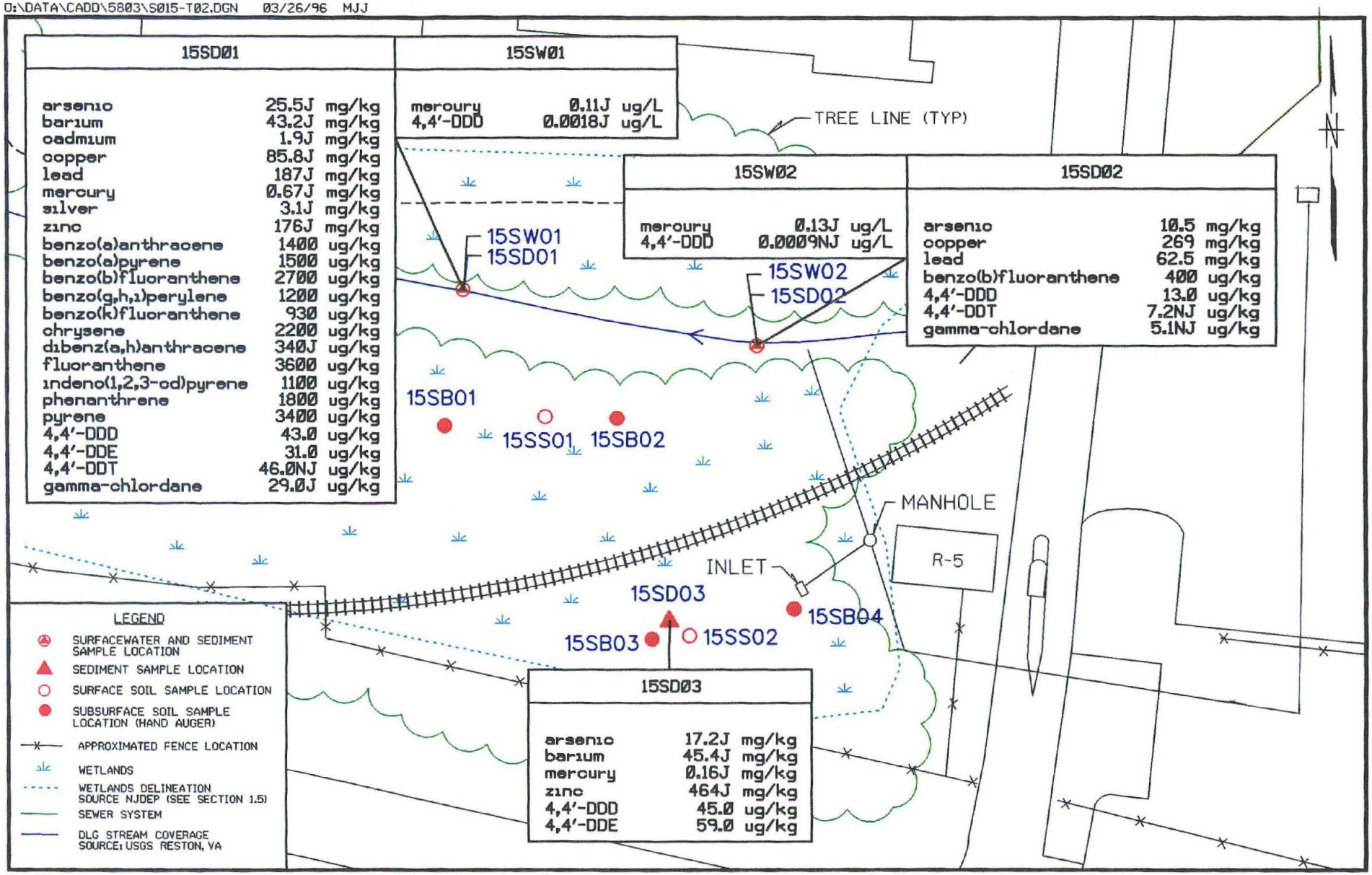
Q - Sediment quality criterion. Source: USEPA. 1996. ECO Update. Volume 3: Number 2. EPA 540/F-95/038.

S - Sediment screening benchmark. Source: Suter, G. W., and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota. Oak Ridge National Laboratory, Oak Ridge, TN.

T - Threshold for soils. Source: Direction des Substances Dangereuses. 1988. Contaminated Sites Rehabilitation Policy. Gouvernement du Quebec. Ministere de L'Environment. Sainte-Foy, Quebec, Canada. In: R.L. Siegrist. 1989. International Review of Approaches for Establishing Cleanup Goals for Hazardos Waste Contaminated Land. Institute for Georesearch and Pollution Research. Norway.

W - Screening value for wet soil. Source: Will, M.E., and G.W. Suter. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory.

O:\DATA\CADD\5803\S015-T02.DGN 03/26/96 MJJ



CONCENTRATIONS ABOVE SURFACE WATER AND SEDIMENT SCREENING LEVELS

SITE 15 - SLUDGE DISPOSAL SITE

FIGURE 17-3

Brown & Root Environmental

Pesticides detected at similar levels in site-related sediment samples include 4,4'-DDT (7.2 ug/kg to 46 ug/kg), 4,4'-DDD (13 ug/kg to 45 ug/kg), and 4,4'-DDE (2.1 ug/kg to 59 ug/kg). Gamma-chlordane (5.1 ug/kg to 29 ug/kg) was detected at levels greater than background ranges. Alpha-chlordane (3.8 ug/kg to 31 ug/kg), endrin (10 ug/kg), and heptachlor epoxide (0.47 ug/kg to 3.2 ug/kg) were also detected in sediment samples collected at Site 15 but were not observed in background samples. Site-related sediment samples also revealed Aroclor 1260 (16 ug/kg in 15 SD 02 and 100 ug/kg in 15 SD 01). Styrene (11 ug/kg) and 2-butanone (86 ug/kg) were each detected in one sediment sample (15 SD 03).

17.5.3.3 Miscellaneous Parameters

The three sediment samples collected at Site 15 were analyzed for moisture, pH, and TPH (370 mg/kg to 3100 mg/kg). TPH levels in background subsurface soil samples ranged from 50.0 mg/kg to 660 mg/kg.

17.5.4 Surface Water

Two surface water samples were collected at Site 15: 15 SW 01 and 15 SW 02 (Figure 17-1). Tables 17-7 and 17-8 present the occurrence and distribution of inorganic and organic chemicals detected in site-related surface water samples and compare them to background. Table 17-7a presents a comparison of detected compounds to ARARs and TBCs. Figure 17-3 shows sample locations and concentrations of compounds that exceed ARARs and TBCs. TPH was analyzed for but not detected in surface water samples.

17.5.4.1 Inorganics

Concentrations of most metals in the two site-related samples were similar or lower than background. Slightly higher levels of cobalt and manganese were detected in both site-related samples.

17.5.4.2 Organics

4,4'-DDD was detected in one site-related surface water sample from Site 15 at a concentration of 0.0018 ug/L (15 SW 01). This compound was not detected in background surface water samples.

17.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 15 is described in this subsection. Various chemicals detected and their transport potential in the environment are discussed in Section 17.6.1. Persistence of detected chemicals in the environment is discussed in Section 17.6.2. Section 17.6.3 presents a brief discussion of contaminant trends.

TABLE 17-7
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 15
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 17-8
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE WATER AT SITE 15
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
4,4'-DDD	NOT DETECTED	-	-	1 / 1	0.0018	0.0018

TABLE 17-7a

COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCs - SITE 15

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	15SW01	15SW02	---	---	ARARS & TBCs				
LOCATION:	15SW01	15SW02	---	---					
DATA SOURCE:	1995 RI	1995 RI			AWQC Freshwater Chronic Aquatic Life	AWQC Ingestion of Water and Fish	AWQC Ingestion of Fish Only	NJDEP Criteria Freshwater Chronic Aquatic Life	NJDEP Surface Water Criteria for Protection of Human Health
INORGANICS	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
aluminum	104	338 J			-	-	-	-	-
barium	34.6	49.5			-	-	-	-	2000
beryllium	0.22	0.88			-	-	-	-	-
cadmium	0.37	0.31			1.10 +	-	-	-	-
calcium	22200	26900			-	-	-	-	-
cobalt	5.0	10.9			-	-	-	-	-
copper	3.3	6.8			11.0 +	-	-	-	-
iron	7460 J	7940 J			-	-	-	-	-
lead	0.74 U	2.0			3.20 +	-	-	-	5.00
magnesium	7300 J	9020 J			-	-	-	-	-
manganese	885 J	1120 J			-	-	-	-	-
mercury	0.11 E J	0.13 E J			0.0120	0.140	0.150	-	-
nickel	5.6	12.5			160 +	610	4600	-	516
potassium	4180	4870			-	-	-	-	-
sodium	61400 J	80800 J			-	-	-	-	-
zinc	14.7 J	68.1 J			101 +	-	-	-	-
PESTICIDES	**ug/L**	**ug/L**			**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**
4,4'-DDD	0.0018 E J	0.0009 E NJ			-	0.000830	0.000840	-	-
beta-BHC	0.0010 R	0.050 U			-	0.0140	0.0460	-	0.137

TABLE 17-7a
COMPARISON OF SURFACE WATER ANALYTICAL DATA TO ARARS AND TBCS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Footnotes to sample results:

U - Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

UJ - Not detected. Detection limit or quantitation limit shown is considered estimated due to exceedance of data validation quality control criteria.

No Value - Constituent was not analyzed for in this sample.

UR - Nondetected result is considered rejected based on exceedance of data validation quality control criteria.

J - Value is estimated because concentration is below the quantitation limit or because of exceedance of data validation quality control criteria.

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

N - Compound is considered to be tentatively identified based on exceedance of QC criteria for compound identification.

E - Result exceeds one or more of the selected ARARs.

Footnotes to Ambient Water Quality Criteria:

. - No standard is available for this chemical in this classification.

+ - Criterion is hardness dependent and is generated based upon an assumed hardness of 100 mg/L.

17.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 15 indicate relatively low levels of TPH, metals, volatiles, PCBs, semivolatiles, and pesticides in sediment, PAHs and pesticides in surface soil, and limited metals in surface water. The physical transport data for the detected contaminants are presented in Table 2-10.

Organic contaminants in sediment fall into three classes: PCBs and PAHs (which are considered relatively immobile), pesticides (which have varying degrees of mobility), and volatiles (which are considered mobile). Of these classes, the detected levels of PAHs are the highest. The potential for PAH migration impacts is low due to the organic carbon present in sediments, which tend to bind PAHs.

PCBs, which were detected in site-related sediments, 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.

Arsenic, copper, iron, lead, and zinc, which were detected in site-related sediments, are absorbed onto soil and sediment easily but may also exist in dissolved or suspended forms. Cobalt and manganese were found in surface water at concentrations slightly greater than background but were not detected at levels notably greater than background in sediment.

Certain surface or subsurface soils revealed antimony, cadmium, and lead at levels slightly greater than background. Inorganic compounds have a strong tendency to adsorb onto soil particles, a factor that greatly reduces their tendency to leach from soil or be transported in groundwater. Many metals are water insoluble; however, some soluble species of metals have increased mobility. The low pH (3.44 to 4.96) in three subsurface soils and two surface soils may facilitate the solubilization and transport of metals at these locations.

17.6.2 Contaminant Persistence

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

Although most chemicals are resistant to chemical change because of their stability and/or lack of reaction sites, many of the more mobile species are subjected to at least limited transformation. Because of more

frequent contact with reactive dissolved species and catalysts when compared to unsaturated conditions, the contaminants found in saturated media (groundwater, saturated zone soils, surface water, and sediment) are most likely to be transformed in the environment. Higher molecular weight contaminants tend to be less mobile and less prone to chemical transformation.

PCBs are considered highly persistent and undergo biodegradation at slow rates that vary according to the chlorinated isomer substitution pattern for each type of PCB congener in Aroclor mixtures. PAHs can be biodegraded but the rate of degradation is slower for the higher molecular weight compounds. TPH is considered readily biodegradable. Styrene and 2-butanone are considered to have low persistence due to their volatility, solubility, and susceptibility to biodegradation.

17.6.3 Observed Chemical Contaminant Trends

TPH was detected at levels up to 3,100 mg/kg in site-related sediments. Benzene, toluene, ethylbenzene, and xylenes were not detected in site-related sediments. In addition, the highest levels of PAHs were noted in the same sample (stream sediment 15 SD 01) that contained the highest level of TPH. This suggests that the form of TPH that is present may be heavier range hydrocarbons such as oils or diesel range fuels, rather than light fuels.

PCBs were present at a maximum concentration of 100 ug/kg (Aroclor 1260) in 15 SD 01, at a level approximately six times greater than the other stream sediment sample 15 SD 02 (16.0 mg/kg of Aroclor 1260). Both stream sediments are within a region that could potentially be impacted by the site, although 15 SD 02 is somewhat farther upstream. Subsurface and surface soil samples from the sludge disposal site did not reveal PCBs. Based upon these data, additional upstream sources of PCBs cannot be ruled out.

Slightly elevated levels of certain metals in sediment may be related to sludge disposal activities. Surface water samples at Site 15 do not demonstrate continuous chemical migration impacts from this area. The detected sediment contamination is likely the result of runoff and erosional dispersion.

17.6.4 Conclusions

Heavy molecular weight organic contaminants detected in the sediments at Site 15 have low potential for impacts to groundwater. Runoff and erosional dispersion may allow 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. Since 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 or from disposal activities at locations not sampled within the Site 15 area.

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 is suggested at Site 15. However, the low pH of several subsurface and surface soils may facilitate migration of metals in the environment. Historical data collected during a 1992 investigation cannot be used to conclude 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.

17.7 BASELINE RISK ASSESSMENT

This section presents the results of the baseline risk assessment for Site 15. The risk assessment was performed using the approach outlined in Section 2.4. Tables 17-9 through 17-12 provide the selected COPCs and representative concentrations of inorganics and organics in site-related surface soil, subsurface soil, sediment, and surface water, respectively. COPCs and representative concentrations were selected as described in Sections 2.4.1.1, 2.4.1.2, and 2.4.1.3. Exposure pathways, potential receptors, uncertainties, and conclusions are included.

The result of the conservative baseline risk assessment was greater than the EPA target acceptable range for cancer risk and greater than a value of 1.0 for non-cancer risk; therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6. Section 17.7.1.7 discusses the modifications made to the conservative preliminary baseline risk assessment.

The risk assessment only identifies exposure and risks, not acceptable levels of these parameters. The results of this risk assessment are used for input into the risk management process, where clean-up goals and remediation procedures are identified for a site.

TABLE 17-9
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE SOIL - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	9250	NONPARAMETRIC
ANTIMONY	1.8	NONPARAMETRIC
ARSENIC	19.2	NONPARAMETRIC
BERYLLIUM	0.97	NONPARAMETRIC
CADMIUM	3.4	NONPARAMETRIC
CHROMIUM	37.7	NONPARAMETRIC
COPPER	33.2	NONPARAMETRIC
LEAD	110	NONPARAMETRIC
NICKEL	7.5	NONPARAMETRIC
ZINC	52.4	NONPARAMETRIC
4,4'-DDE*	43	NONPARAMETRIC
4,4'-DDT*	12	NONPARAMETRIC
ALPHA-BHC*	0.13	NONPARAMETRIC
BENZO(A)ANTHRACENE*	71	NONPARAMETRIC
BENZO(A)PYRENE*	69	NONPARAMETRIC
BENZO(B)FLUORANTHENE*	160	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	110	NONPARAMETRIC
CHRYSENE*	90	NONPARAMETRIC
FLUORANTHENE*	180	NONPARAMETRIC
PHENANTHRENE*	100	NONPARAMETRIC
PYRENE*	210	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

TABLE 17-10
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SUBSURFACE SOILS - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	7185	NONPARAMETRIC
ARSENIC	20.5	NONPARAMETRIC
BERYLLIUM	0.275	NONPARAMETRIC
CADMIUM	2.8	NONPARAMETRIC
CHROMIUM	16.8	NONPARAMETRIC
LEAD	6.65	NONPARAMETRIC
SELENIUM	1.6	NONPARAMETRIC
BIS(2-ETHYLHEXYL)PHTHALATE*	260	NONPARAMETRIC

* = UNITS FOR ORGANIC CHEMICALS ARE IN ug/kg

TABLE 17-11
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SEDIMENT - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION (mg/kg)	STATISTICAL DISTRIBUTION
ALUMINUM	10600	NONPARAMETRIC
ARSENIC	25.5	NONPARAMETRIC
BARIUM	45.4	NONPARAMETRIC
BERYLLIUM	1.7	NONPARAMETRIC
CADMIUM	1.9	NONPARAMETRIC
CHROMIUM	58.7	NONPARAMETRIC
COBALT	7.1	NONPARAMETRIC
COPPER	269	NONPARAMETRIC
IRON	84000	NONPARAMETRIC
LEAD	187	NONPARAMETRIC
MANGANESE	72.8	NONPARAMETRIC
MERCURY	0.67	NONPARAMETRIC
NICKEL	15.5	NONPARAMETRIC
SELENIUM	2.2	NONPARAMETRIC
SILVER	3.1	NONPARAMETRIC
THALLIUM	2.8	NONPARAMETRIC
VANADIUM	48.7	NONPARAMETRIC
ZINC	464	NONPARAMETRIC
2-BUTANONE*	86	NONPARAMETRIC
2-METHYLNAPHTHALENE*	300	NONPARAMETRIC
4,4'-DDD*	45	NONPARAMETRIC
4,4'-DDE*	59	NONPARAMETRIC
4,4'-DDT*	46	NONPARAMETRIC
ACENAPHTHENE*	140	NONPARAMETRIC
ALPHA-CHLORDANE*	31	NONPARAMETRIC
ANTHRACENE*	240	NONPARAMETRIC
AROCLOR-1260*	100	NONPARAMETRIC
BENZO(A)ANTHRACENE*	1400	NONPARAMETRIC
BENZO(A)PYRENE*	1500	NONPARAMETRIC
BENZO(B)FLUORANTHENE*	2700	NONPARAMETRIC
BENZO(G,H,I)PERYLENE*	1200	NONPARAMETRIC
BENZO(K)FLUORANTHENE*	930	NONPARAMETRIC
BUTYLBENZYLPHTHALATE*	910	NONPARAMETRIC
CARBAZOLE*	250	NONPARAMETRIC
CHRYSENE*	2200	NONPARAMETRIC
DI-N-BUTYLPHTHALATE*	160	NONPARAMETRIC
DIBENZ(A,H)ANTHRACENE*	340	NONPARAMETRIC
DIBENZOFURAN*	130	NONPARAMETRIC
ENDRIN*	10	NONPARAMETRIC
FLUORANTHENE*	3600	NONPARAMETRIC
FLUORENE*	180	NONPARAMETRIC
GAMMA-CHLORDANE*	29	NONPARAMETRIC
HEPTACHLOR EPOXIDE*	3.2	NONPARAMETRIC
INDENO(1,2,3-CD)PYRENE*	1100	NONPARAMETRIC
NAPHTHALENE*	140	NONPARAMETRIC
PHENANTHRENE*	1800	NONPARAMETRIC
PYRENE*	3400	NONPARAMETRIC
STYRENE*	11	NONPARAMETRIC

* = UNITS FOR ORGANICS ARE IN ug/kg

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TABLE 17-12
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF COPCS
SURFACE WATER - SITE 15 (ug/L)
NWS EARLE, COLTS NECK, NEW JERSEY

CHEMICAL OF CONCERN	REPRESENTATIVE CONCENTRATION	STATISTICAL DISTRIBUTION
BARIUM	49.5	NONPARAMETRIC
BERYLLIUM	0.88	NONPARAMETRIC
CADMIUM	0.37	NONPARAMETRIC
COBALT	10.9	NONPARAMETRIC
IRON	7940	NONPARAMETRIC
LEAD	2	NONPARAMETRIC
MANGANESE	1120	NONPARAMETRIC
MERCURY	0.13	NONPARAMETRIC
NICKEL	12.5	NONPARAMETRIC
ZINC	68.1	NONPARAMETRIC
4,4'-DDD	0.0018	NONPARAMETRIC

17.7.1 Risk Characterization

The results of the risk assessment are presented in the risk characterization and are discussed on a receptor-specific basis. The identified potential receptors have been evaluated on the basis of current land use (industrial employee) and hypothetical future land use (residential, recreational, and industrial receptors).

17.7.1.1 Current Industrial Employee

The estimated total cancer risks for the current industrial employee for exposure to COPCs in surface soil at Site 15 are 1.2E-05 (ingestion), 4.9E-05 (dermal contact), and 2.7E-08 (inhalation of COPCs in fugitive dust). The total surface soil cancer risk is within the 1E-04 to 1E-06 target acceptable risk range often used by EPA to determine the need for action at CERCLA/RCRA sites or to formulate standards and criteria (ARARs). The principal COPCs contributing to the surface soil cancer risk are arsenic (ingestion, 86 percent of the cancer risk for this pathway) and beryllium (dermal contact, 93 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the current industrial employee assuming exposure to COPCs in surface soil at Site 15 are less than 1.0 for ingestion, dermal contact, and inhalation exposure pathways. Adverse noncarcinogenic health effects are not expected when the HQs are below 1.0.

Estimated carcinogenic risks and noncarcinogenic HQs are presented for current industrial receptors exposed to surface soils at Site 15 in Tables 17-13 and 17-14, respectively.

17.7.1.2 Future Industrial Employee

The estimated total cancer risks for the future industrial employee for exposure to COPCs in subsurface soil (assuming subsurface soils become future surface soils) at Site 15 are 1.1E-05 (ingestion), 1.6E-05 (dermal contact), and 1.6E-08 (inhalation of COPCs in fugitive dust). The total subsurface soil cancer risk is within the 1E-04 to 1E-06 target acceptable risk range. The principal COPCs contributing to the subsurface soil cancer risk are arsenic (ingestion, 96 percent of the cancer risk for this pathway; and dermal contact, 22 percent of the cancer risk for this pathway) and beryllium (dermal contact, 79 percent of the cancer risk for this pathway).

The estimated individual noncarcinogenic HQs for the future industrial employee assuming exposure to COPCs in subsurface soil (assuming subsurface soils become future surface soils) at Site 15 are less than 1.0 for ingestion, dermal contact, and inhalation exposure pathways. Adverse noncarcinogenic health effects are not expected when the HQs are below 1.0.

TABLE 17-13
RME CARCINOGENIC RISK TO CURRENT INDUSTRIAL RECEPTORS - SITE 15
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
4,4'-DDE	5.1E-09	1.0E-08	9.5E-13
4,4'-DDT	1.4E-09	2.8E-09	3.2E-13
ALPHA-BHC	2.9E-10	4.5E-10	6.4E-14
BENZO(A)ANTHRACENE	1.8E-08	5.7E-08	3.9E-12
BENZO(A)PYRENE	1.8E-07	1.8E-06	3.8E-11
BENZO(B)FLUORANTHENE	4.1E-08	1.3E-07	8.8E-12
BIS(2-ETHYLHEXYL)PHTHALATE	5.4E-10	1.7E-09	1.0E-13
CHRYSENE	2.3E-10	7.2E-10	5.0E-14
FLUORANTHENE	N/A	N/A	N/A
PHENANTHRENE	N/A	N/A	N/A
PYRENE	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
ANTIMONY	N/A	N/A	N/A
ARSENIC	1.0E-05	3.3E-06	5.6E-09
BERYLLIUM	1.5E-06	4.5E-05	2.7E-10
CADMIUM	N/A	N/A	2.8E-10
CHROMIUM	N/A	N/A	2.0E-08
COPPER	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	1.2E-05	5.1E-05	2.7E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 17-14
RME NONCARCINOGENIC HQS, CURRENT INDUSTRIAL RECEPTORS - SITE 15
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION	SURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
4,4'-DDE	N/A	N/A	N/A
4,4'-DDT	2.3E-05	4.6E-05	4.3E-09
ALPHA-BHC	N/A	N/A	N/A
BENZO(A)ANTHRACENE	N/A	N/A	N/A
BENZO(A)PYRENE	N/A	N/A	N/A
BENZO(B)FLUORANTHENE	N/A	N/A	N/A
BIS(2-ETHYLHEXYL)PHTHALATE	5.4E-06	1.7E-05	1.0E-09
CHRYSENE	N/A	N/A	N/A
FLUORANTHENE	4.4E-06	1.4E-05	8.2E-10
PHENANTHRENE	N/A	N/A	N/A
PYRENE	6.8E-06	2.1E-05	1.3E-09
ALUMINUM	9.1E-03	2.8E-03	1.7E-06
ANTIMONY	4.4E-03	2.7E-02	8.2E-07
ARSENIC	6.3E-02	2.1E-02	1.2E-05
BERYLLIUM	1.9E-04	5.9E-03	3.5E-08
CADMIUM	6.7E-03	4.2E-02	3.4E-06
CHROMIUM	7.4E-03	1.2E-01	1.4E-06
COPPER	8.1E-04	4.2E-04	1.5E-07
LEAD	N/A	N/A	N/A
NICKEL	3.7E-04	7.6E-04	6.8E-08
ZINC	1.7E-04	2.1E-04	3.2E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future industrial receptors exposed to surface soils at Site 15 in Tables 17-15 and 17-16, respectively.

17.7.1.3 Future Residential Receptor Surface Soil

The conservative preliminary baseline risk assessment yielded an estimated total cancer risk of approximately 1E-04 (the upper end of the target range) for the future lifetime resident assuming exposure to COPCs in surface soil at Site 15. In addition, this risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future residential child assuming exposure to surface soil. (Dermal contact exposures contributed the significant portion of cancer risk and ingestion and dermal contact contributed to non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 17.7.1.4 and presented in Tables 17-17, 17-18, and 17-18a.

Subsurface Soil

The conservative preliminary baseline risk assessment yielded an estimated total cancer risk greater than 1E-04 for the future lifetime resident assuming exposure to COPCs in surface soil (assuming subsurface soils become future surface soils). In addition, this risk assessment yielded an estimated noncarcinogenic HI with a value greater than 1.0 for the future residential child assuming exposure to subsurface soil. (Ingestion and dermal contact exposures contributed the significant portion of cancer and non-cancer risks.) Therefore, additional risk analysis was performed according to EPA guidance as discussed in Section 2.4.6; the amended carcinogenic and noncarcinogenic risks for residential exposure to groundwater are discussed in Section 17.7.1.4 and presented in Tables 17-19, 17-20, and 17-20a.

17.7.1.4 Future Recreational Receptor

The estimated total cancer risks for the future recreational child assuming exposure to COPCs in sediment during wading at Site 15 are 7.0E-07 (ingestion) and 3.4E-07 (dermal contact). The cancer risks for exposure to COPCs in surface water during wading at Site 15 are 4.2E-08 (ingestion) and 1.9E-07 (dermal contact). This sediment cancer risk is below the 1E-04 to 1E-06 target acceptable risk range. This surface water cancer risk is below the 1E-04 to 1E-06 target acceptable risk range.

The estimated individual noncarcinogenic HQs for the future recreational child assuming exposure to COPCs in sediment during wading at Site 15 are less than 1.0 for ingestion and dermal contact exposure pathways. The estimated noncarcinogenic HQs for exposure to COPCs in surface water during wading at Site 15 are less than 1.0 for ingestion and dermal contact exposure pathways. Adverse noncarcinogenic health effects are not anticipated when the HI is below 1.0.

TABLE 17-15
RME CARCINOGENIC RISK TO FUTURE INDUSTRIAL RECEPTORS - SITE 15
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOIL INGESTION	SUBSURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
BIS(2-ETHYLHEXYL)PHTHALATE	1.3E-09	4.0E-09	2.4E-13
ALUMINUM	N/A	N/A	N/A
ARSENIC	1.1E-05	3.5E-06	6.0E-09
BERYLLIUM	4.1E-07	1.3E-05	7.7E-11
CADMIUM	N/A	N/A	2.3E-10
CHROMIUM	N/A	N/A	9.1E-09
LEAD	N/A	N/A	N/A
SELENIUM	N/A	N/A	N/A
TOTAL RISK	1.1E-05	1.6E-05	1.5E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-16
RME NONCARCINOGENIC HQS, FUTURE INDUSTRIAL RECEPTORS - SITE 15
SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOIL INGESTION	SUBSURFACE SOIL DERMAL CONTACT	INHALATION OF COPCS IN FUGITIVE DUST
BIS(2-ETHYLHEXYL)PHTHALATE	1.3E-05	4.0E-05	2.4E-09
ALUMINUM	7.0E-03	4.4E-02	1.3E-06
ARSENIC	6.7E-02	2.2E-02	1.2E-05
BERYLLIUM	5.4E-05	1.7E-03	1.0E-08
CADMIUM	5.5E-03	3.4E-03	2.8E-06
CHROMIUM	3.3E-03	5.1E-02	6.1E-07
LEAD	N/A	N/A	N/A
SELENIUM	3.1E-04	4.9E-04	5.8E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-17
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE SOIL INGESTION - LIFETIME	SURFACE SOIL DERMAL CONTACT - LIFETIME	INHALATION OF COPCS IN FUGITIVE DUST -LIFETIME
4,4'-DDE	2.3E-08	N/A	5.8E-13
4,4'-DDT	6.4E-09	N/A	1.9E-13
ALPHA-BHC	1.3E-09	N/A	3.9E-14
BENZO(A)ANTHRACENE	8.1E-08	N/A	2.4E-12
BENZO(A)PYRENE	7.9E-07	N/A	2.3E-11
BENZO(B)FLUORANTHENE	1.8E-07	N/A	5.4E-12
BIS(2-ETHYLHEXYL)PHTHALATE	2.4E-09	N/A	6.1E-14
CHRYSENE	1.0E-09	N/A	3.0E-14
FLUORANTHENE	N/A	N/A	N/A
PHENANTHRENE	N/A	N/A	N/A
PYRENE	N/A	N/A	N/A
ANTIMONY	N/A	N/A	N/A
ARSENIC	4.5E-05	3.3E-05	3.4E-09
BERYLLIUM	6.5E-06	N/A	1.7E-10
CADMIUM	N/A	N/A	1.7E-10
COPPER	N/A	N/A	N/A
LEAD	N/A	N/A	N/A
ZINC	N/A	N/A	N/A
TOTAL RISK	5.3E-05	3.3E-05	3.8E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 17-18
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		SURFACE SOIL INGESTION BY TARGET ORGAN					
SUBSTANCE	SURFACE SOIL INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM
4,4'-DDE	N/A						
4,4'-DDT	3.1E-04				3.1E-04		
ALPHA-BHC	N/A						
BENZO(A)ANTHRACENE	N/A						
BENZO(A)PYRENE	N/A						
BENZO(B)FLUORANTHENE	N/A						
BIS(2-ETHYLHEXYL)PHTHALATE	7.0E-05				7.0E-05		7.0E-05
CHRYSENE	N/A						
FLUORANTHENE	5.8E-05	5.8E-05		5.8E-05	5.8E-05		
PHENANTHRENE	N/A						
PYRENE	8.9E-05			8.9E-05			
ANTIMONY	5.8E-02	5.8E-02					
ARSENIC	8.2E-01		8.2E-01				
BERYLLIUM	2.5E-03						
CADMIUM	8.7E-02			8.7E-02			
COPPER	1.1E-02	1.1E-02		1.1E-02	1.1E-02		
LEAD	N/A	N/A				N/A	
ZINC	2.2E-03	2.2E-03					
	HI BY TARGET ORGAN	7.0E-02	8.2E-01	9.8E-02	1.1E-02		7.0E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL

TABLE 17-18
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		SURFACE SOIL DERMAL CONTACT BY TARGET ORGAN						
SUBSTANCE	SURFACE SOIL DERMAL CONTACT - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
4,4'-DDE	N/A							N/A
4,4'-DDT	N/A				N/A			4.6E-09
ALPHA-BHC	N/A							N/A
BENZO(A)ANTHRACENE	N/A							N/A
BENZO(A)PYRENE	N/A							N/A
BENZO(B)FLUORANTHENE	N/A							N/A
BIS(2-ETHYLHEXYL)PHTHALATE	N/A				N/A		N/A	1.1E-09
CHRYSENE	N/A							N/A
FLUORANTHENE	N/A	N/A		N/A	N/A			8.6E-10
PHENANTHRENE	N/A							N/A
PYRENE	N/A			N/A				1.3E-09
ANTIMONY	N/A	N/A	N/A					8.6E-07
ARSENIC	5.1E-01		5.1E-01					1.2E-05
BERYLLIUM	N/A							3.7E-08
CADMIUM	1.7E-02			1.7E-02				3.6E-06
COPPER	N/A	N/A		N/A	N/A			1.6E-07
LEAD	N/A	N/A				N/A		N/A
ZINC	N/A	N/A						3.3E-08
	HI BY TARGET ORGAN		5.1E-01	1.7E-02				

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL

TABLE 17-18a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		INGESTION BY TARGET ORGAN					
SUBSTANCE	SURFACE SOIL INGESTION - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM
4,4'-DDE	N/A						
4,4'-DDT	1.5E-04				1.5E-04		
ALPHA-BHC	N/A						
BENZO(A)ANTHRACENE	N/A						
BENZO(A)PYRENE	N/A						
BENZO(B)FLUORANTHENE	N/A						
BIS(2-ETHYLHEXYL)PHTHALATE	3.4E-05				3.4E-05		3.4E-05
CHRYSENE	N/A						
FLUORANTHENE	2.5E-05	2.5E-05		2.5E-05	2.5E-05		
PHENANTHRENE	N/A						
PYRENE	3.7E-05			3.7E-05			
ANTIMONY	1.8E-02	1.8E-02					
ARSENIC	3.1E-01		3.1E-01				
BERYLLIUM	6.3E-04						
CADMIUM	2.7E-02			2.7E-02			
COPPER	3.8E-03	3.8E-03		3.8E-03	3.8E-03		
LEAD	N/A	N/A				N/A	
ZINC	6.4E-04	6.4E-04					
	HI BY TARGET ORGAN	2.2E-02	3.1E-01	3.1E-02	4.0E-03		3.4E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL

TABLE 17-18a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		DERMAL CONTACT BY TARGET ORGAN						
SUBSTANCE	SURFACE SOIL DERMAL CONTACT - CHILD	CARDIO-VASCULAR SYSTEM	SKIN	KIDNEY	LIVER	CENTRAL NERVOUS SYSTEM	REPRO-DUCTIVE SYSTEM	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
4,4'-DDE	N/A							N/A
4,4'-DDT	N/A				N/A			4.6E-09
ALPHA-BHC	N/A							N/A
BENZO(A)ANTHRACENE	N/A							N/A
BENZO(A)PYRENE	N/A							N/A
BENZO(B)FLUORANTHENE	N/A							N/A
BIS(2-ETHYLHEXYL)PHTHALATE	N/A				N/A		N/A	1.0E-09
CHRYSENE	N/A							N/A
FLUORANTHENE	N/A	N/A		N/A	N/A			7.4E-10
PHENANTHRENE	N/A							N/A
PYRENE	N/A			N/A				1.1E-09
ANTIMONY	N/A	N/A	N/A					5.3E-07
ARSENIC	3.9E-01		3.9E-01					9.3E-06
BERYLLIUM	N/A							1.9E-08
CADMIUM	1.1E-02			1.1E-02				2.2E-06
COPPER	N/A	N/A		N/A	N/A			1.1E-07
LEAD	N/A	N/A				N/A		N/A
ZINC	N/A	N/A						1.9E-08
	HI BY TARGET ORGAN		3.9E-01	1.1E-02				

N/A = NOT APPLICABLE, NO TOXICITY VALUE ARE ESTABLISHED FOR THIS CHEMICAL

TABLE 17-19
RME CARCINOGENIC RISK TO FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SUBSURFACE SOILS INGESTION - LIFETIME	SURFACE SOILS DERMAL CONTACT - LIFETIME	INHALATION OF COPCS IN FUGITIVE DUST - LIFETIME
BIS(2-ETHYLHEXYL)PHTHALATE	5.7E-09	N/A	1.4E-13
ARSENIC	4.8E-05	3.5E-05	3.7E-09
CADMIUM	N/A	N/A	1.4E-10
SELENIUM	N/A	N/A	N/A
TOTAL RISK	4.8E-05	3.5E-05	3.8E-09

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-20
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		SOIL INGESTION BY TARGET ORGAN			
SUBSTANCE	SUBSURFACE SOIL INGESTION - CHILD	SKIN	KIDNEY	LIVER	REPRO-DUCTIVE SYSTEM
BIS(2-ETHYLHEXYL)PHTHALATE	1.7E-04			1.7E-04	1.7E-04
ARSENIC	8.7E-01	8.7E-01			
CADMIUM	7.2E-02		7.2E-02		
SELENIUM	4.1E-03	4.1E-03			
	HI BY TARGET ORGAN	8.8E-01	7.2E-02	1.7E-04	1.7E-04

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-20
RME NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		DERMAL CONTACT BY TARGET ORGAN				
SUBSTANCE	SUBSURFACE SOIL DERMAL CONTACT - CHILD	SKIN	KIDNEY	LIVER	REPRO-DUCTIVE SYSTEM	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
BIS(2-ETHYLHEXYL)PHTHALATE	N/A			N/A	N/A	2.5E-09
ARSENIC	5.4E-01	5.4E-01				1.3E-05
CADMIUM	1.4E-02		1.4E-02			2.9E-06
SELENIUM	N/A	N/A				6.1E-08
	HI BY TARGET ORGAN	5.4E-01	1.4E-02			

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-20a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		SOIL INGESTION BY TARGET ORGAN			
SUBSTANCE	SUBSURFACE SOIL INGESTION - CHILD	SKIN	KIDNEY	LIVER	REPRO-DUCTIVE SYSTEM
BIS(2-ETHYLHEXYL)PHTHALATE	5.2E-05			5.2E-05	5.2E-05
ARSENIC	2.6E-01	2.6E-01			
CADMIUM	1.9E-02		1.9E-02		
SELENIUM	1.3E-03	1.3E-03			
	HI BY TARGET ORGAN	2.7E-01	1.9E-02	5.2E-05	5.2E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-20a
CENTRAL TENDENCY NONCARCINOGENIC HQS, FUTURE RESIDENTIAL RECEPTORS - SITE 15
SURFACE SOIL, AMENDED RISK
NWS EARLE, COLTS NECK, NEW JERSEY

		DERMAL CONTACT BY TARGET ORGAN				
SUBSTANCE	SUBSURFACE SOIL DERMAL CONTACT - CHILD	SKIN	KIDNEY	LIVER	REPRO-DUCTIVE SYSTEM	INHALATION OF COPCS IN FUGITIVE DUST - CHILD
BIS(2-ETHYLHEXYL)PHTHALATE	N/A			N/A	N/A	1.6E-09
ARSENIC	3.3E-01	3.3E-01				7.9E-06
CADMIUM	7.4E-03		7.4E-03			1.6E-06
SELENIUM	N/A	N/A				3.9E-08
	HI BY TARGET ORGAN	3.3E-01	7.4E-03			

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

Estimated carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to sediment at Site 15 in Tables 17-21 and 17-22, respectively. Estimated carcinogenic risks and noncarcinogenic HQs are presented for future recreational receptors exposed to surface water at Site 15 in Tables 17-23 and 17-24, respectively.

17.7.1.5 Lead Results

Lead was not found above the EPA level of concern (400 mg/kg) in soil or sediment samples taken during the RI or previous sampling. The IEUBK Lead Model (v. 0.99) was used to characterize potential effects associated with exposure to media containing lead. The IEUBK histograms for default and Site 15 exposures are presented in Appendix I.

17.7.1.6 Amended Risk Assessment

The amended risk assessment recalculated the cancer and non-cancer risks at Site 15 for future residential receptors assuming exposure to COPCs in surface soil and subsurface soil.

Comparison to Background: Surface Soil

Aluminum, chromium, and nickel were eliminated from consideration as surface soil COPCs based on a comparison of average levels to twice the background level. Table 17-1 presents the comparison of COPCs to background concentrations. No other metals could be eliminated based on comparison to background upper 95 percent UTLs.

Comparison to Background: Subsurface Soil

Aluminum, beryllium, chromium, and lead were eliminated from consideration as subsurface soil COPCs based on a comparison of average levels to twice the background level. However, since arsenic is a class A carcinogen, it could not be eliminated from consideration. Table 17-3 presents the comparison of COPCs to background concentrations.

Consideration of Modified Dermal Absorption and Target Organ Grouping: Surface Soil

As discussed in Section 2.4.6.2, cancer and non-cancer risks were recalculated using modified soil-to-skin absorption factors for three chemicals and excluding dermal effects for other COPCs. After these steps, the revised RME cancer risks are within the target acceptable risk range. The final RME cancer risks for the future lifetime resident assuming exposure to COPCs in surface soil at Site 17 are 5.3E-05 (ingestion), 3.3E-05 (dermal contact), and 3.8E-09 (inhalation of fugitive dust). Arsenic is the principal COPC contributing to surface soil RME cancer risks.

TABLE 17-21
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 15
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
2-BUTANONE	N/A	N/A
2-METHYLNAPHTHALENE	N/A	N/A
4,4'-DDD	1.2E-10	2.9E-11
4,4'-DDE	2.2E-10	5.4E-11
4,4'-DDT	1.7E-10	4.2E-11
ACENAPHTHENE	N/A	N/A
ALPHA-CHLORDANE	4.4E-10	1.1E-10
ANTHRACENE	N/A	N/A
AROCLOR-1260	8.4E-09	2.4E-09
BENZO(A)ANTHRACENE	1.1E-08	4.4E-09
BENZO(A)PYRENE	1.2E-07	1.6E-07
BENZO(B)FLUORANTHENE	2.2E-08	8.6E-09
BENZO(G,H,I)PERYLENE	N/A	N/A
BENZO(K)FLUORANTHENE	7.4E-10	2.9E-10
BUTYLBENZYLPHTHALATE	1.4E-10	2.8E-11
CARBAZOLE	5.5E-11	1.1E-11
CHRYSENE	1.8E-10	7.0E-11
DI-N-BUTYLPHTHALATE	N/A	N/A
DIBENZ(A,H)ANTHRACENE	2.7E-08	5.4E-08
DIBENZOFURAN	N/A	N/A
ENDRIN	N/A	N/A
FLUORANTHENE	N/A	N/A
FLUORENE	N/A	N/A
GAMMA-CHLORDANE	4.1E-10	1.0E-10
HEPTACHLOR EPOXIDE	3.2E-10	1.6E-10
INDENO(1,2,3-CD)PYRENE	8.8E-09	3.5E-09
NAPHTHALENE	N/A	N/A
PHENANTHRENE	N/A	N/A
PYRENE	N/A	N/A
STYRENE	N/A	N/A
ALUMINUM	N/A	N/A
ARSENIC	4.2E-07	1.7E-08
BARIUM	N/A	N/A
BERYLLIUM	8.0E-08	3.2E-07
CADMIUM	N/A	N/A
CHROMIUM	N/A	N/A
COBALT	N/A	N/A
COPPER	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
NICKEL	N/A	N/A
SELENIUM	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
VANADIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	7.0E-07	5.7E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 17-22
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 15
SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
2-BUTANONE	1.8E-08	7.3E-09
2-METHYLNAPHTHALENE	NA	NA
4,4'-DDD	NA	NA
4,4'-DDE	NA	NA
4,4'-DDT	1.2E-05	2.9E-06
ACENAPHTHENE	3.0E-07	1.2E-07
ALPHA-CHLORDANE	6.6E-05	1.6E-05
ANTHRACENE	1.0E-07	4.1E-08
AROCLOR-1260	NA	NA
BENZO(A)ANTHRACENE	NA	NA
BENZO(A)PYRENE	NA	NA
BENZO(B)FLUORANTHENE	NA	NA
BENZO(G,H,I)PERYLENE	NA	NA
BENZO(K)FLUORANTHENE	NA	NA
BUTYLBENZYLPHTHALATE	5.8E-06	1.2E-06
CARBAZOLE	NA	NA
CHRYSENE	NA	NA
DI-N-BUTYLPHTHALATE	2.0E-07	4.5E-08
DIBENZ(A,H)ANTHRACENE	NA	NA
DIBENZOFURAN	4.2E-06	8.2E-07
ENDRIN	4.3E-06	1.3E-06
FLUORANTHENE	1.2E-05	4.6E-06
FLUORENE	5.8E-07	2.3E-07
GAMMA-CHLORDANE	6.2E-05	1.5E-05
HEPTACHLOR EPOXIDE	3.1E-05	1.6E-05
INDENO(1,2,3-CD)PYRENE	NA	NA
NAPHTHALENE	4.5E-07	1.8E-07
PHENANTHRENE	NA	NA
PYRENE	1.4E-05	5.7E-06
STYRENE	7.0E-09	2.8E-09
ALUMINUM	1.4E-03	1.1E-03
ARSENIC	1.1E-02	4.5E-04
BARIUM	8.3E-05	8.2E-05
BERYLLIUM	4.3E-05	1.7E-04
CADMIUM	4.9E-04	3.8E-04
CHROMIUM	1.5E-03	3.0E-03
COBALT	1.5E-05	1.2E-05
COPPER	8.6E-04	5.7E-05
IRON	3.6E-02	2.8E-02
LEAD	NA	NA
MANGANESE	1.9E-03	2.5E-03
MERCURY	2.9E-04	1.6E-04
NICKEL	9.9E-05	2.6E-05
SELENIUM	5.6E-05	2.8E-06
SILVER	7.9E-05	1.6E-05
THALLIUM	4.5E-03	3.5E-03
VANADIUM	8.9E-04	3.5E-03
ZINC	2.0E-04	3.1E-05

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-23
RME CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 15
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
4,4'-DDD	4.7E-12	3.7E-10
BARIUM	N/A	N/A
BERYLLIUM	4.1E-08	1.9E-07
CADMIUM	N/A	N/A
COBALT	N/A	N/A
IRON	N/A	N/A
LEAD	N/A	N/A
MANGANESE	N/A	N/A
MERCURY	N/A	N/A
NICKEL	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	4.1E-08	1.9E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

TABLE 17-24
RME NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - SITE 15
SURFACE WATER
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
4,4'-DDD	N/A	N/A
BARIUM	9.0E-05	1.1E-05
BERYLLIUM	2.3E-05	1.0E-04
CADMIUM	9.5E-05	8.8E-06
COBALT	2.3E-05	2.2E-05
IRON	3.4E-03	3.1E-03
LEAD	N/A	N/A
MANGANESE	2.9E-02	4.4E-02
MERCURY	5.5E-05	3.7E-05
NICKEL	8.0E-05	2.5E-05
ZINC	2.9E-05	5.4E-06

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

Revised HIs for the future residential child assuming exposure to COPCs in surface soil at Site 17 are less than 1.0 for the ingestion and dermal contact exposure pathways, but the sum of these HIs exceeded 1.0 for the residential child receptor. After surface soil ingestion risks and dermal risks were grouped by target organ, the sum was still greater than 1.0 (arsenic was the COPC contributing to the RME ingestion HI (0.88) and the RME dermal HI (0.54) for the target organ skin. Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented in Tables 17-17 and 17-18, respectively, for future residential receptors exposed to surface soil.

Consideration of Modified Dermal Absorption and Target Organ Grouping: Subsurface Soil

After recalculation of cancer and non-cancer risks (using modified absorption factors and excluding dermal effects for some COPCs), the revised RME cancer risks are within the target acceptable risk range. The final RME cancer risks for the future lifetime resident assuming exposure to COPCs in subsurface soil (assuming subsurface soil becomes future surface soil) at Site 17 are 4.8E-05 (ingestion), 3.5E-05 (dermal contact), and 3.8E-09 (inhalation of fugitive dust). Arsenic is the principal COPC contributing to subsurface soil RME cancer risks.

Revised HIs for the future residential child assuming exposure to COPCs in subsurface soil at Site 17 are less than 1.0 for the ingestion and dermal contact exposure pathways, but the sum of these HIs exceeded 1.0 for the residential child receptor. After subsurface soil ingestion risks and dermal risks were grouped by target organ, the sum was still greater than 1.0 (arsenic was the COPC affecting the RME ingestion HI (0.82) and the RME dermal HI (0.51) for the target organ skin. Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0.

Estimated RME carcinogenic risks and noncarcinogenic HQs are presented in Tables 17-19 and 17-20, respectively, for future residential receptors exposed to subsurface soil (assuming subsurface soil becomes future surface soil).

Application of Central Tendencies Guidance

Central tendency assumptions were applied to calculate non-cancer risks for exposure to COPCs in surface soil and subsurface soil for future residential receptors. 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. Based on this evaluation, the central tendency HIs for the soil ingestion, dermal contact, and dust inhalation pathways yield a sum which is less than 1.0 for the future residential child

exposed to surface soil and for the future residential child exposed to subsurface soil (assuming subsurface soils become future surface soils).

17.7.2 Conclusions

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. The cancer risks associated with surface and subsurface soil exposure for the future residential exposure scenarios were within the 1E-04 to 1E-06 target acceptable 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 scenarios 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 overconservative 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 amended risk assessment procedure resulted in the elimination of all cancer and non-cancer risks above target guideline limits.

Risk characterization results (total cancer risks and total noncarcinogenic HIs) are presented for all potential receptors at Site 15 in Table 17-25 for surface soil, subsurface soil, sediment, and surface water. Table 17-25a presents the relevant central tendency risk estimates associated with future industrial and future residential receptors for groundwater.

17.8 ECOLOGICAL RISK ASSESSMENT

17.8.1 Preliminary Problem Formulation

Habitat Types and Ecological Receptors

Site 15 is a relatively small area located in the Waterfront complex north of Highway 36. The entire site is located within a red maple/sweetgum wetland. The site is near an abandoned railroad bed built

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.

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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.

approximately 6 feet higher on grade than the surrounding area. The railroad bed area contains some ferns, grasses, and skunk cabbage. Soils are Elkton loam and are generally saturated at 7 inches below the ground. A drainage swale is located adjacent to the abandoned railroad spur, but water in the swale is ephemeral. Runoff from the site and a nearby road and parking lot flows toward the swale and eventually to a tributary of Ware Creek, therefore, the site is located in the Ware Creek watershed. The stream empties into a large, tidal *Phragmites* salt marsh approximately 600 feet to the northwest, although the site itself does not appear to be tidally influenced. The site provides excellent habitat for ecological receptors, primarily for terrestrial receptors since the site is wooded and water is ephemeral in the drainage swale. Wetland species are expected to use the salt marsh to the northwest. Aquatic mammals and wading birds probably forage in the marsh area. RI Sites 12, 16, and 17 are located north of Site 15 and are also located within the Ware Creek watershed. No sensitive habitats, other than the wetlands, and no threatened or endangered species are known to occur in the area.

Contaminant Sources, Release Mechanisms, and Migration Pathways

The major contaminant release pathways from the site are overland runoff and infiltration of contaminants. Overland runoff from precipitation may carry constituents from the site and from the road and parking lot to drainage swale surface waters, sediments, and possibly to surface water and sediments in the wetlands and salt marsh. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water in the swale or the marsh; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms.

Exposure Routes

Terrestrial receptors at Site 15 may be exposed to surface soil contaminants via incidental ingestion of soil or by ingestion of contaminated food items. Terrestrial receptors may also come into contact with contaminants in Site 15 surface water by using it for drinking. Terrestrial vegetation may also be exposed to contaminants in soils at Site 15. Aquatic and semi-aquatic organisms and terrestrial organisms inhabiting the nearby wetlands may be exposed to contaminants via direct contact with surface water and sediments, incidental ingestion of surface water and sediments, and consumption of contaminated food items. Aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water.

Selection of Preliminary Contaminants of Potential Concern (COPCs)

Preliminary COPCs were those contaminants identified in 1995 RI activities for this site. In particular, contaminants detected in Site 15 surface water, sediments, and surface soils were considered preliminary

COPCs. Constituents in 1993 SI subsurface soil, sediment, and groundwater samples, and 1995 RI subsurface soil samples were evaluated qualitatively.

Assessment and Measurement Endpoints

A detailed description of facility-wide assessment and measurement endpoints is provided in Section 2.6.

Conceptual Site Model

Site-specific conceptual models were beyond the scope of this initial screening. A facility-wide conceptual model is provided in Section 2.6.

17.8.2 Ecological Effects Assessment

Ecotox threshold (ET) values were used for screening potential ecological risks from contaminated surface water, sediments, and surface soils. Surface water, sediment, surface soil, and terrestrial plant ET values are presented in Tables 2-28, 2-29, 2-30, and 2-31, respectively.

17.8.3 Preliminary Exposure Assessment

Contaminant concentrations in environmental media used for this initial screening were obtained from data generated during 1995 RI activities. The maximum detected contaminant concentrations in surface water, sediment, and surface soil were used as conservative representative exposure point concentrations. In addition, subsurface soil, sediment, and groundwater samples from the SI and 1995 RI subsurface soil samples are discussed qualitatively in Section 17.8.5. Background concentrations presented for comparative purposes were obtained from facility-wide background samples. Section 2.4.1 contains a detailed description of data validation, treatment, and selection used in the ERA.

17.8.4 Risk Characterization

In Site 15 surface water, aluminum (HQ = 3.89), barium (HQ = 12.7), cobalt (HQ = 3.6), and manganese (HQ = 14) exceeded ET values and were retained as final COPCs (Table 17-26). In Site 15 sediments, the inorganics arsenic, cadmium, copper, lead, mercury, silver, and zinc all slightly exceeded most conservative ET values and were retained as final COPCs, but only zinc exceeded a less conservative value (Table 17-27). The organics alpha-chlordane (HQ = 4.43), fluoranthene (HQ = 1.24), and gamma-chlordane (HQ = 4.14) exceeded the only ET values available for those compounds in sediments. Several organics exceeded most conservative ETs and were retained as final COPCs but did not exceed less conservative ET values, including the pesticide 4,4'-DDD and several PAHs. The pesticide 4,4'-DDE exceeded the most conservative ET available and slightly exceeded a less conservative value, as did a

TABLE 17-26
SURFACE WATER CONTAMINANTS OF POTENTIAL CONCERN - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (μg/L)	Maximum Concentration (μg/L)	Ecotox Threshold (μg/L)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	2/2	409	338	87	3.89	Retained-HQ > 1
Barium	2/2	34	49.5	3.9	12.7	Retained-HQ > 1
Beryllium	2/2	0.33	0.88	5.1	0.17	Eliminated-Does not exceed threshold
Cadmium	2/2	0.18	0.37	1.0	0.37	Eliminated-Does not exceed threshold
Cobalt	2/2	1.9	10.9	3.0	3.6	Retained-HQ > 1
Copper	2/2	9.8	6.8	11	0.62	Eliminated-Does not exceed threshold
Lead	1/2	4.4	2	2.5	0.8	Eliminated-Does not exceed threshold
Manganese	2/2	55.5	1120	80	14	Retained-HQ > 1
Mercury	2/2	0.028	0.13	1.3	0.10	Eliminated-Does not exceed threshold
Nickel	2/2	7.1	12.5	160	0.08	Eliminated-Does not exceed threshold
Zinc	2/2	29.4	68.1	100	0.68	Eliminated-Does not exceed threshold
Organics						
4,4'-DDD	1/1	ND	0.0018	0.013	0.14	Eliminated-Does not exceed threshold

ND = None detected

TABLE 17-27
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Butylbenzylphthalate	1/3	ND	910	11000	0.08	Eliminated-Does not exceed threshold
Carbazole	1/3	ND	250	330	0.76	Eliminated-Does not exceed threshold
Chrysene	3/3	940	2200	330/2800	6.67/0.79	Retained-HQ > 1
Di-N-butylphthalate	1/3	ND	160	11,000	0.01	Eliminated-Does not exceed threshold
Dibenzo(a,h)anthracene	1/3	ND	340	330/5100	1.03/0.07	Retained-HQ > 1
Dibenzofuran	1/3	ND	130	2000	0.07	Eliminated-Does not exceed threshold
Endrin	1/3	ND	10	20	0.5	Eliminated-Does not exceed threshold
Fluoranthene	3/3	1800	3600	2900	1.24	Retained-HQ > 1
Fluorene	1/3	190	180	540	0.33	Eliminated-Does not exceed threshold
Gamma-Chlordane	2/3	0.095	29	7	4.14	Retained-HQ > 1
Heptachlor Epoxide	2/3	ND	3.2	5	0.64	Eliminated-Does not exceed threshold
Indeno(1,2,3-cd)pyrene	2/3	310	1100	330/1700	3.33/0.65	Retained-HQ > 1
Napthalene	1/3	ND	140	480	0.29	Eliminated-Does not exceed threshold
Phenanthrene	3/3	1900	1800	850/1500	2.12/1.2	Retained-HQ > 1
Pyrene	3/3	1900	3400	660/2600	5.15/1.3	Retained-HQ > 1
Styrene	1/3	ND	11	NA		Retained-No suitable threshold available

ND = None detected
NA = No suitable threshold was available
1 When two values are presented, the left value is the most conservative available and the right value is a less conservative value, if available. In these instances, two HQ values are presented.
2 Contaminants were retained as final COPCs if the most conservative ET value available was exceeded.
3 All organic values are in μg/kg.

TABLE 17-27
SEDIMENT CONTAMINANTS OF POTENTIAL CONCERN - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold[1] (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC[2]
Inorganics						
Aluminum	3/3	3940	10600	NA		Retained-No suitable threshold available
Arsenic	3/3	6.2	25.5	8.2/70	3.1/0.36	Retained-HQ > 1
Barium	3/3	10.6	45.4	40	1.14	Retained-HQ > 1
Beryllium	2/3	0.57	1.7	NA		Retained-No suitable threshold available
Cadmium	1/3	ND	1.9	1.2/9.6	1.58/0.2	Retained-HQ > 1
Chromium	3/3	56	58.7	81	0.72	Eliminated-Does not exceed threshold
Cobalt	2/3	2.1	7.1	50	0.14	Eliminated-Does not exceed threshold
Copper	3/3	13	269	34/270	7.91/0.99	Retained-HQ > 1
Lead	3/3	34.3	187	47/218	3.98/0.86	Retained-HQ > 1
Manganese	3/3	9.2	72.8	460	0.16	Eliminated-Does not exceed threshold
Mercury	3/3	0.068	0.67	0.15/0.71	4.45/0.94	Retained-HQ > 1
Nickel	2/3	6	15.5	21	0.74	Eliminated-Does not exceed threshold
Selenium	2/3	ND	2.2	NA		Retained-No suitable threshold available
Silver	2/3	ND	3.1	1.0/3.7	3.10/0.84	Retained-HQ > 1
Thallium	3/3	ND	2.8	NA		Retained-No suitable threshold available
Vanadium	3/3	42.7	48.7	NA		Retained-No suitable threshold available
Zinc	3/3	26.9	464	150/410	3.09/1.13	Retained-HQ > 1
Organics[3]						
2-Butanone	1/3	ND	86	NA		Retained-No suitable threshold available
2-Methylnapthalene	1/3	ND	300	330	0.91	Eliminated-Does not exceed threshold
4,4'-DDD	3/3	21	45	1.6/46	28.1/0.98	Retained-HQ > 1
4,4'-DDE	3/3	1.7	59	2.2/27	26.8/2.19	Retained-HQ > 1
4,4'-DDT	2/3	19	46	1.6/46	28.8/1.0	Retained-HQ > 1
Acenapthene	1/3	ND	140	620	0.23	Eliminated-Does not exceed threshold
Alpha-Chlordane	2/3	ND	31	7	4.43	Retained-HQ > 1
Anthracene	2/3	ND	240	330	0.73	Eliminated-Does not exceed threshold
Aroclor 1260	2/3	ND	100	22.7/180	4.40/0.56	Retained-HQ > 1
Benzo(a)anthracene	2/3	560	1400	330/1600	4.24/0.88	Retained-HQ > 1
Benzo(a)pyrene	2/3	590	1500	430/1600	3.49/0.94	Retained-HQ > 1
Benzo(b)fluoranthene	3/3	490	2700	330/1700	8.18/1.59	Retained-HQ > 1
Benzo(g,h,i)perylene	2/3	380	1200	330/1700	3.64/0.71	Retained-HQ > 1
Benzo(k)fluoranthene	2/3	470	930	330/1700	2.82/0.55	Retained-HQ > 1

few PAHs. Some inorganics, including aluminum, beryllium, selenium, thallium, vanadium, and some organics, including 2-butanone and styrene, were conservatively retained as final COPCs in sediments since no suitable ET values were available.

In Site 15 surface soils, the inorganics aluminum (HQ = 15.4), chromium (HQ = 94.2), mercury (HQ = 1.6), and vanadium (HQ = 1.8) exceeded ET values (Table 17-28). Benzo(b)fluoranthene (HQ = 1.6), fluoranthene (HQ = 1.8), phenanthrene (HQ = 1.0), and pyrene (HQ = 2.1) all slightly exceeded ET values and were retained as final COPCs. Antimony, beryllium, thallium, and bis(2-ethylhexyl) phthalate were conservatively retained as final surface soil COPCs since no suitable ET values were available. Aluminum (HQ = 185), arsenic (HQ = 1.92), cadmium (HQ = 1.13), chromium (HQ = 37.7), lead (HQ = 2.2), thallium (HQ = 1.0), vanadium (HQ = 18.0), and zinc (HQ = 1.05) exceeded terrestrial plant ET values (Table 17-29). Terrestrial plant ET values for organics are scarce and were not available for any organics in Site 15 surface soils, and therefore, potential risks to terrestrial plants from organics in surface soil could not be quantitatively evaluated.

The toxicological properties of final COPCs in all media are summarized in Appendix M.

17.8.5 Summary and Conclusions

Site 15 is located in the Waterfront complex and is 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 areas 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.

TABLE 17-28
SURFACE SOIL CONTAMINANTS OF POTENTIAL CONCERN - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	2/2	5310	9250	600	15.4	Retained-HQ > 1
Antimony	1/2	ND	1.8	NA		Retained-No suitable threshold available
Arsenic	2/2	14.4	19.2	60	0.32	Eliminated-Does not exceed threshold
Barium	2/2	31	18	3000	0.006	Eliminated-Does not exceed threshold
Beryllium	1/2	0.28	0.97	NA		Retained-No suitable threshold available
Cadmium	2/2	0.57	3.4	20	0.17	Eliminated-Does not exceed threshold
Chromium	2/2	59.5	37.7	0.4	94.2	Retained-HQ > 1
Cobalt	2/2	5	2.8	1000	0.003	Eliminated-Does not exceed threshold
Copper	2/2	8.4	33.2	50	0.66	Eliminated-Does not exceed threshold
Lead	2/2	39.4	110	500	0.22	Eliminated-Does not exceed threshold
Manganese	2/2	214	92.9	100	0.93	Eliminated-Does not exceed threshold
Mercury	2/2	0.17	0.16	0.10	1.6	Retained-HQ > 1
Nickel	2/2	7.2	7.5	200	0.03	Eliminated-Does not exceed threshold
Thallium	1/2	1.9	1.5	NA		Retained-No suitable threshold available
Vanadium	2/2	64	36	20	1.8	Retained-HQ > 1
Zinc	2/2	27.6	52.4	200	0.26	Eliminated-Does not exceed threshold
Organics						
4,4'-DDE	2/2	330	43	100	0.43	Eliminated-Does not exceed threshold
4,4'-DDT	1/1	420	12	100	0.12	Eliminated-Does not exceed threshold
Alpha-BHC	1/2	ND	0.13	100	0.001	Eliminated-Does not exceed threshold
Benzo(a)anthracene	1/2	ND	71	100	0.71	Eliminated-Does not exceed threshold
Benzo(a)pyrene	2/2	ND	69	100	0.69	Eliminated-Does not exceed threshold
Benzo(b)fluoranthene	2/2	ND	160	100	1.6	Retained-HQ > 1
Bis(2-ethylhexyl)phthalate	2/2	ND	110	NA		Retained-No suitable threshold available
Chrysene	2/2	ND	90	100	0.9	Eliminated-Does not exceed threshold
Fluoranthene	2/2	84	180	100	1.8	Retained-HQ > 1
Phenanthrene	2/2	ND	100	100	1.0	Retained-HQ > 1
Pyrene	2/2	46	210	100	2.1	Retained-HQ > 1

ND = None detected
NA = No suitable threshold was available
• all organic values are in μg/kg

TABLE 17-29
TERRESTRIAL PLANT CONTAMINANTS OF POTENTIAL CONCERN - SITE 15
NWS EARLE, COLTS NECK, NEW JERSEY

Contaminant of Potential Concern (COPC)	Frequency of Detection	Background Concentration (mg/kg)	Maximum Concentration (mg/kg)	Ecotox Threshold (mg/kg)	Hazard Quotient	Reason for Retention or Elimination as Final COPC
Inorganics						
Aluminum	2/2	5310	9250	50	185	Retained-HQ > 1
Antimony	1/2	ND	1.8	5.0	0.36	Eliminated-Does not exceed threshold
Arsenic	2/2	14.4	19.2	10	1.92	Retained-HQ > 1
Barium	2/2	31	18	500	0.04	Eliminated-Does not exceed threshold
Beryllium	1/2	0.28	0.97	10	0.10	Eliminated-Does not exceed threshold
Cadmium	2/2	0.52	3.4	3	1.13	Retained-HQ > 1
Chromium	2/2	59.5	37.7	1	37.7	Retained-HQ > 1
Cobalt	2/2	4.27	2.8	20	0.14	Eliminated-Does not exceed threshold
Copper	2/2	8.4	33.2	100	0.33	Eliminated-Does not exceed threshold
Lead	2/2	39.4	110	50	2.2	Retained-HQ > 1
Manganese	2/2	182.6	92.9	500	0.19	Eliminated-Does not exceed threshold
Mercury	2/2	0.17	0.16	0.3	0.53	Eliminated-Does not exceed threshold
Nickel	2/2	7.2	7.5	30	0.25	Eliminated-Does not exceed threshold
Thallium	1/2	1.9	1.5	1	1.5	Retained-HQ > 1
Vanadium	2/2	64	36	2	18.0	Retained-HQ > 1
Zinc	2/2	27.6	52.4	50	1.05	Retained-HQ > 1
Organics						

ND = None detected
NA = No suitable benchmark was available
* No suitable ETs were available for organics

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 exceeded a less conservative ET value. Nonetheless, it only slightly exceeded the less conservative ET. The concentration of this zinc may be naturally elevated. Some inorganics were retained as final COPCs in sediments since 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 not be the result of intense past seashore vector control programs not due to Site-15-related activities and were not detected atg relatively high concentrations. Styrene and 2-butanone were conservatively retained as final COPCs since no suitable ETs were available but 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 was less than background. The elevated HQ value for this inorganic is probably due to the heavily conservative ET used. HQs for organics were also indicative of low potential risk. A phthalate compound was conservatively retained as a final COPC since no ET value was available, but it was detected at a low concentration. Phthalates are ubiquitous in the environment. 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 each 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 since they bind to organic fractions in sediments.

In Site 15 surface soils, no inorganics exceeded ETs and were retained as final COPCs. Aluminum was retained since no ET was available, but it was 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, since surface drainage from those areas empties into the drainageway next to the site, as a result of past oily bilge water dumping.

The site 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 does not appear to be necessary, nor does remediation at the site based on ecological concerns.

Additional sediment samples could be taken downstream to investigate potential off-site migration of contaminants into the Ware Creek watershed and possible cumulative addition of Site-15-related contaminants with contaminants from other RI sites nearby, but the usefulness of these samples, especially for determining corrective action, is questionable.

17.9 EVALUATION AND RECOMMENDATIONS

17.9.1 Evaluation Summary

Arsenic, antimony, cadmium, and chromium were found in site soils at concentrations greater than background. Arsenic and cadmium were found in site soils at levels above NJDEP soil residential direct contact cleanup criteria in the area west of Building R-5.

Results of the human health risk assessment concluded that all calculated risks were below guideline limits.

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

17.9.1 Recommendations

Additional surface water and sediment samples taken farther downgradient would confirm the ecological risk screening conclusion and could be used to gauge combined ecological impacts from all waterfront sites.