N62269.AR.000710
NAWC WARMINSTER
5090.3a

REMEDIAL INVESTIGATION (RI) REPORT
OPERABLE UNIT 10 (OU-10)
(SITE 5 MEDIA OTHER THAN GROUNDWATER)
for
NAVAL AIR WARFARE CENTER
WARMINSTER, PENNSYLVANIA

Northern Division
Naval Facilities Engineering Command
Contract No. N62472-90-D-1298
Contract Task Order 159

August 2000

TETRA TECH NUS, INC.

190

TETRA TECH NUS, INC.
600 Clark Avenue, Suite 3 ▪ King of Prussia, PA 19406-1433
(610) 491-9688 ▪ FAX (610) 491-9645 ▪ www.tetratech.com

PHIL-14379

August 4, 2000

Project 1412

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mailstop #82
10 Industrial Highway
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N642472-90-D-1298
Contract Task Order (CTO) No. 290

Subject: Final Remedial Investigation (RI) Report for Operable Unit 10 (OU-10)
Site 5 Media Other than Groundwater
Former Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Monaco:

Enclosed please find two copies of the final RI report for Site 5 soils and Area B surface water and sediment. Copies are being sent to the individuals identified in the distribution list.

Please contact me if you have any questions or comments.

Sincerely,

Garth Glenn
Project Coordinator

ANT/ejc

Enclosures

c: Michael Fohner (NAVFACENGCOM)
April Flipse (PADEP)
Darius Ostrauskas (EPA Region III) (with two enclosures)
Everett Hogg (Bucks County Department of Health)
Richard Lander (Northampton Township)
Bob Cormack (FLRA)
Norm Kelly (FLRA Co-Chair)
Mitchell Rotbert (Greenberg Traurig Attorneys at Law)
John Geyer (Northampton Township)
Administrative Record
David Fennimore (Earth Data, Inc.)
Anthony Sauder (Pennoni Associates)
Neil Teamerson (Tetra Tech NUS)
Jeffrey Orient (Tetra Tech NUS)

190

PHIL-13748

REMEDIAL INVESTIGATION/(RI) REPORT
FOR OPERABLE UNIT 10 (OU-10)
(SITE 5 MEDIA OTHER THAN GROUNDWATER)

NAWC WARMINSTER

COMPREHENSIVE LONG - TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) PROGRAM

Submitted to:
Northern Division
Environmental Branch, Mail Stop No. 82
Naval Facilities Engineering Command
10 Industrial Highway
Lester, Pennsylvania 19112-5094

Submitted by:
Tetra Tech NUS
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

Contract No. N62472-90-D-1298
Contract Task Order Number 0159

AUGUST 2000

SUBMITTED BY:

for Neil Veamerson

JEFFREY P. ORIENT, P.G.
PROJECT MANAGER
TETRA TECH NUS
PITTSBURGH, PENNSYLVANIA

APPROVED BY:

John Trepanowski

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

L/DOCUMENTS/NAVY/1412/SITE5/13748/COVTOC

TABLE OF CONTENTS

SECTION		PAGE
EXECUTIVE SUMMARY		**ES-1**
GLOSSARY		**GL-1**
1.0	**INTRODUCTION**	**1-1**
1.1	PURPOSE OF THE REPORT	1-1
1.2	FACILITY BACKGROUND AND HISTORY	1-2
1.2.1	Facility Description	1-2
1.2.2	Facility History	1-5
1.2.3	Environmental Investigations	1-6
1.2.3.1	Area A Investigation and Response Actions	1-7
1.2.3.2	Area B Investigation and Response Actions	1-8
1.2.3.3	Area C Investigation and Response Actions	1-10
1.2.3.4	Area D Investigation and Response Actions	1-11
1.3	SITE 5 DESCRIPTION AND HISTORY AND DESCRIPTION	1-12
1.3.1	Site Description	1-12
1.3.2	Site History	1-12
1.3.3	Previous Response Actions	1-21
1.4	Summary of Previous Investigations at Site 5	1-21
1.4.1	Groundwater Studies	1-23
1.5	CURRENT STATUS	1-25
1.6	REPORT ORGANIZATION	1-25
2.0	**SITE 5 REMEDIAL INVESTIGATIONS**	**2-1**
2.1	INTRODUCTION	2-1
2.2	GENERAL FIELD INVESTIGATION PROCEDURES	2-3
2.2.1	Scope of Work	2-3
2.2.2	Soil Gas Survey	2-4
2.2.3	Soil Borings	2-7
2.2.4	Stream Sampling and Analysis	2-8
2.2.4.1	Surface Water Sampling	2-8
2.2.4.2	Sediment Sampling	2-11
2.2.5	Surface Soil Sampling	2-11
2.2.6	Subsurface Soil Sampling	2-17
2.2.7	Wetlands Assessment	2-19
2.2.8	Background Sampling	2-19
2.2.8.1	Background Soil Sampling	2-19
2.2.9	Surveying	2-21
2.3	ANALYTICAL PROCEDURES AND DATA VALIDATION	2-23
2.3.1	Analytical Procedures	2-23
2.3.2	Data Validation	2-23
2.4	DATA EVALUATION	2-26
2.4.1	Representative Concentrations	2-27
2.4.2.	Data Reduction/Tabulation	2-30
2.4.3	Comparison of Data to Screening Criteria	2-30
3.0	**PHYSICAL CHARACTERISTICS**	**3-1**
3.1	METEOROLOGY	3-1
3.2	SURFACE WATER HYDROLOGY AND TOPOGRAPHY	3-1
3.3	SOILS	3-4

TABLE OF CONTENTS (continued)

SECTION		PAGE
3.4	GEOLOGY	3-4
3.4.1	Regional Geology	3-4
3.4.2	Geology of Site 5	3-5
3.5	HYDROGEOLOGY	3-6
3.5.1	Regional Hydrogeology	3-6
3.5.2	Hydrogeology of Site 5	3-7
3.6	ECOLOGY	3-8
3.7	GROUNDWATER USE	3-12
4.0	**NATURE AND EXTENT OF CONTAMINATION**	**4-1**
4.1	INTRODUCTION	4-1
4.2	GEOPHYSICAL SURVEY	4-1
4.3	SOIL GAS SURVEY RESULTS	4-1
4.3.1	Phase I RI	4-1
4.3.2	Phase III RI	4-1
4.4	AIR MONITORING RESULTS	4-6
4.5	EXTENT OF POTENTIAL BURIED WASTES	4-6
4.6	SURFACE SOIL RESULTS	4-12
4.7	SUBSURFACE SOIL	4-19
4.8	COMPARISON OF SOIL CONCENTRATIONS TO OTHER SCREENING LEVELS	4-24
4.9	SURFACE WATER RESULTS	4-27
4.10	SEDIMENT RESULTS	4-35
4.11	SUMMARY AND CONCLUSIONS	4-40
5.0	**CONTAMINANT FATE AND TRANSPORT**	**5-1**
5.1	PHYSICAL AND CHEMICAL TRANSPORT PROPERTIES	5-1
5.1.1	Solubility	5-1
5.1.2	Octanol-Water Partitioning Coefficient (Kow)	5-4
5.1.3	Organic Carbon Partitioning Coefficient (Koc)	5-4
5.1.4	Vapor Pressure	5-5
5.1.5	Bioconcentration Factor (BCF)	5-5
5.1.6	Specific Gravity	5-5
5.2	POTENTIAL MIGRATION ROUTES	5-6
5.2.1	Atmospheric Migration via Vapor Emissions	5-6
5.2.2	Atmospheric Migration via Particulate Emissions	5-6
5.2.3	Subsurface Contaminant Migration to Surface Water and Sediment	5-7
5.2.4	Surface Water and Sediment Transport	5-8
5.2.5	Soil Transport and Migration to Groundwater and Other Media	5-8
5.3	CONTAMINANT PERSISTENCE	5-9
6.0	**BASELINE RISK ASSESSMENT**	**6-1**
6.1	HUMAN HEALTH RISK ASSESSMENT	6-1
6.2	DATA EVALUATION	6-3
6.2.1	Background Comparison Tests	6-3
6.2.2	Identification of COPCs	6-6
6.2.2.1	Surface Soil COPC Selection	6-6
6.2.2.2	Subsurface Soil COPC Selection	6-11
6.2.2.3	Sediment COPC Selection	6-14

TABLE OF CONTENTS (continued)

SECTION		PAGE
6.2.2.4	Surface Water COPC Selection	6-15
6.2.3	Distributional Analysis of the Data	6-16
6.2.4	Exposure Point Concentrations	6-25
6.2.4.1	Calculation of Exposure Point Concentrations	6-25
6.2.4.2	Reasonable Maximum Exposure EPCs	6-27
6.2.4.3	EPCs for Current/Future and Future Surface Soil Exposure Pathways	6-28
6.2.4.4	EPCs for Current/Future and Future Subsurface Soil Exposure Pathways	6-28
6.2.4.5	EPCs for Future Sediment Exposure Pathways	6-28
6.2.4.6	EPCs for Future Surface Water Exposure Pathways	6-29
6.3	EXPOSURE ASSESSMENT	6-29
6.3.1	Characterization of the Exposure Setting	6-29
6.3.2	Potential Receptors	6-29
6.3.2.1	Surface Soil Exposure	6-31
6.3.2.2	Subsurface Soil Exposure	6-31
6.3.2.3	Sediment Exposure	6-32
6.3.2.4	Surface Water (Total Inorganics and Organics) Exposure	6-32
6.3.3	Exposure Estimates	6-32
6.3.3.1	Surface and Subsurface Soil Exposure Estimates	6-33
6.3.3.2	Sediment Soil Exposure Estimates	6-34
6.3.3.3	Surface Water Exposure Estimates	6-49
6.3.4	Blood-Lead Modeling	6-49
6.4	DOSE-RESPONSE ASSESSMENT	6-53
6.4.1	Reference Doses	6-53
6.4.2	Cancer Slope Factors (SFs)	6-58
6.4.3	EPA Weight of Evidence	6-59
6.4.4	Adjustment of Dose-Response Parameters for Dermal Exposure	6-59
6.4.5	Carcinogenicity of PAHs	6-60
6.4.6	Toxicity Criteria for Chromium	6-60
6.5	RISK CHARACTERIZATION	6-60
6.5.1	Noncarcinogenic Risks	6-61
6.5.2	Carcinogenic Risks	6-61
6.5.3	Comparison of Quantitative Risk Estimates to Benchmark Criteria	6-62
6.5.4	Site-Specific Noncarcinogenic Risks	6-63
6.5.4.1	Surface Soil	6-63
6.5.4.2	Subsurface Soil	6-73
6.5.4.3	Sediment	6-73
6.5.4.4	Surface Water (Total Inorganics and Organics)	6-73
6.5.5	Site-Specific Carcinogenic Risks	6-85
6.5.5.1	Surface Soil	6-85
6.5.5.2	Subsurface Soil	6-85
6.5.5.3	Sediment	6-101
6.5.5.4	Surface Water	6-101
6.5.6	Lead Risks	6-101
6.6	UNCERTAINTY ANALYSIS FOR THE HHRA	6-113
6.6.1	Uncertainties Associated with Data Evaluation	6-113
6.6.2	Uncertainties Associated with Exposure Assessment	6-116
6.6.3	Uncertainties Associated with Dose-Response Assessment	6-118
6.6.4	Uncertainties Associated with Risk Characterization	6-120
6.7	HHRA CONCLUSIONS FOR SITE 5	6-121
6.8	Ecological Risk Assessment	6-122
6.8.1	ERA Approach	6-122

TABLE OF CONTENTS (continued)

SECTION		PAGE
6.8.2	Preliminary Problem Formulation	6-124
6.8.2.1	Environmental Setting	6-124
6.8.2.2	Ecological Contaminants of Potential Concern	6-127
6.8.2.3	Contaminant Exposure Pathways	6-128
6.8.2.4	Potential Ecological Receptors	6-129
6.8.2.5	Assessment and Measurement Endpoints	6-129
6.8.3	Ecological Effects Characterization	6-132
6.8.4	Exposure Assessment	6-142
6.8.4.1	Screening Food Web Model	6-142
6.8.4.2	Toxicity Reference Values	6-144
6.8.5	Risk Characterization	6-145
6.8.5.1	Environmental Effects Quotient (EEQ) Results	6-145
6.8.5.2	Food Web Modeling Results	6-149
6.8.6	Uncertainty Analysis	6-152
6.8.6.1	Uncertainty in the Preliminary Problem Formulation	6-153
6.8.6.2	Uncertainty in the Ecological Effects Characterization	6-154
6.8.6.3	Uncertainty in the Exposure Assessment	6-154
6.8.6.4	Uncertainty in the Risk Characterization	6-155
6.8.7	Conclusions	6-156

REFERENCES **R-1**

APPENDICES

A ANALYTICAL DATABASE

- **A-1 Site 5 Surface Soil**
- **A-2 Site 5 Subsurface Soil**
- **A-3 Area B Surface Water**
- **A-4 Area B Sediment**
- **A-5 Miscellaneous Parameters**

B PHASE III SOIL GAS RESULTS

C PHASE II AND PHASE III BORING LOGS

D PHASE I CONFIRMATION BORINGS

E TABULATED SURVEY DATA

F SAMPLE LOGSHEETS

G EXAMPLE CALCULATIONS

- **G-1 BLOOD-LEAD LEVEL MODELING**
- **G-2 BACKGROUND COMPARISON TESTS**
- **G-3 EXAMPLE RISK CALCULATIONS**

H TOXICITY PROFILES

TABLE OF CONTENTS (continued)

I SUPPLEMENTAL SITE 5 SAMPLING AND ANALYSIS PLAN (NOVEMBER 23, 1999)

J DERMAL DERIVATIONS FOR EXPOSURE ASSESSMENT

TABLES

TABLE		PAGE
2-1	Summary of RI Field Work and Other Activities	2-2
2-2	Occurrence and Distribution of Total Inorganics in Background Area B	2-12
2-3	Occurrence and Distribution of Dissolved Inorganics in Surface Water in Background Area B	2-13
2-4	Occurrence and Distribution of Total Inorganics in Sediment in Background Area B	2-14
2-5	Occurrence and Distribution of Organics in Sediment in Background Area B	2-15
2-6	Occurrence and Distribution of Organics and Inorganics in Background Soil	2-22
2-7	Summary of Analytical Parameters Phase III RI	2-24
2-8	Soil Criteria for Chemicals Detected in Site 5 Soils	2-32
4-1	Site 5 Air Sampling Locations	4-8
4-2	Air Monitoring Gas Chromatography – Mass Spectrometry Results	4-9
4-3	Air Monitoring – Charcoal Tube	4-10
4-4	Occurrence and Distribution of Organics and Inorganics in Site 5 Surface Soil	4-14
4-5	Occurrence and Distribution of Organics and Inorganics in Site 5 Subsurface Soil	4-20
4-6	Occurrence and Comparison of Soil EPCs to Soil-to-Groundwater Soil Screening Levels for Site 5 Soils	4-25
4-7	Occurrence and Distribution of Organics in Surface Water at Area B	4-32
4-8	Occurrence and Distribution of Total Inorganics in Surface Water at Area B	4-33
4-9	Occurrence and Distribution of Dissolved Inorganics in Surface Water at Area B	4-34
4-10	Occurrence and Distribution of Organics in Sediment at Area B	4-37
4-11	Occurrence and Distribution of Inorganics in Sediment at Area B	4-39
5-1	Summary of Physical and Chemical Data for Site 5 Contaminants	5-2
6-1	Summary of COPC Selection Criteria, Site 5 Surface Soil, Subsurface Soil, Sediment and Surface Water	6-7
6-2	Medium-Specific Exposure Point Concentration Summary	6-8
6-3	Medium-Specific Exposure Point Concentration Summary	6-12
6-4	Representative Concentration and Statistical Distribution of Contaminants Surface Soil	6-17
6-5	Representative Concentration and Statistical Distribution of Contaminants Subsurface Soil	6-19
6-6	Occurrence and Distribution of Contaminants in Sediment	6-21
6-7	Occurrence and Distribution of Contaminants in Surface Water	6-23
6-8	Values used for Daily Intake Calculations – RME Child Resident Contact with Site 5 Surface Soil	6-35
6-9	Values used for Daily Intake Calculations – RME Child Resident Particulate Dust Inhalation from Site 5 Surface Soil	6-36
6-10	Values used for Daily Intake Calculations – RME Child Resident Contact with Site 5 Subsurface Soil	6-37
6-11	Values used for Daily Intake Calculations – RME Child Resident Particulate Dust Inhalation from Site 5 Subsurface Soil	6-38
6-12	Values used for Daily Intake Calculations – RME Adult Resident Contact with Site 5 Surface Soil	6-39
6-13	Values used for Daily Intake Calculations – RME Adult Resident Particulate Dust Inhalation from Site 5 Surface Soil	6-40

TABLE OF CONTENTS (continued)

TABLE		PAGE
6-14	Values used for Daily Intake Calculations – RME Adult Resident Contact with Site 5 Subsurface Soil	6-41
6-15	Values used for Daily Intake Calculations – RME Adult Resident Particulate Dust Inhalation from Site 5 Subsurface Soil	6-42
6-16	Values used for Daily Intake Calculations – RME Adult Industrial Worker Contact with Site 5 Surface Soil	6-43
6-17	Values used for Daily Intake Calculations – RME Adult Industrial Worker Particulate Dust Inhalation from Site 5 Surface Soil	6-44
6-18	Values used for Daily Intake Calculations – RME Adult Industrial Worker Contact with Site 5 Subsurface Soil	6-45
6-19	Values used for Daily Intake Calculations – RME Adult Industrial Worker Particulate Dust Inhalation from Site 5 Subsurface Soil	6-46
6-20	Exposure Input Parameters – Sediment Ingestion	6-47
6-21	Exposure Input Parameters – Dermal Contact with Sediment	6-48
6-22	Exposure Input Parameters – Surface Water Ingestion	6-50
6-23	Exposure Input Parameters – Dermal Contact with Surface Water	6-51
6-24	Non-Cancer Toxicity Data – Oral/Dermal	6-54
6-25	Non-Cancer Toxicity Data – Inhalation	6-55
6-26	Cancer Toxicity Data – Oral/Dermal	6-56
6-27	Cancer Toxicity Data – Inhalation	6-57
6-28	Calculation of Non-Cancer Hazards – Child Resident Contact (Ing. & Der.) with Site 5 Surface Soil	6-64
6-29	Calculation of Non-Cancer Hazards – Child Resident Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-66
6-30	Calculation of Non-Cancer Hazards – Adult Resident Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-67
6-31	Calculation of Non-Cancer Hazards – Adult Resident Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-69
6-32	Calculation of Non-Cancer Hazards – Adult Industrial Worker Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-70
6-33	Calculation of Non-Cancer Hazards – Adult Industrial Worker Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-72
6-34	Calculation of Non-Cancer Hazards – Child Resident Contact (Ing. & Der.) with Site 5 Subsurface Soil	6-74
6-35	Calculation of Non-Cancer Hazards – Child Resident Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-76
6-36	Calculation of Non-Cancer Hazards – Adult Resident Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-77
6-37	Calculation of Non-Cancer Hazards – Adult Resident Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-79
6-38	Calculation of Non-Cancer Hazards – Adult Industrial Worker Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-80
6-39	Calculation of Non-Cancer Hazards – Adult Industrial Worker Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-82
6-40	Noncarcinogenic HQS, Wading, Future Recreational Receptors – Area B Sediment	6-83
6-41	Noncarcinogenic HQS, Wading, Future Recreational Receptors – Area B Surface Water	6-84
6-42	Calculation of Cancer Risks – Child Resident Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-86
6-43	Calculation of Cancer Risks – Child Resident Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-88

TABLE OF CONTENTS (continued)

TABLE

		PAGE
6-44	Calculation of Cancer Risks – Adult Resident Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-89
6-45	Calculation of Cancer Risks – Adult Resident Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-91
6-46	Calculation of Cancer Risks – Lifetime Resident Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-92
6-47	Calculation of Cancer Risks – Lifetime Resident Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-94
6-48	Calculation of Cancer Risks – Adult Industrial Worker Contact (Ing. & Der.) with Site 5 Surface Soil Reasonable Maximum Exposure	6-95
6-49	Calculation of Cancer Risks – Adult Industrial Worker Particulate Dust Inhalation from Site 5 Surface Soil Reasonable Maximum Exposure	6-97
6-50	Calculation of Cancer Risks – Child Resident Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-98
6-51	Calculation of Cancer Risks – Child Resident Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-100
6-52	Calculation of Cancer Risks – Adult Resident Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-102
6-53	Calculation of Cancer Risks – Adult Resident Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-104
6-54	Calculation of Cancer Risks – Lifetime Resident Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-105
6-55	Calculation of Cancer Risks – Lifetime Resident Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-107
6-56	Calculation of Cancer Risks – Adult Industrial Worker Contact (Ing. & Der.) with Site 5 Subsurface Soil Reasonable Maximum Exposure	6-108
6-57	Calculation of Cancer Risks – Adult Industrial Worker Particulate Dust Inhalation from Site 5 Subsurface Soil Reasonable Maximum Exposure	6-110
6-58	Carcinogenic Risk, Wading, Future Recreational Receptors – Area B – Sediment	6-111
6-59	Carcinogenic Risk, Wading, Future Recreational Receptors – Area B – Surface Water	6-112
6-60	Summary of Noncarcinogenic and Carcinogenic Risks, Site 5 – All Exposure Pathways	6-114
6-61	Data Summary for Surface Water Organics – Area B	6-133
6-62	Data Summary for Surface Water Inorganics (Total Metals) – Area B	6-134
6-63	Data Summary for Sediment Organics – Area B	6-135
6-64	Data Summary for Sediment Inorganics – Area B	6-136
6-65	Selection of Ecological Contaminants of Concern for Surface Water Organics – Area B	6-138
6-66	Selection of Ecological Contaminants of Concern for Surface Water Inorganics (Total Metals) – Area B	6-139
6-67	Selection of Ecological Contaminants of Concern for Sediment Organics – Area B	6-140
6-68	Selection of Ecological Contaminants of Concern for Sediment Inorganics – Area B	6-141
6-69	Data Summary for Organics – Area B and Stream	6-147
6-70	Data Summary for Inorganics – Area B and Stream	6-148
6-71	Maximum Concentration Ecological Hazard Quotient Value from Food Web Model	6-150
6-72	Comparison of Ecological COPCs to ER-M Values	6-157

FIGURES

FIGURE **PAGE**

1-1	Site Location	1-3
1-2	On-Base Areas of Investigation	1-4

FIGURES (continued)

FIGURE		PAGE
1-3	Area B Layout	1-14
1-4	Area B Layout	1-15
1-5	Area B Layout	1-16
1-6	Area B Layout	1-17
1-7	Area B Layout	1-18
1-8	Area B Layout	1-19
1-9	Area B Layout	1-20
1-10	Area B Conceptual Layout of Site 5 Trenches	1-22
1-11	Well Locations Area B	1-24
2-1	Soil Gas Survey Area A Phase III RI – Site 5	2-5
2-2	Soil Boring Sample Location Map Area B	2-9
2-3	Surface Water/Sediment Sample Locations Area B	2-10
2-4	Surface Soil Sample Location Map Area B	2-16
2-5	Cofirmation Boring Locations Phase I Site 5	2-18
2-6	Background Soil Sample Locations	2-20
3-1	Wetlands Along Southampton Creek	3-3
3-2	Wetlands Assessment South of Area B	3-10
4-1	Soil Gas Survey Results Phase I – Site 5	4-2
4-2	Total VOC Soil Gas Results Area B	4-3
4-3	Total Halogenated Organics Soil Gas Results Area B	4-4
4-4	BTEX Soil Gas Results Area B	4-5
4-5	Air Sampling Locations Building 401 Area B – Site 5	4-7
4-6	Confirmation Boring Results Phase I – Site 5	4-11
4-7	Probable Locations of Waste Materials Area B – Site 5	4-13
4-8	Surface Soil Exceedances Sample Location Map Area B – Site 5	4-17
4-9	Subsurface Soil Exceedances Sample Location Map Area B – Site 5	4-22
4-10	Surface Soil Concentrations SSL Exceedances Area B – Site 5	4-28
4-11	Subsurface Soil Concentrations SSL Exceedances Area B – Site 5	4-29
4-12	Surface Water Exceedances Area B Stream	4-30
4-13	Sediment Exceedances Area B Stream	4-36
6-1	Area B, Site 5 Human Health Risk Assessment	6-30
6-2	Steps in the Ecological Risk Assessment Process Area B	6-125
6-3	Conceptual Site Model – Ecological Risk Assessment Area B Stream	6-131

EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

In response to Contract Task Order No. 159 under Contract N62472-90-D-1298, Tetra Tech NUS, Inc. (TtNUS) is submitting this remedial investigation (RI) report for Site 5 media other than groundwater (Operable Unit 10 or OU-10) at the Naval Air Warfare Center (NAWC) (formerly the Naval Air Development Center), Warminster, Pennsylvania. OU-10 addresses soils associated with Site 5 along with surface water and sediment associated with Area B. Groundwater near Area B is being addressed under OU-1B. This work is part of the Navy's Installation Restoration (IR) Program, which is designed to identify contamination of Navy and Marine Corps facilities resulting from past operations and to institute corrective measures, as needed.

SCOPE AND OBJECTIVES

The main areas of concern at NAWC Warminster involve several inactive waste sites that have been grouped into four general areas (Areas A, B, C, and D) for investigative purposes. The area of concern for this report, Area B, includes Site 5 as well as Sites 6 and 7, and lies in the southeastern corner of the base. Site 5, however, is the focus of this RI report. The objectives of the RI were to describe the nature and extent of contamination at OU-10 and to provide a baseline risk assessment based on this information. The results of the risk assessment were used to determine whether response actions were warranted for Site 5 and the Area B stream.

Environmental investigations at Site 5 were conducted in several long-term remedial phases. Three separate investigations, Phases I, II, and III, were performed between October 1989 and December 1999. This report addresses Site 5 soils and the Area B stream. To the extent practicable, the results of all RI phases have been incorporated into this report; however, the report primarily focuses on the Phase III investigation.

FACILITY HISTORY AND DESCRIPTION

The former NAWC Warminster property is located in the township of Warminster, Bucks County, Pennsylvania. The total area of the facility is approximately 734 acres. The facility lies in a populated suburban area surrounded by private homes, various commercial and industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

Commissioned in 1944, NAWC Warminster's main mission was research, development, testing, and evaluation for naval aircraft systems. NAWC Warminster also conducted studies in anti-submarine warfare systems and software development. Historically, wastes were generated during aircraft maintenance and repair, pest control, fire-fighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils.

Under the Base Realignment and Closure (BRAC) Program, the Department of Defense (DOD) realigned NAWC Warminster. The realignment was completed in September 1996 and most facility property was turned over to the Bucks County Federal Land Reuse Authority (FLRA). The FLRA is currently coordinating reuse planning for the base property, and most Navy activities have been eliminated. Site 5, however, continues to be retained by the Navy as an enlisted housing area for personnel stationed at the nearby Naval Air Station (NAS) Willow Grove, Pennsylvania.

BACKGROUND INFORMATION

Site 5 lies in the southeastern corner of the base bordering a residential neighborhood. The site is located south of the inactive main runway and adjacent to a baseball field. Site 5 was initially reported to been used for waste disposal purposes in the Navy Shore Facility Fact Form (1980). It reportedly consisted of six to eight trenches which were used for the disposal of demolition wastes, paint, solvents, scrap metal, aircraft paints, cans, and asphalt. With the exception of a reported 30 drums of asphalt, the quantity of materials disposed was reported as unknown. The asphalt may have been related to expansion or repairs to the main runway at the base. These disposal trenches were reportedly within 100 feet of the enlisted men's housing units located south of the runway, within 700 feet of the Inertial Navigation facility and 400 feet from the NAWC property boundary. The trenches were reportedly operated from 1955 to 1970, were approximately 12 feet by 70 feet by 8 feet in dimension and were covered with 2 feet of fill, graded and seeded. The majority of the site probably lies under Building 401, which houses three separate and attached residences.

An interpretation of historical aerial photographs taken between 1938 and 1990 identified at least two trenches that may be part of the disposal site reported as Site 5. Trench TR3 was identified in an aerial photo dated September 1958 and measured approximately 225 feet in length, while trench TR5 measured 150 feet in length in a photograph dated March 1965. Both former trenches were located within the current enlisted men's housing area at the base within Area B. It was reported that during the construction of Building 401 in the fall of 1970 or 1971, buried waste was encountered in the northwestern corner of this building. Construction ceased until the spring of the following year, when the waste was excavated and presumably disposed off base. It was hypothesized that the waste removed from the site was the reported 30 drums of asphalt as noted by the Navy's 1980 Fact Form. While between six and

eight trenches were reportedly used for disposal in this area, only four general trench locations (i.e., trenches TR3, TR5, TR5B, and TR5C) in the housing area were initially identified.

In addition to trenches TR3 and TR5, a more detailed review of additional aerial photographs between 1965 and 1967 indicated several locations of apparent disturbed ground with areal dimensions similar to those of TR3 and TR5 immediately north of these trenches. The possible trenches were labeled as trenches TR5B and TR5C.

SITE CHARACTERISTICS

Soil thicknesses at Site 5 were between 4 and 14 feet. The soils at the site primarily consist of silt loam with slow to moderate permeability. Based on soil borings, the thickness of the waste materials at Site 5 ranged from 2 to 10 feet below the ground surface, and the thickness of clean fill varied between 3.5 and 8 feet.

Surface topography across Area B slopes away from the main runway to the north, precluding surface water flow onto Area B in general from surrounding properties. The slope across Site 5 is about 3 percent. Stormwater collecting in the vicinity of Area B is piped underground (via Outfall No. 10) from the south-central NAWC Warminster property boundary to a point approximately 500 feet to the south, where it flows through a residential area in a concrete channel. The channel flows through the residential subdivision for about 1,000 feet and then travels through a road culvert before flowing into a streambed. This stream flows through a shaded 250-foot reach before entering a small and shallow off-base pond, which overflows into a second small pond, which in turn flows into Southampton Creek. The base flow rate was 98 gallons per minute, as measured in an area where the creek is contained within a cement culvert. There is very little flow and virtually no biotic component within the approximately 1,000-foot length of the concrete-lined ditch.

A second drainage channel exists near Building 108, located west of Site 5. This channel collects water from the vicinity of the building and discharges through Outfall No. 11, and then flows through the same residential neighborhood described above. A stormwater drain running parallel to the base property boundary east of Building 108 also collects surface water runoff and stormwater from Area B and other areas to the northeast and discharges at outfall No. 11.

Several wetlands occur downstream along Southampton Creek south of the site. These wetlands are primarily palustrine, forested, broad-leaved deciduous, and temporary. There are no endangered or threatened species within the vicinity of the base, including Area B.

RI FIELD ACTIVITIES

RI work at Site 5 and for the Area B stream focused on characterizing known and potential sources of contamination within Site 5. The results of previous investigations and analysis of historical aerial

photographs identified these sources. Field work included soil gas sampling, air monitoring, surface soil sampling and analysis, subsurface soil sampling and analysis, and a wetlands assessment. The subsurface studies consisted of drilling soil borings to better determine the nature and extent of subsurface contamination. In addition, a surface water and sediment sampling and analysis program was conducted to evaluate the impacts of Area B on the nearby stream.

Soil gas surveys were employed in areas of suspected subsurface disposal of wastes containing volatile organic compounds (VOCs). The locations of the soil gas surveys took into consideration those potential sources identified from aerial photos, the results of previous investigations, and historical information regarding the locations of subsurface disposal sites. Coordinates of suspected historical disposal locations, provided by the Environmental Photographic Interpretation Center (EPIC), were used to focus the surveys along with any other available information.

Soil borings were used to characterize actual subsurface conditions at known or potential disposal sites. The locations of the soil borings were selected based on the results of the soil gas and geophysical surveys, as well as on aerial photo records, field observations, and previous fieldwork findings. Subsurface soil/waste samples were obtained from the borings to characterize the encountered materials.

Surface soil and waste sampling and analysis were conducted in areas where surface disposal of wastes was a potential concern. In addition, a background soil sampling and analysis program was performed to provide a background database with which to compare potentially impacted soil results. Three rounds of surface water and sediment sampling and analysis were conducted to determine the nature and extent of contamination in nearby streams. A wetlands assessment was also performed to provide a qualitative appraisal of the plants and animals associated with wetlands downstream of the base.

NATURE AND EXTENT OF CONTAMINATION

Site 5 has apparently been reworked and filled with waste and natural clean soils used as backfill. Wastes were found north, east, and south of Building 401 and west of Building 403. The material that was encountered included ash, wood, glass, cardboard, paper, tree limbs, roots, brick fragments, wire, charcoal, and scrap metal pieces in a matrix of fill material. HNu readings were recorded above background in three soil borings; however, the VOC vapors may be attributable to water-saturated soil at these locations. The thickness of waste and clean fill ranged from 2 to 10 feet below ground surface (bgs) and 3.5 to 8 feet bgs, respectively. A portion of trench TR3 probably lies under Building 401; this portion could not be investigated during the RI.

Low concentrations of VOCs were detected during the soil gas surveys at Site 5. Detected chemicals included BTEX compounds, PCE, and TCE. Only one soil gas sample location showed the presence of PCE or TCE. No clear pattern of subsurface contamination was noted, based on the soil gas results.

A low concentration of toluene was reported in an air monitoring sample from Building 401. The source of the toluene was unknown but may be related to household materials rather than waste materials disposed at Site 5.

Surface Soil

Among the Site 5 surface soil results, the highest organic compound detections were found within trench TR5. Low levels of TCE (ranging from 5J to 33 ug/kg) were found in about 15 percent of the surface soil samples. Benzene, toluene, and xylene were also detected at very low levels in at least one sample.

A variety of semivolatile organic compounds [including polycyclic aromatic hydrocarbon (PAHs) and phthalates], pesticides, and polychlorinated biphenyls (PCBs) were detected in some surface soil samples. Most contaminant levels were at low levels and did not exceed risk-based soil screening concentrations (RBCs) for residential land use. Only copper (in one sample), lead (two samples), vanadium (two samples), benzo(a)pyrene (two samples), and the PCB Aroclor-1254 (three samples) were contained in samples at levels greater than RBCs. The highest surface soil concentrations for lead, vanadium, and Aroclor-1254 were contained in samples collected beneath asphalt roadways. An elevated level (24,000 ug/kg) of Aroclor-1254 was reported for one sample collected west of Building 403 and beneath Skyhawk Drive. Given the magnitude of this concentration, it is suspected that PCBs may have been used as a dust suppressant during road construction. The semivolatile organic compounds and pesticide concentrations may be related to the urban environment (e.g., runoff from asphalt roads and roofs; application of pesticides and fertilizers for lawns and gardens) near Site 5.

Several metals were also found in surface soil samples at levels above background soil concentrations. The presence of these compounds may be related to disposal operations; however, no consistent pattern of inorganic soil contamination was identified. The highest metal concentrations were from the middle and eastern ends of trench TR5.

Subsurface Soil

VOCs, PAHs, and pesticides were detected in some subsurface soil samples. Most organic compounds detected in Site 5 subsurface soil samples were found at low concentrations, with the exception of the PCB Aroclor-1254, which was detected in two samples at concentrations of 340 and 395 ug/kg, and several PAHs, which were contained in one sample. These were the only organic compounds for which the soil screening criteria were exceeded. These samples were collected from locations near the estimated boundary of trench TR5.

Several metals were present at concentrations above background soil levels in the northern portions of trenches TR3 and TR5, as well as outside the approximate boundaries of these trenches. The presence of these compounds may be related to disposal operations at the site. Arsenic, copper, lead, and vanadium concentrations all exceeded their respective RBCs at one or more subsurface sample locations. The metal concentrations that were greater than screening levels were either collected from samples near the western ends of trenches TR3 and TR5 or outside the estimated boundary of trench TR3 near Patrol Road and the eastern edge of Area B Site 7.

Surface Water and Sediment

Chloroform, carbon disulfide, and trace concentrations of two phthalates were detected in surface water downstream of Area B. No other organic compounds were found among the Area B surface water samples. The presence of a well-developed neighborhood just south of Area B may be contributing to surface water quality to the extent that the actual impact of suspected sources within Area B could not be fully evaluated. However, none of the organic compounds detected in surface water were at levels significantly above human health or ecological risk based screening criteria.

Among the surface water metal results, downstream surface water concentrations were equal to or slightly greater than background surface water levels. None of the metal concentrations was considered to be significantly elevated.

PAHs, phthalates, pesticides, and PCBs were found in sediment downstream of Area B. Aroclor-1260 concentrations, ranging from 270J to 580KJ ug/kg, were detected in sediment samples collected along the drainage pathway emanating from the stormwater discharged from Building 108. Levels decreased in a downstream direction within this drainage pathway and no PCBs were detected in the actual open waterway below the base property line. No other PCBs were found in the Area B sediment samples. The highest levels of PAHs, phthalates and pesticides were detected in sediments in a portion of the drainage channel located below the discharge point of the stormwater outfall and other drainage pathways. This portion of the drainage channel is located within a developed area and does not provide significant aquatic habitat. These

compounds were found at significantly lower levels orders of magnitude lower in samples collected downstream in the open waterway portion of the study area that exhibits a higher quality aquatic habitat.

In general, pesticide levels in the sediments were higher than any levels detected in Area B (Sites 5, 6, and 7) surface soils. Regional background soil samples also contained pesticide levels higher than within the study area.

Inorganic contaminant levels slightly above screening criteria were also detected in sediments. In general, several of the detected elements were at similar levels in regional background soils. Levels of cadmium, copper, lead, thallium, and zinc appear to be elevated in stream sediments.

ASSESSMENT OF RISKS

Both human health and ecological risk assessments were conducted to estimate the actual or potential risks to human health and the environment resulting from the presence of contamination in Site 5 soils. A risk assessment was also performed to evaluate the actual or potential risks to human health and the environment due to the presence of contamination in surface water and sediment in the stream (i.e., Southampton Creek and related Area B drainage) adjacent to the Area B sites.

The current and intended re-use for Site 5 is residential. Residential and industrial re-use or exposure scenarios was evaluated in the human health risk assessment. Both carcinogenic and noncarcinogenic risks were assessed. In general, carcinogenic risks in the range of 10^{-4} to 10^{-6} are considered acceptable. Cumulative incremental cancer risks greater than 1×10^{-4} generally indicate that some degree of remediation is required, and cancer risks below 1×10^{-6} normally will not result in remedial efforts. A cancer risk of 1×10^{-6} indicates that the exposed receptor has a one in a million chance of developing cancer under the defined exposure scenario. Noncarcinogenic risk was assessed using the concept of hazard quotients (HQs) and hazard indices (HIs). HIs were generated by summing individual HQs for contaminants of potential concern. An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure.

<u>Human Health Risks for Soils</u>

No estimated carcinogenic risk for exposure to surface of subsurface soil, under any of the risk scenarios, exceeded the 1×10^{-4} to 1×10^{-6} risk range. The highest carcinogenic risks identified under the current or reasonably anticipated potential land use scenarios for Site 5 were for the residential child and lifetime exposure scenarios for subsurface soils. The total child carcinogenic risk was estimated at 8×10^{-6} and the total lifetime carcinogenic risk was 1.2×10^{-5}.

Similarly, calculated noncarcinogenic risks, under all exposure scenarios, do not present an unacceptable risk. Noncarcinogenic risks for the residential child (the most sensitive receptor) exposed to subsurface soils was estimated at an HI of 1.3. This HI is associated with the potential ingestion of soils containing iron. No toxicity value for iron has been estimated in either IRIS or HEAST. The oral reference dose used for the risk assessment calculations was obtained from the EPA Region III RBC tables. This value is based on allowable daily intake and is not based on an adverse health effect level. Iron is considered an essential mineral. Consequentially, the estimated HI (1.3) calculated for the child ingestion of subsurface soil may not be indicative of adverse health effects and should not warrant action.

Adverse effects to residential children (age 0 – 6) are not expected from lead concentrations in surface and subsurface soil at Site 5.

Human Health Risks for Surface Water and Sediment

Estimated cancer and noncancer risks for recreational children exposed to surface water via wading and to sediment via ingestion and dermal contract were not found to be significant (i.e., all cancer risks equal to or less than 1.0×10^{-6} ; all HIs less than 1.0) for nearby Area B surface water and sediment.

Ecological Risks

A screening level ecological risk assessment was conducted to estimate potential risks to aquatic receptors from site-related contaminants in surface water and sediments. A screening food-web model was used to evaluate potential ecological risks to semi-aquatic receptors.

Potential risks presented to aquatic and semi-aquatic receptors by surface water were found to be low. Potential risks presented by sediments to aquatic and semi-aquatic receptors were found to be low to moderate. The compounds that present the highest potential risk to these receptors do not appear to be related to contamination identified in surface soils at Area B sites 5, 6, and 7.

Southampton Creek and its headwaters originate from and receive runoff and channelized discharges from a large area that includes urbanized land, fields, and lawns as well as Area B sites 5, 6, and 7. The portion of the stream that contained the highest levels of contamination of concern consists of a drainage channel located in a developed area that contains lesser quality aquatic habitat. Areas downstream from this location, where habitat increases in quantity and quality, contained lower levels of contamination. Most levels were near or below screening levels, indicating a low potential risk to ecological receptors and limited migration of these contaminants.

CONCLUSIONS

Based on the findings of the RI, significant conclusions regarding the nature and extent of contamination at Site 5 included the following:

- Most of the buried waste materials at Site 5 are covered by existing residences, roadways, and other impenetrable surfaces. The probability of encountering these materials is low.

- Both surface and subsurface soils in the vicinity of the site are not significantly impacted by the historical disposal of potential waste materials at Site 5.

- Site 5 does not show the presence of significantly contaminated soils above RBCs or SSLs and therefore does not appear to be a source of contamination in Area B groundwater.

- Surface water and sediment samples collected from Southampton Creek and related drainage near Area B shows contaminant concentrations at slightly elevated levels. The highest concentrations of contaminants are restricted for low-quality areas subject to stormwater and outfall discharges.

The total carcinogenic risks posed by subsurface soil to the residential child and lifetime resident were 8.2×10^{-6} and 1.2×10^{-5}, respectively. These are the highest carcinogenic risks identified under the current and reasonably anticipated potential land use scenarios for Site 5. These carcinogenic risks fall within the range identified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERLCA, as amended) and therefore may be considered safe to human health.

Noncarcinogenic risks to a specific target organ group were below EPA's target risk level of 1.0 for the residential child in surface soil. In subsurface soil, the noncarcinogenic risk to the target organs liver and pancreas was 1.3 for the residential child. This risk marginally exceeded 1.0 and was driven by iron (an essential mineral) via ingestion. Noncarcinogenic risks were below 1.0 for the residential adult and adult industrial worker in all soils.

Potential risks to aquatic and semi-aquatic receptors in the natural streambed, ponds, and Southampton Creek appear to be low to moderate. Southampton Creek and its headwaters originate from and receive runoff and channelized discharges from a large area that includes urbanized land, fields, and lawns as well as Area B sites 5, 6, and 7. The compounds that present the highest potential risk to ecological receptors do not appear to be related to contamination identified at Area B sites. Sites 6 and 7 are being remediated to preclude migration of contaminants (if present) from this area. Site 5 is covered by impermeable

structures, roadways, and parking lots and/or grass covered lawns which preclude any erosion or migration of contaminants from this area.

Based on the nature and extent of contamination at Site 5 as well as the Area B stream and the risk assessment results, and in accordance with CERCLA and the NCP and its related laws and regulations no response action is warranted at Site 5 or within Area B streams to protect human health and the surrounding environment.

1.0 INTRODUCTION

In response to Contract Task Order No. 159 under Contract N62472-90-D-1298, Tetra Tech NUS, Incorporated (TtNUS) is submitting this remedial investigation (RI) report for Operable Unit 10 (OU-10) (Site 5 soil, surface water, and sediment) at the former Naval Air Warfare Center (NAWC) (formerly the Naval Air Development Center), Warminster, Pennsylvania. This work is part of the Navy's Installation Restoration Program (IRP), which is designed to identify contamination of Navy and Marine Corps facilities resulting from past operations and to institute corrective measures, as needed.

IRP activities are typically performed in four distinct phases. The first phase consists of a preliminary assessment (PA). Phase II involves a site inspection (SI). The third phase is an RI, which is intended to characterize physical and chemical parameters and risks associated with the facility. The last phase consists of remedial actions designed to control and mitigate contamination. This report is prepared under Phase III IRP activities.

1.1 PURPOSE OF REPORT

The purpose of this report is to describe investigation results for Site 5 soils and nearby Area B surface water and sediment, draw conclusions based on these results, and recommend any additional actions. Data from these investigations support the baseline risk assessment, which is used to help identify disposal locations warranting possible remediation. The risk assessment is included as part of this report (Section 6.0).

This report addresses surface soils, subsurface soils, and wastes at Site 5. This report also addresses surface waters and sediments potentially impacted by the site as well as adjacent sites (i.e., Sites 6 and 7). Groundwater impacts associated with this general area have previously been reported and are currently being addressed as Operable Unit 1B (OU-1B) (Tetra Tech NUS, 2000a). Therefore, groundwater at Site 5 is not addressed by this report.

Section 300.430 (a)(1)(ii)(A) of the National Oil and Hazardous Substances Pollution Contingency Act (NCP) provides that hazardous substance facilities should generally be remediated in operable units when early actions are necessary or appropriate to achieve a significant and accelerated risk reduction, when phased analysis or response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of a total cleanup. Several operable units at NAWC Warminster have been identified to facilitate these objectives. OU-10 includes media other than groundwater associated with Site 5.

The main focus of the RI was to characterize soils and wastes in potential source areas at the site, particularly for suspected sources that were not addressed under the base-wide Environmental Baseline Survey (EBS). The RI also investigated nearby surface waters and sediments potentially impacted by Site 5 and other adjacent sites.

1.2 FACILITY BACKGROUND AND HISTORY

This section describes NAWC Warminster and provides a brief synopsis of the facility's background and history. More detailed discussion is provided in the RI work plans.

1.2.1 Facility Description

NAWC Warminster is located in the township of Warminster, Bucks County, Pennsylvania. The facility can be found on the United States Geological Survey (U.S.G.S.) Hatboro 7.5-minute topographic quadrangle map, a portion of which is reproduced as Figure 1-1. The total area of NAWC Warminster is approximately 734 acres. The facility lies in a populated suburban area surrounded by private homes, various commercial/industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

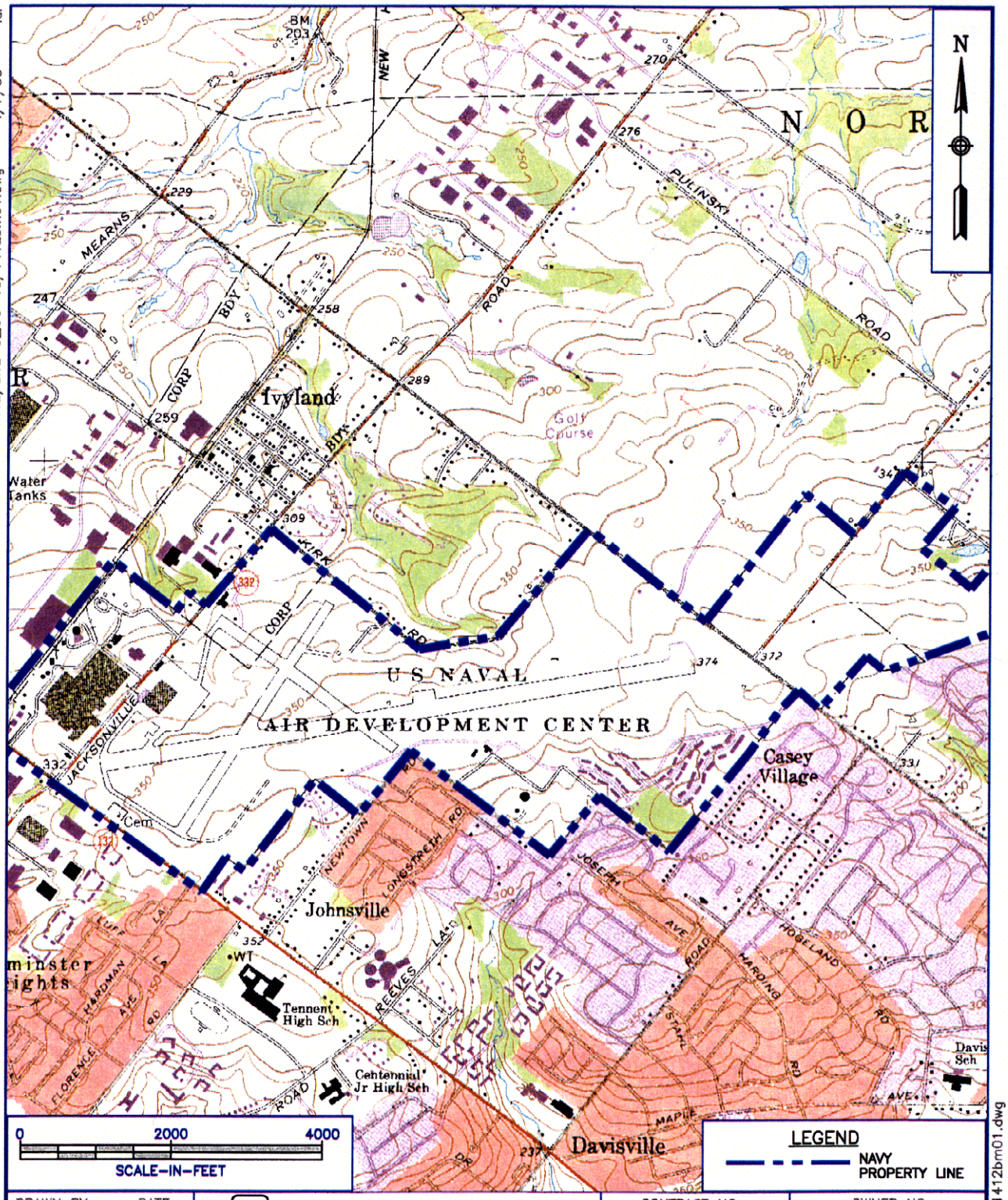
The facility is located on a ridge, generally oriented east-west, with elevations ranging from 297 feet at the northwestern property boundary to 377 feet at the eastern boundary. Slopes are gentle and average 3 to 5 percent. The northern portion of the facility (about 65 percent) drains into small, unnamed tributaries of Little Neshaminy Creek. The remaining portion drains into unnamed tributaries of Pennypack Creek.

The main areas of investigation at NAWC Warminster include several waste sites covering more than 15 acres (Figure 1-2). All sites are located within the NAWC Warminster property and include the following:

- Three waste burn and disposal pits (Sites 1, 3, and 6)
- Two sludge disposal pit areas (Sites 2 and 7)
- Two landfills located on the north and south sides of the active runway (Sites 4 and 5)
- One fire training area (Site 8)
- A series of eight unlined impoundments (Impoundment Area)

These sites, along with other suspected sources at the base, have been grouped into four general areas based on geographic location (i.e., their proximity to one another), similarities regarding source and waste characteristics (i.e., methods of waste disposal and types of wastes deposited), and their common effects on nearby receptors (e.g., aquifers, surface water bodies, and human populations) (Figure 1-2).

001900B18Y



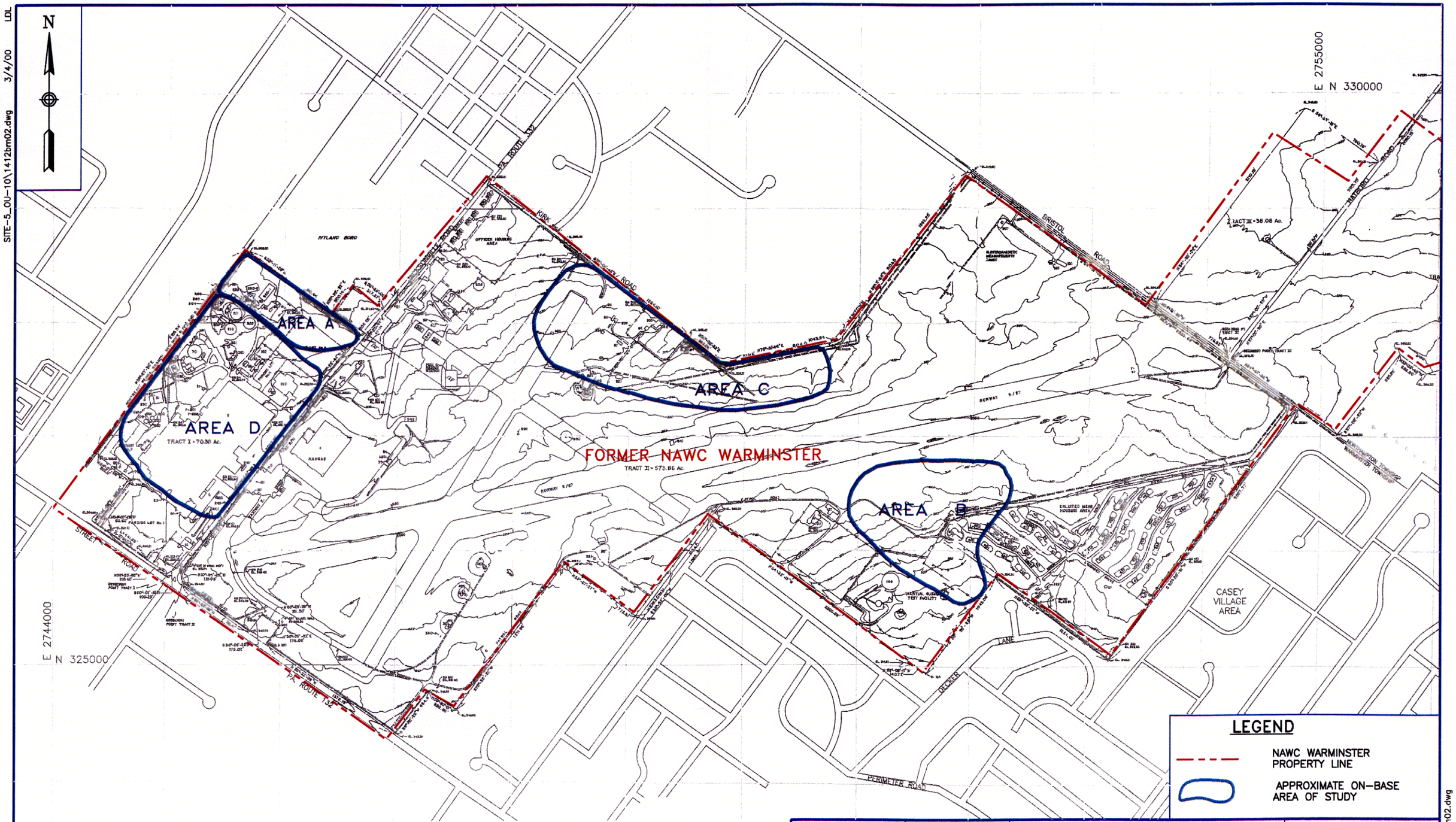
DRAWN BY LDL DATE 4/18/00	Tetra Tech NUS Inc.	CONTRACT NO. N62472-90-D-1298	OWNER NO. CTO 0159
CHECKED BY DATE	SITE LOCATION MAP	APPROVED BY Tea	DATE 5 Jul 00
COST/SCHED-AREA	FORMER NAWC WARMINSTER	APPROVED BY	DATE
SCALE 1"=2000'	WARMINSTER, PENNSYLVANIA	DRAWING NO. FIGURE 1-1	REV.

SOURCE: (7.5 MINUTE SERIES) U.S.G.S. HATBORO, PA QUADRANGLE

1412/SITE-5_OU-10/1412bm01.dwg 4/7/00 ldl

1412/SITE-5_OU-10/1412bm01.dwg

SITE-5_OU-10\1412bm02.dwg 3/4/00 LDL



0 800 1600

SCALE IN FEET

DRAWN BY LDL	DATE 3/7/00	Tetra Tech NUS, Inc.	ON – BASE AREAS OF INVESTIGATION FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 1412

OWNER NO. 6010

APPROVED BY Tea DATE 5 Jul 00

DRAWING NO. FIGURE 1-2 REV.

SITE-5_OU-10\1412bm02.dwg

The general areas are

- Area A, located in the northwestern corner of the base (Sites 1, 2, 3, and the Impoundment Area)
- Area B, located south of the main runway (Sites 5, 6, and 7)
- Area C, located north of the main runway (Site 4 and 8)
- Area D, consisting of the main building complex at the base

Historically, wastes were generated during aircraft maintenance and repair, pest control, firefighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils. None of the sites are currently used for waste disposal. A description of Site 5 can be found in Section 1.3 of this report.

The longest runway, which is inactive, is generally located along the topographically highest area at the facility. Many of the primary facility buildings are located west of the airstrip, along Jacksonville Road. A housing development for military enlisted personnel is within the southeastern portion of NAWC Warminster. A wastewater treatment plant is located in the northwestern corner of the facility.

Approximately 100 employees currently work at the former base, and 1,000 people reside at the enlisted personnel's housing area year round. The residents living at the enlisted housing area are the nearest population center, but most work at a nearby Navy base in Willow Grove, Pennsylvania. The closest off-base home is about 200 feet away.

NAWC Warminster is underlain by the Stockton Formation, which provides water for more than 100,000 people within the area. Local surface water bodies are used for recreation and industrial purposes.

1.2.2 Facility History

The facility was originally the location of Brewster Aeronautical Corporation, a manufacturer of military aircraft. In 1944, the Navy assumed full control of the Brewster plant. The Naval Air Modification Unit was installed at the base to add design modifications to military aircraft produced at other locations. After World War II, activities at the base were altered; in 1949, the facility was designated the Naval Air Development Center (NADC), and its main mission, research, development, testing, and evaluation for Naval aircraft systems, was established. NAWC Warminster also conducted studies in anti-submarine warfare systems and software development. The facility name was changed from NADC to NAWC, Aircraft Division, on January 1, 1992. In 1996, NAWC Warminster was realigned under the Base Realignment and Closure (BRAC) Program managed by the Department of Defense (DOD). This realignment, which is due to the

downsizing of the entire DOD budget, was implemented in September 1997. The realignment resulted in the relocation of NAWC Warminster activities to Naval Air Station (NAS) Patuxent River, Maryland. The base is now closed and is being redeveloped for non-military use by the Federal Lands Reuse Authority (FLRA).

The U.S. Environmental Protection Agency (EPA) officially recognized the NAWC Warminster sites as possibly needing investigation in September 1979. In November 1979, EPA completed a PA. In 1980, the Department of the Navy began its environmental investigative work at NAWC Warminster. The first study, known as the Clay/Law Report, inventoried disposal activities at each of the eight sites. Since 1980, a variety of environmental consultants under Navy contracts have studied these sites. The first of the resulting reports, prepared by JRB Associates in 1983, concluded that on-site contamination existed but probably was not affecting off-site water supply wells.

In 1985, EPA completed a PA/SI Report. In 1986, NAWC Warminster was proposed for inclusion on the National Priorities List (NPL) based on a Hazard Ranking System (HRS) score greater than 28.50. EPA used the HRS to assess the relative threat from releases of hazardous substances from the eight NAWC Warminster sites to surrounding groundwater and surface water. The facility score was based on the likelihood that a hazardous substance would be released from the sites, the toxicity and amount of hazardous substances at the sites, and the people and sensitive environments potentially affected by contamination at the sites.

On October 4, 1989, NAWC Warminster was placed on the final NPL. That same year, EPA submitted a draft Interagency Agreement to the Navy for formalizing and scheduling remedial activities. The contents of this agreement were negotiated in 1990. In 1991, TtNUS (formerly Halliburton NUS Corporation, then Brown & Root Environmental) was tasked to complete RI/FS activities at the facility.

1.2.3 Environmental Investigations

Since 1979, NAWC Warminster, regulatory agencies, and others have been involved in various regional environmental response actions for the study area. Some regional actions have been specific investigations of the NAWC Warminster sites. A number of wells within Warminster Township and other nearby townships have been sampled for VOCs, and contamination by VOCs has made some groundwater unsuitable for potable use.

Since 1989, several remedial investigations and feasibility studies have been conducted at NAWC Warminster for the various areas of concern (i.e., Area A, Area B, Area C, and Area D). The Phase I RI was performed between October 1989 and April 1991 by SMC Environmental Services Group (SMC Martin, 1991). Phase II was performed between May 1992 and April 1993 (HNUS, 1992, 1993a). In October 1993, focused RI/FS work for groundwater contamination attributable to the base began and was

completed in June 2000 (Tetra Tech NUS, 2000a, 2000b, and 2000d: Halliburton NUS, 1994b). Phase III, which addresses potential source areas and their impacts to soils, surface waters, and sediments, began in January 1995 and was completed in July 2000. The Phase III RI field work for OU-10 was completed in December1999.

The following sections briefly summarize the status of investigations and response actions for each of the four areas of concern. A Technical Review Committee (later a Restoration Advisory Board), which consists of representatives of the Navy, EPA, the Pennsylvania Department of Environmental Protection (PADEP), the Bucks County Health Department, the Northampton Township Municipal Authority, the Warminster Township Municipal Authority, and Upper Southampton Township, assisted in the planning and review of these activities

1.2.3.1 Area A Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): RI activities involved mapping VOCs in soil gas and detecting magnetic and conductive anomalies through electromagnetic surveys. Approximate site boundaries were identified and confirmation of site contamination was made through soil borings, installation of new overburden and shallow bedrock monitoring wells, and groundwater sampling and analysis. Other media (surface water and sediment) were also sampled and tested. Test pits were excavated, local wells were inventoried, and a fracture-trace analysis was conducted. A biological characterization of a nearby stream was also done (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work helped determine the nature and extent of groundwater contamination, evaluate shallow groundwater flow and add to the hydrogeologic database, and ascertain possible remedial alternatives. Activities included installing additional overburden and shallow bedrock monitoring wells, sampling and analyzing groundwater, surface water, sediment, and soils, and evaluating aquifer characteristics through water-level monitoring and a pumping test. Groundwater-related RI and FS reports for OU-1 were released in April 1993 (HNUS, 1992, 1993a, and 1993b).

- Focused RI/FS for Groundwater (1993 - 2000): This activity investigated groundwater conditions within and downgradient of Area A, as well as in other areas of the base. Monitoring wells were installed and water samples collected for analysis. A water-level study and a more comprehensive aquifer pump test were also performed. A final RI report for Area A groundwater was released in June 2000 (Tetra Tech NUS, 2000b).

- Phase III (1995 - 1999): The primary RI objective was to characterize sources of contamination, primarily soils and wastes at known and potential waste disposal sites. RI work included a soil gas survey, multiple surface geophysical surveys, test pits and soil borings, along with soil and waste sampling and analysis. A surface water and sediment sampling and analysis program was performed to evaluate the impacts of Area A on a nearby stream. An assessment of wetlands near Area A was also conducted (HNUS, 1994d). The Area A RI/FS report for soil, surface water, and sediment was released in April 2000 (Tetra Tech NUS, 2000c).

Response Actions

- Operable Unit 1 (OU-1): At the end of Phase II, the Navy and EPA selected an interim remedy for contaminated shallow groundwater attributable to Area A at the base, referred to as OU-1. The OU-1 Record of Decision (ROD) was signed in September 1993. The interim remedy included installing extraction wells and building a treatment system, and was constructed by July 1999. A final ROD for OU-1 will be prepared later this year.

- During the construction of the OU-1 remedy, the Navy excavated and disposed of contaminated soils in an off-base landfill that were beneath the footprint of the treatment plant building or along the route of groundwater transfer piping near Area A. This work was performed in 1996.

- Using Navy funds, one commercial property with a contaminated well was connected to the Warminster Municipal Authority system in the summer of 1995. This property was located north of Area A, specifically Site 2.

- OU-9: Based on the Phase III RI, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated soils and wastes from several locations within Sites 1, 2, and 3 between August 1998 and January 1999. An Action Memorandum for the Area A soil removal action was signed by the Navy in June 1998. The ROD for OU-9 was signed in June 2000.

1.2.3.2 Area B Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): Activities were similar in scope to Area A. An air sampling program was also performed to evaluate the potential for atmospheric contamination in nearby residences (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work was similar to Area A. Several off-base well samples were also collected for analysis. Groundwater-related RI and FS reports for OU-1 were prepared in April 1993 (HNUS, 1993a, and 1993b).

- Focused RI for Groundwater (1993 – 2000): Investigated groundwater conditions within and downgradient of Sites 5, 6, and 7. The focused groundwater scope of work was similar to Area A. Based on this work, the RI report for Area B groundwater was released in May 2000 (TtNUS, 2000a).

- Phase III (1995 - 1999): The Phase III RI objective was to characterize sources of contamination, primarily soils and wastes at known and potential waste disposal sites. RI work was similar to what was conducted for Area A. Additional investigations for Sites 6 and 7 were performed in 1996 and 1997 to support limited removal actions for these sites. Following the removal actions, RI and FS reports for Sites 6 and 7 were prepared (TtNUS, 1999b and 1999c). A supplemental soil investigation for Site 5 was conducted in December 1999.

Response Actions

- OU-1: At the end of Phase II, the OU-1 ROD was signed to implement an interim remedy for contaminated shallow groundwater attributable to Area B. Extraction wells were installed in December 1994, however, the groundwater sample results indicated the general absence of significant contamination. The interim remedy is currently on-hold, and is now being reevaluated. A final ROD for Area B groundwater will be prepared later this year.

- OU-2: Following Phase II, the Navy performed sampling of off-base drinking water wells in the vicinity of NAWC Warminster. Results from well water samples collected during the testing indicated that at several residences, the groundwater had levels of VOCs greater than EPA's Maximum Contaminant Levels (MCLs). Beginning in April 1993, the Navy installed water treatment systems at these residences despite the lack of clear evidence that the Navy was responsible for all of the elevated contaminant levels of concern. In the summer of 1994, EPA and the Navy connected homes in the Casey Village Area (located south of Sites 5, 6, and 7) to the Warminster Municipal Authority and Upper Southampton Water and Sewer Authority systems.

- OU-7: Based on the Phase III RI findings, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated soils and wastes from several locations within Sites 6 and 7 in 1997. The ROD for OU-7 was signed in June 2000.

- OU-10: Based on the results of the Phase III RI report findings, a supplemental investigation was conducted to more fully determine the lateral extent of the disposal locations and to more clearly define

the nature and extent of the contamination associated with former disposal activities within Site 5. OU-10 is the subject of this report.

1.2.3.3 Area C Investigations and Response Actions

Investigations

- Phase I (1989 - 1991): Activities were similar in scope to Area A (SMC Martin, 1991).

- Phase II (1992 - 1993): RI/FS work was similar to Areas A and B. One off-base well sample was tested (HNUS, 1992).

- Focused RI for Groundwater (1993 - 1994): Investigated groundwater conditions within and downgradient of Sites 4 and 8. The focused groundwater scope of work was similar to Areas A and B. Based on this work, separate RI and FS were submitted for Area C groundwater in August 1994 reports (HNUS, 1994b and 1994c). A schematic design for shallow groundwater remediation was completed in July 1994.

- Phase III (1995 - 1999): The Phase III RI objectives and field work were similar to what were conducted for Areas A and B. A maintenance area and septic drain field, both located between Site 4 and Site 8, were also investigated within Area C (TtNUS, 1999d and 2000f). An engineering evaluation/cost analysis (EE/CA) report was prepared to help support a removal action for Site 4 in July 1995 (HNUS, 1995b). A supplemental study for Site 8 was conducted between July 1998 and March 1999 to complete RI work for this site (TtNUS, 1999a).

Response Actions

- OU-2: Following Phase II, the Navy performed sampling of off-base drinking water wells in the vicinity of Area C. In 1994, EPA and the Navy connected homes along Kirk Road to the Warminster Municipal Authority system.

- OU-3: The interim OU-1 remedy for Areas A and B was modified to incorporate the additional volume of contaminated groundwater associated with OU-3. The ROD for OU-3, was signed in March 1995. Construction of the groundwater treatment plant was completed in May 1996. Six extraction wells were installed in Area C, and piping and electrical wiring were run between these wells and the treatment plant. The system began full operation in July 1996.

- OU-5: Based on the Phase III RI findings, including the results of several supplemental investigations, the Navy excavated and disposed of contaminated surface soils along the western edge of the Site 8 runway extension in February 1999. The Action Memorandum for the Site 8 removal action was also signed in February 1999. The ROD for OU-5 (Site 8 media other than groundwater) was signed in June 2000.

- OU-6: The Action Memorandum for the Site 4 removal action was signed in June 1996. Based on the Phase III RI and EE/CA findings, the Navy excavated and disposed of contaminated soils and wastes from eight buried trenches at Site 4 in the fall of 1996. All work was completed in July 1997. The ROD for OU-6 (Site 4 media other than groundwater) was signed in June 2000.

1.2.3.4 Area D Investigations and Response Actions

Investigations

- Focused RI for Groundwater (1993 - 2000): Investigated groundwater conditions within and downgradient of Area D. The focused RI groundwater scope of work was similar to the investigations for Areas A, B, and C. Based on this work, separate RI and FS reports were submitted for Area D groundwater in May 2000 (TtNUS, 2000d).

- Area D RI (1996 - 1998): The Area D RI objective was to characterize sources of contamination, primarily soils and wastes at potential waste disposal sites within the main building complex at the base, including the hangar area east of Jacksonville Road. RI work included a soil gas survey, soil borings, and soil sampling and analysis. The RI report for Area D media other than groundwater was released in September 1998 (TtNUS, 1998). Based on the Area D RI results for media other than groundwater, an FS report was not warranted.

Response Actions

- OU-4: At the end of the focused groundwater RI for Area D groundwater, an interim ROD for OU-4 was released in September 1997. The interim remedy included installing extraction wells and connecting these wells to the existing groundwater treatment system and was completed in July 1999. A final ROD for OU-4 was signed in June 2000.

- OU-8: To date, no CERCLA response actions for specific Area D sources have been conducted. However, the Navy has removed several petroleum-related aboveground and underground storage tanks (USTs) within Area D and other areas at the base. The ROD for OU-8 (Area D Soils) was signed in June 2000.

The results and findings of all previous investigations are maintained in two local information repositories that contain the Administrative Record for NAWC Warminster. One repository is located at the base; the second can be found at the Bucks County Library, Doylestown Branch.

1.3 SITE 5 DESCRIPTION AND HISTORY

Site 5, the former south runway landfill, is part of Area B. Area B includes Sites 6 and 7, which were reportedly used for disposal of wastes potentially containing CERCLA hazardous substances. Area B also includes nearby locations where releases may have resulted in groundwater contamination. Details regarding the nature and extent of groundwater contamination in this area can be found in the RI report for Area B groundwater (Tetra Tech NUS, 2000a).

1.3.1 Site Description

Site 5 is located south of the main runway and adjacent to a baseball field at NAWC Warminster (Figure 1-3). Portions of the site are located under Building 401 in the Navy's enlisted housing area. Sites 6 and 7 are south of the main runway and north of the patrol road near the eastern end of the facility. Groundwater and surface water flow and runoff are generally to the south for Area B. The history and status of Site 5 are discussed below.

1.3.2 Site History

The Navy initially reported Site 5 as a disposal site in the Navy Shore Activity Disposal Fact Form (U.S. Navy, 1980) and Notification of Hazardous Waste Sites (U.S. Navy, 1981). Site 5 reportedly consisted of six to eight trenches which were used for the disposal of demolition wastes, paint, solvents, scrap metal, aircraft paints, cans, and asphalt. With the exception of a reported 30 drums of asphalt, the quantity of materials disposed was reported as unknown. These disposal trenches were reportedly within 100 feet of the enlisted housing area (i.e., Shenandoah Woods) located south of the runway, within 700 feet of the inertial navigation facility, and 400 feet from the base property boundary. The trenches were reportedly operated from 1955 to 1970, were approximately 12 feet x 70 feet x 8 feet in dimension, and were covered with 2 feet of fill, graded, and seeded.

Significant additional site background and historical information were provided by an aerial photographic site analysis report for the base (EPIC, 1994). This report evaluated aerial photographs from March 1938 through March 1990 and identified several features within Site 5 that suggested possible or probable disposal areas. These features are displayed on Figure 1-3. The following information regarding the site analysis report is pertinent to this report.

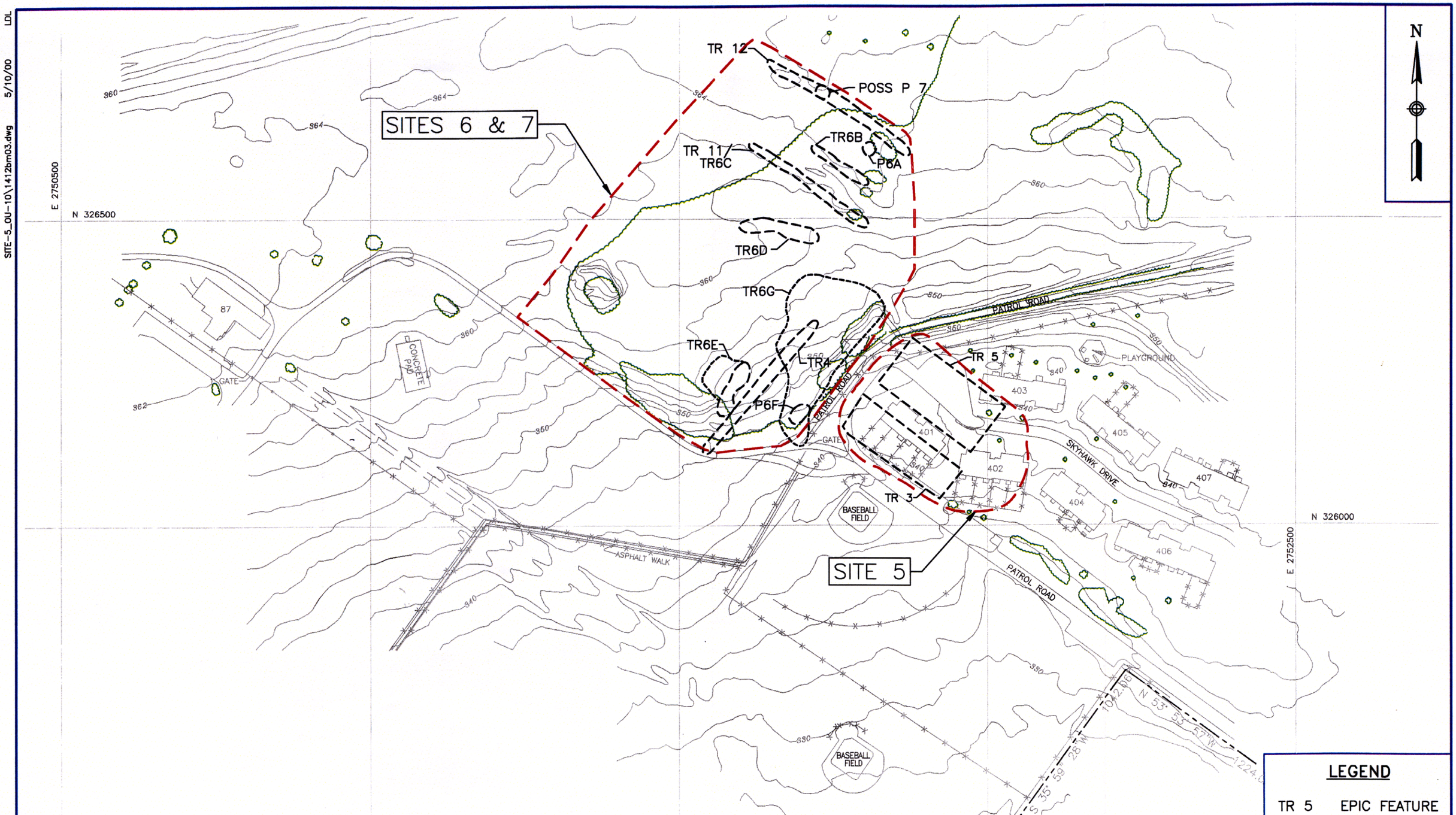
The historical aerial photos indicate that at least two general disposal locations were used to deposit or bury debris and other potential wastes. Aerial photographs taken before the mid-1950s did not show the presence of any significant features. In a photograph from September 1958, a trench (TR3) was identified in the general vicinity of Site 5 (Figure 1-4). No suspect materials were identified within TR3, which measured approximately 225 feet in length. By March 1965, TR3 had apparently been filled and a new and smaller trench (TR5) constructed adjacent and to the north of it (Figure 1-5). TR5 measured about 150 feet in length. A small quantity of potential waste material was present within the estimated boundary of TR3.

While six to eight trenches were reportedly used by the Navy for disposal in this area, only two trenches in the housing area were identified by historical aerial photos. The Navy and EPA subsequently reviewed additional photographs taken between 1965 and 1973. This review revealed the possible presence of apparent disturbed ground with areal dimensions similar to those of TR3 and TR5 immediately north of these trenches (EPA, 1999) (Figures 1-6 and 1-7). The potential trenches were labeled as TR5B and TR5C. These apparent areas of disturbed ground were investigated to determine whether these features represent remnants of the other trenches that may have been used for disposal in this area. However, the discrepancy between the reported and the photo-identified number of trenches may be because the two long trenches (i.e., TR3 and TR5) are the expression of several shorter trenches dug end-to-end or because trenches related to other Area B sites (specifically Site 6) were added to the reported number for Site 5.

By August 1971, TR5 had been filled and the area associated with both TR3 and TR5 had been revegetated (Figure 1-8). In a photograph from March 1973, mounded debris was present on the top of the former location of TR3, while TR5 was still visible (Figure 1-9). The March 1973 photograph revealed that the Navy had begun constructing multi-family housing near the estimated boundaries of TR3 and TR5. The specific housing unit (i.e., Building 401) built on top of the location of TR3, however, had not yet been constructed. By 1977, housing construction was completed and a majority of the surrounding area was revegetated.

00190 D B19Y

LDL 5/10/00 SITE-5_OU-10\1412bm03.dwg



LEGEND

TR 5 EPIC FEATURE

0 150 300

SCALE IN FEET

DRAWN BY LDL	DATE 7/7/00	Tetra Tech NUS, Inc.	AREA B LAYOUT FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 1412

OWNER NO. 6010

APPROVED BY TRA DATE 12 Jul 00

DRAWING NO. FIGURE 1-3 REV.

1412bm03.dwg

00190B19Y

1412\SITE-5_OU-10\1412CM02.dwg 7/11/00 LDL

DRAWN BY LDL DATE 7/11/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH SEPTEMBER 1958 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY rea DATE 12 Jul 00
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-4 REV.

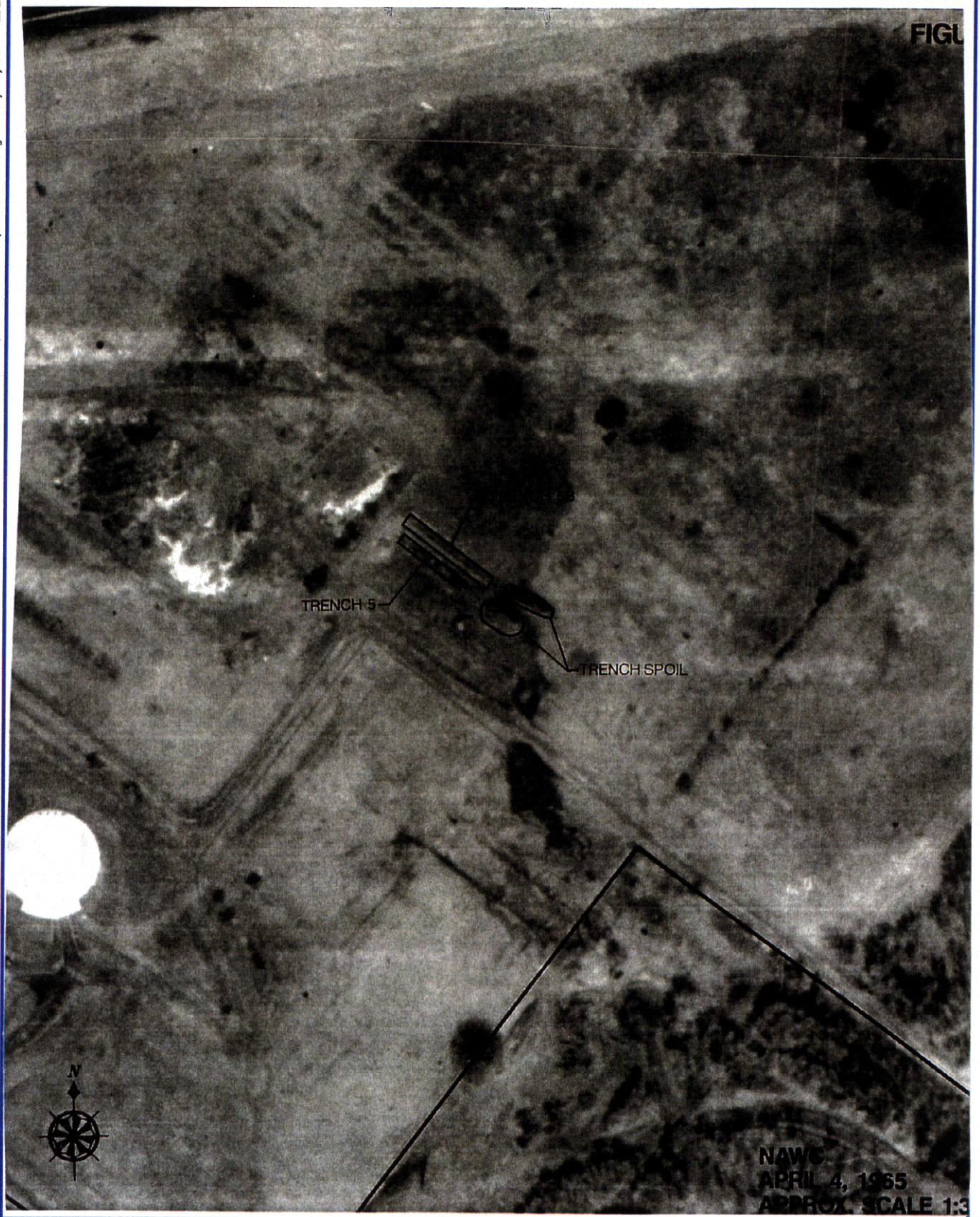
1412cm02.dwg

1412\SITE-5_OU-10\1412cm03.dwg 7/11/00 LDL

DRAWN BY LDL DATE 7/11/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH MARCH 1965 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY 12 Jul 00 DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-5 REV.

1412cm03.dwg

1412\SITE-5_OU-10\1412cm04.dwg 7/11/00 LDL



DRAWN BY LDL DATE 7/12/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH APRIL 1965 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY Tea DATE 12 Jul 00
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-6 REV.

1412cm04.dwg

1412\SITE-5_OU-10\1412cm07.dwg 7/11/00 LDL

DRAWN BY LDL DATE 7/12/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH OCTOBER 1967 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY 12 Jul 00 DATE Ten
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-7 REV.

1412cm07.dwg

1412\SITE-5_OU-10\1412cm05.dwg 7/11/00 LDL

DRAWN BY LDL DATE 7/12/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH AUGUST 1971 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY DATE 12 Jul 00
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-8 REV.

1412cm05.dwg

1412\SITE-5_OU-10\1412cm06.dwg 7/11/00 LDL

DRAWN BY LDL DATE 7/12/00	Tetra Tech NUS, Inc.	AERIAL PHOTOGRAPH MARCH 1973 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1–9 REV.

1412cm06.dwg

Figure 1-10 shows a hypothetical arrangement of at least seven trenches within Site 5.

1.3.3 Previous Response Actions

During the construction of Building 401 as part of family housing at the base, the Navy uncovered waste material in the northwest corner of the unit (SMC Martin, 1991). No additional available information regarding the type and quantity of waste materials excavated and/or removed from the site during the construction of Building 401 is available. Suspected materials disposed of within TR3 and TR5 included demolition wastes, paints, solvents scrap metal, cans, asphalt glass and general household refuse.

1.4 SUMMARY OF PREVIOUS INVESTIGATIONS AT SITE 5

In July 1982, one monitoring well was installed; this well has been sampled several times since 1982 (JRB Associates, 1983). Analysis of groundwater samples from monitoring wells near Site 5 detected copper, chromium, nickel, and zinc. Analysis in 1983 of a downstream surface water sample did not detect any priority pollutant list (PPL) contaminants.

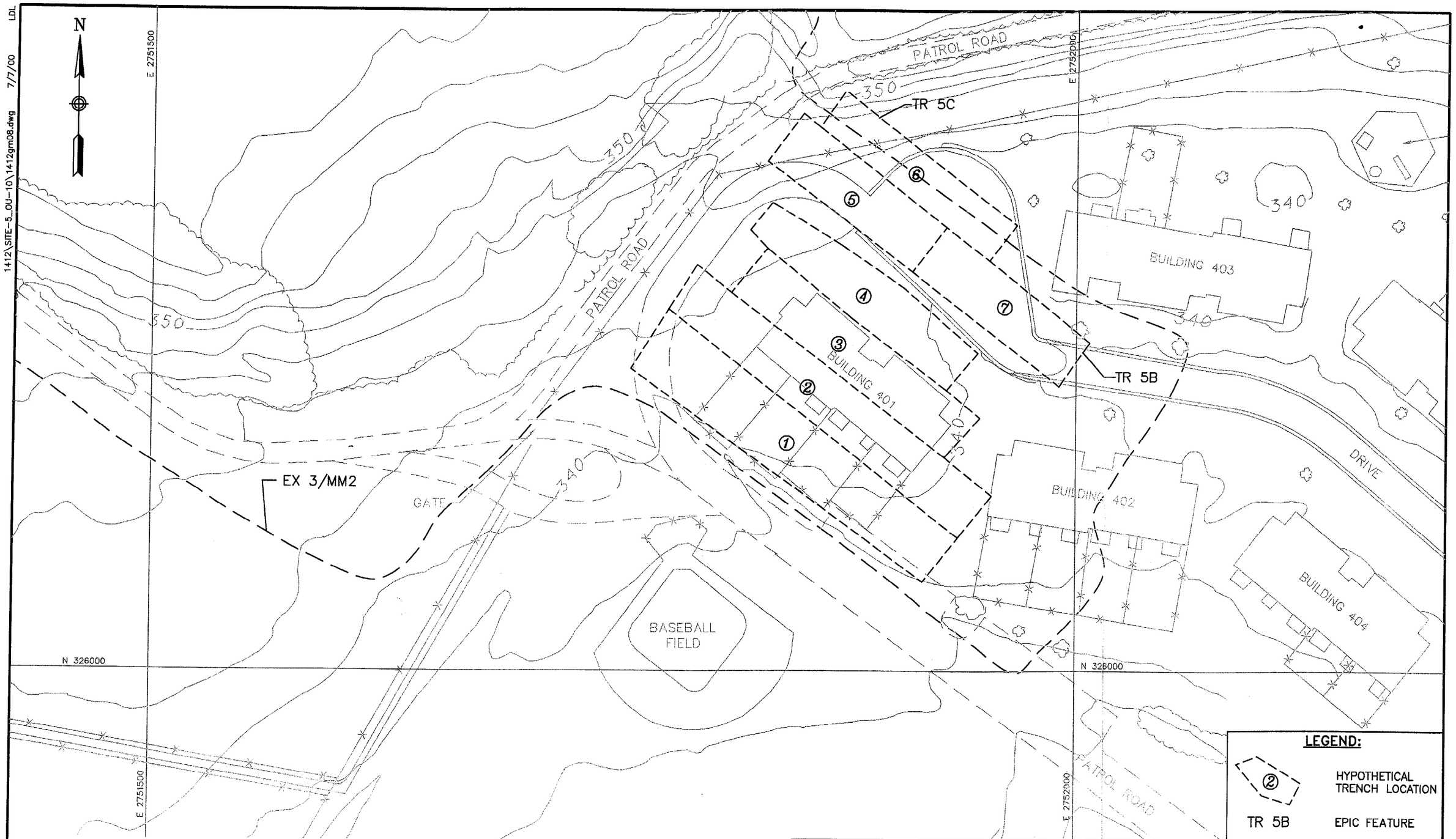
In October 1988, SMC Martin observed that the site was well vegetated and covered by roads, pavement, lawns, and buildings (SMC Martin, 1989).

Air monitoring samples were obtained from three locations at Site 5 during Phase I RI work. Two air sample locations were indoors at 566 and 572 Skyhawk Drive on the western and eastern ends of Building 401. The third sample was collected outside Building 401 on the patio of 566 Skyhawk Drive. The results of the air monitoring survey are presented in Section 4.4.

Also during Phase I, a soil gas survey was performed at Site 5. The survey consisted of 30 soil gas stations located north, west, and south of Building 401 on Skyhawk Drive. Ten confirmation borings were also drilled in the vicinity of this housing unit.

Subsurface soil samples were obtained from three locations at Site 5 during the Phase II RI. These samples were taken from areas of high soil gas readings and/or waste material, based on the results of the confirmation borings.

00N0D302



DRAWN BY LDL DATE 7/7/00	Tetra Tech NUS, Inc.	CONCEPTUAL LAYOUT OF SITE 5 TRENCHES AREA B – SITE 5 FORMER NAWC WARMINSTER NAWC, WARMINSTER, PA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 5010
REVISED BY DATE			APPROVED BY TPa DATE 14 Jul 00
SCALE AS NOTED			DRAWING NO. FIGURE 1–10 REV.

LDL 7/7/00 1412\SITE-5_OU-10\1412gm08.dwg

1412gm08.dwg

Because of the proximity and large number of cultural sources of interference, including buildings, fences, utility lines, and parked vehicles, a geophysical (electromagnetic) survey of reasonable quality could not be conducted at Site 5.

Both surface water and sediment samples were collected from Southampton Creek near Area B during Phase I. A biological characterization of the study area was also performed as part of Phase I.

1.4.1 Groundwater Studies

Several groundwater investigations have been conducted in and around Area B since the early 1980s. In January 1994, the Navy began focused RI activities for groundwater contamination associated with Area B. Groundwater data suggest that releases from Site 5 may not be the primary source of VOCs in groundwater in this area (TtNUS, 2000a). The locations of monitoring wells within and adjacent to Area B are shown in Figure 1-11.

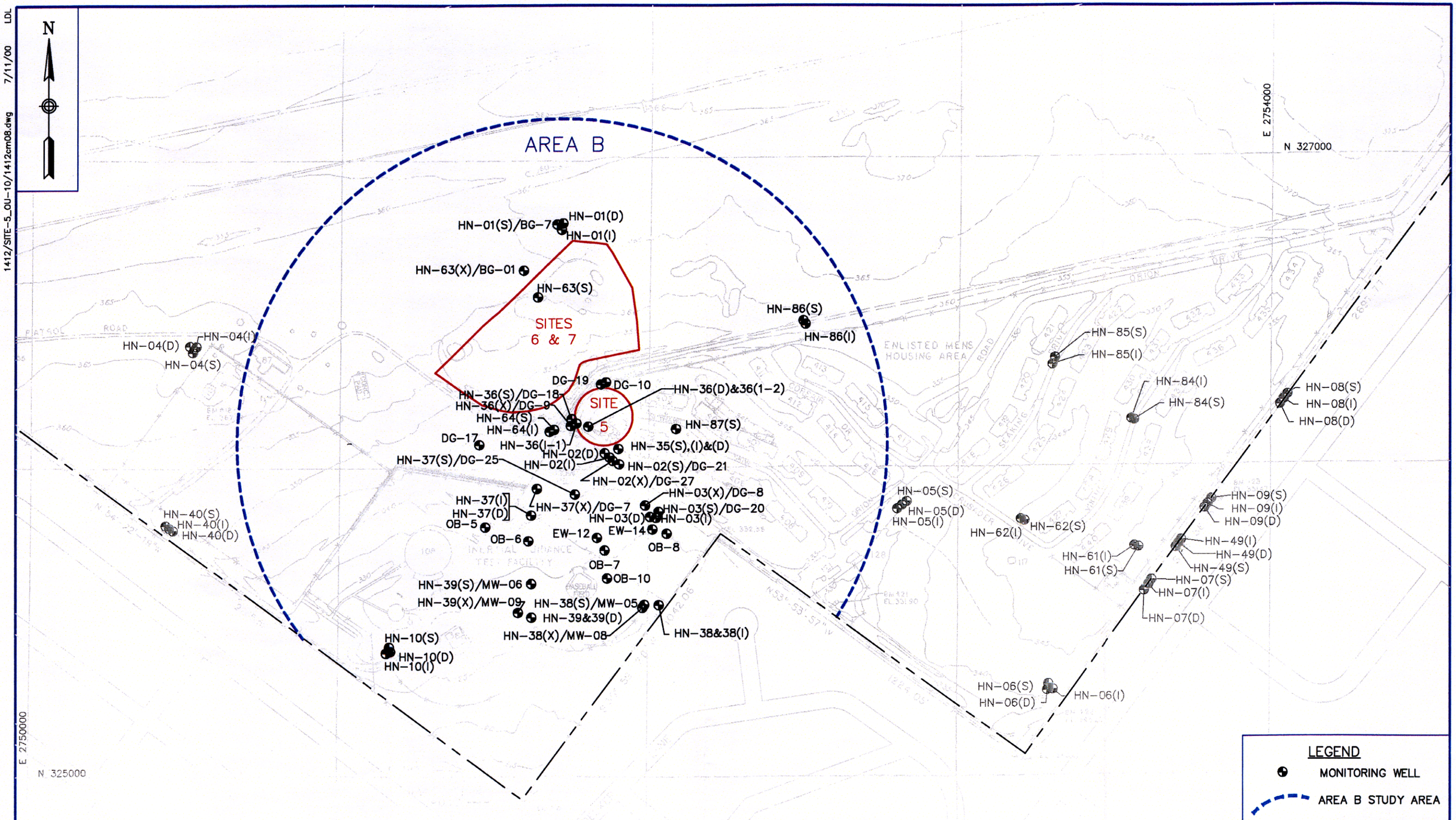
The results from the focused RI indicate that low concentrations of contaminants have been detected in some Area B monitoring wells (TtNUS, 2000a). Trichloroethene (TCE) concentrations above the MCL (5 ug/l) have continued to be found in wells HN-36S and HN-03S. Maximum concentrations have ranged from 5 ug/l to 12 ug/l. Monitoring of groundwater between and downgradient of these wells, which are 300 feet apart, has not detected TCE above the MCL. In addition, pumping tests conducted adjacent to HN-03S did not detected the presence of TCE (TtNUS, 2000a). The Area B Groundwater RI concluded that there are diffuse low-levels of TCE present in Area B groundwater; however, there is no discernable plume that exceeds the MCL of 5 ug/l. No other organic contaminant was identified at levels in excess of MCLs or at levels that presented human health concerns.

Although several inorganics were detected in Area B groundwater, no significant patterns of contamination were noted. Based on comparison to upgradient data, and the occurrence and distribution of contaminant levels in relation to suspended solids in the groundwater samples, the results were characteristic of the normal variation in inorganics that would be expected in groundwater.

In summary, the Area B groundwater RI concluded that the detected concentrations of VOCs in Area B groundwater do not present a threat to human health or the environment and the presence of inorganics is not related to Area B disposal activities.

00190D21Y

1412/SITE-5_OU-10/1412cm08.dwg 7/11/00 LDL



DRAWN BY	DATE	CONTRACT NO.
LDL	7/11/00	7606
CHECKED BY	DATE	OWNER NO. 0102
REVISED BY	DATE	APPROVED BY / DATE: TRA 13 Jul 00
SCALE: AS NOTED		DRAWING NO. FIGURE 1-11 / REV.

Tetra Tech NUS, Inc.

WELL LOCATIONS
AREA B
NAWC WARMINSTER, PA

1412cm08.dwg

1.5 CURRENT STATUS

As part of the DOD realignment of NAWC Warminster, the FLRA has been charged with developing the property and bringing new opportunities for employment at the base. The redevelopment plan for the base calls for open-space recreational land use west of Site 5 (Ernst and Young, 1998; FLRA, 1999). Site 5 itself will be retained for Navy housing purposes, particularly for military personnel and their families stationed at the nearby Naval Air Station Willow Grove.

1.6 REPORT ORGANIZATION

This report presents the results and recommendations related to the following field activities performed at Site 5:

- Air monitoring
- Soil gas surveys
- Surface water and sediment sampling and analysis
- Surface soil sampling and analysis
- Subsurface soil sampling and analysis
- Wetlands assessment
- Surveying

Section 1.0 discusses the purpose, scope, and objectives of the report and provides a brief background summary for Site 5. Section 2.0 details the field activities and other tasks performed (with an emphasis on Phase III RI work) and describes the objectives and methods of each investigative task conducted at the site. Section 3.0 presents the physical characteristics of the site based on existing literature, previous investigations, and recently developed information.

Section 4.0 describes the nature and extent of contamination discovered at Site 5 during field investigation tasks. Section 5.0 summarizes the routes of migration and persistence of contaminants found at the site. These two factors are used to determine the possibility of contamination reaching areas of public or environmental concern. Section 6.0 presents the potential risks posed by the site to human health and the environment given the limiting factors of contaminant fate and transport.

Several appendices have been enclosed as part of the RI report; these present specific results of the field investigations (e.g., analytical data) and other reference information.

2.0 SITE 5 INVESTIGATIONS

2.1 INTRODUCTION

This section summarizes the nature of RI work performed at Site 5. Specific findings regarding the physical characteristics of the site and the nature and extent of contamination are presented in Sections 3.0 and 4.0.

RI work addressing soils, surface water, and sediment in the vicinity of Site 5 has been conducted in phases, as discussed in Section 1.4. The Phase I RI (SMC Martin, 1991) included limited soil gas and geophysical surveys, as well as surface water and sediment sample analysis. The Phase II RI (HNUS, 1992) was limited to sampling of soils, surface water, and sediment from several locations near Site 5. Based on the findings of the Aerial Photographic Site Analysis Report (EPIC, 1994), a more comprehensive Phase III RI was performed beginning in 1995.

The Phase III RI work plan to study NAWC Warminster was submitted as a final document on January 16, 1995 (HNUS, 1995a and 1995c). The work plan incorporated comments received from Restoration Advisory Board (RAB) members. The plan described RI activities that were to be implemented to help characterize the potential sources of contamination within Area B, including Site 5.

Phase III RI field activities focused on characterizing surface soils, subsurface soils, buried materials, surface waters, and sediments potentially impacted by suspected sources at Site 5. The results from the Phase III RI for Site 5 were reported in a draft Phase III RI report, which was issued in November 1996 (Brown & Root Environmental, 1996a). Following the review of the draft Phase III RI report, the Navy conducted a supplemental soil investigation at Site 5 in December 1999 to address remaining concerns regarding the nature and extent of contamination related to the site.

This section primarily discusses the field investigation procedures that were performed at Site 5 during the Phase III RI and supplemental soil sampling at Site 5. Field work activities conducted as part of the Phase I RI (SMC Martin, 1991) and as part of the Phase II RI (HNUS, 1992) are discussed in the Phase I and II RI reports and are not presented in this section. However, the collective results of all RI work at Site 5 are summarized in Section 4.0. Table 2-1 summarizes the RI field work and supporting activities performed at Site 5 during all three RI phases.

TABLE 2-1
SUMMARY OF RI FIELD WORK AND OTHER ACTIVITIES AT SITE 5
NAWC WARMINSTER, PENNSYLVANIA

TASK	PHASE I RI	PHASE II RI	PHASE III RI	COMMENTS
Air Sampling and Analysis	X			
Soil Gas Survey	X		X	
Surface Soil Sampling and Analysis		X	X	
Subsurface Soil Sampling and Analysis using Soil Borings		X	X	
Confirmation Soil Borings	X			No Laboratory Analysis
Surface Water and Sediment Sampling and Analysis	X	X	X	
Horizontal Survey		X	X	
Biological Characterization	X			
Wetlands Assessment			X	
Aerial Photograph Interpretation			X	

2.2 GENERAL FIELD INVESTIGATION PROCEDURES

Field activities performed during the Phase III RI at Site 5 are summarized in Sections 2.2.1 through 2.2.6. The following activities were conducted:

- Air monitoring
- Soil gas surveys
- Surface water and sediment sampling and analysis
- Surface soil sampling and analysis
- Subsurface soil sampling and analysis, including test pits and soil borings
- Wetlands assessment

No geophysical survey was conducted during the Phase III RI due to the close proximity to sources of interference. These interferences included buildings, fences, underground and aboveground utilities, and parked cars that would have put in question the quality of a geophysical electromagnetic survey of the area.

2.2.1 Scope of Work

The Phase III RI work for Site 5 focused on characterizing the potential sources of contamination, particularly with regard to soils and wastes. In addition, a surface water and sediment sampling program was conducted to evaluate the impacts of Site 5 on the nearby stream.

The primary tools of investigation included soil gas surveys, soil borings (with subsurface soil sampling), and surface soil sampling. These methods were applied, as appropriate, in an integrated manner to characterize the potential source areas of contamination targeted for investigation.

Soil gas surveys were employed in areas of suspected disposal of wastes containing volatile organics. The objective of the soil gas survey was to identify potential sources of the chlorinated VOCs detected in local groundwater. The locations of the soil gas surveys took into consideration identified potential sources from aerial photos, past investigation data, field observations, and historic information regarding the locations of subsurface disposal sites.

Coordinates of suspected subsurface disposal sites, provided by EPIC, were used to focus the surveys, along with other available information. These coordinates were field-located by the Navy using Global Positioning System (GPS) technology. For the Phase III RI work, GPS technology involved a hand-held receiver, taking a series of readings from satellites, to determine the coordinates of the receiver's location. The location was adjusted until the readings matched with the desired coordinates, thereby locating the desired point.

Soil borings were used to characterize actual subsurface conditions in potential subsurface disposal sites. The locations of the borings were selected based on the results of the soil gas surveys, as well as on aerial photo records, field observations, and previous field work findings. Subsurface soil samples were obtained from the borings to characterize the materials encountered.

Surface soil sampling was conducted in areas where surface disposal of wastes was a potential concern. In areas of obvious waste disposal on the ground surface (i.e., waste piles or stained soils), the samples were taken directly from the affected materials. In areas of suspected surface disposal where no visible sign of wastes was evident, samples were obtained at various points within the suspected area of disposal. In addition, a basewide background surface soil sampling program was performed to provide a background database with which to compare potentially impacted soil results.

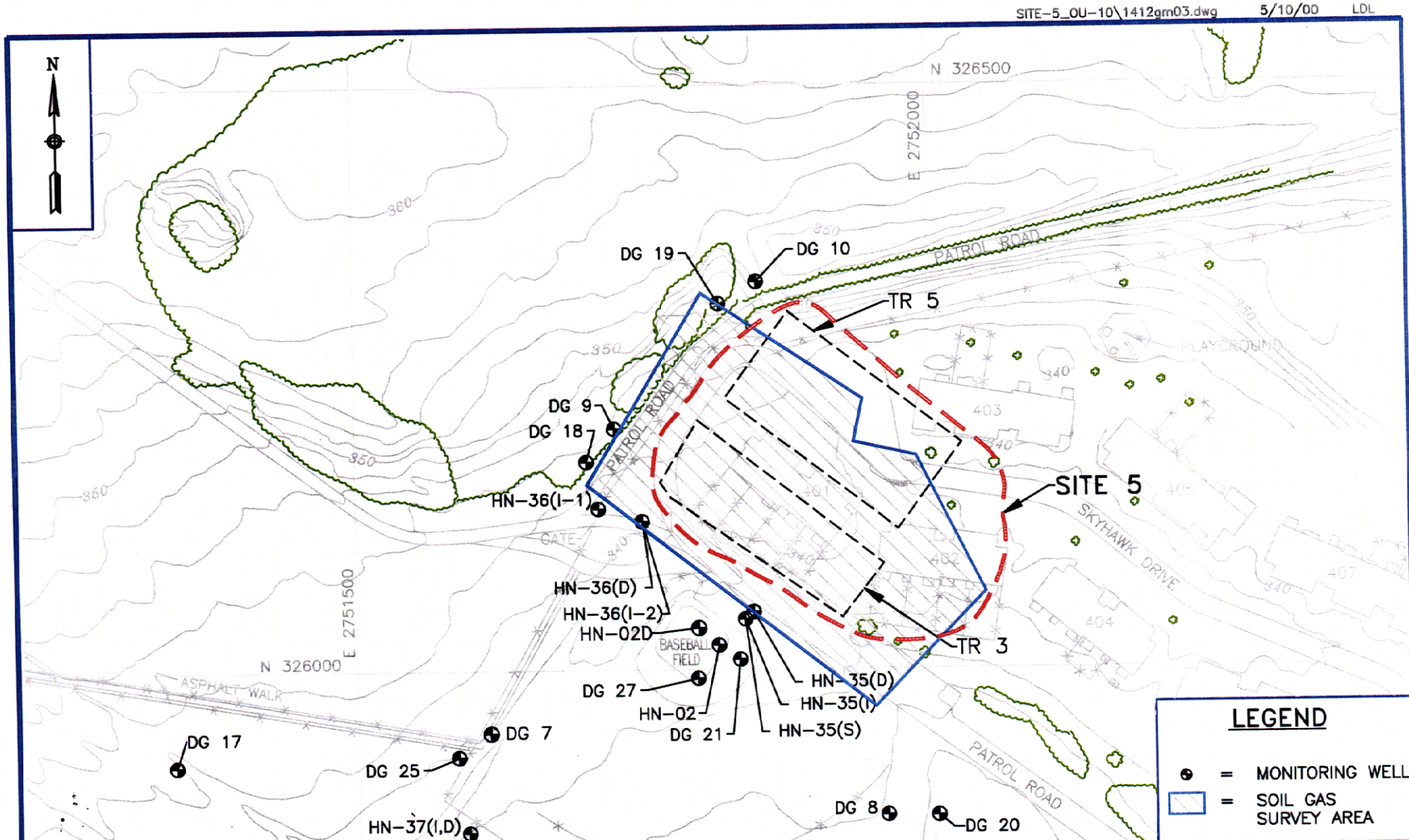
In addition, a supplemental investigation was conducted after the draft Phase III RI report was submitted in order to further characterize the surface and subsurface soil contamination at Site 5: A sampling plan was prepared for the supplemental investigation. In December 1999, a total of 28 soil borings and 20 surface soils were collected during supplemental sampling. The sampling was conducted to determine the lateral extent of trenches TR3 and TR5 and whether the six to eight trenches as reported were present. Sample locations were selected based on the Phase III RI results. Samples were analyzed for full TCL organics, TAL metals, hexavalent chromium, pH, Oxidation Reduction Potential, iron oxide, and sulfides. A separate letter was submitted summarizing the significant findings of this study (TtNUS, 2000e).

The methodologies for the Phase III RI field work are explained in the remainder of this section.

2.2.2 Soil Gas Survey

To determine the extent of Site 5 and to evaluate subsurface soil conditions in and around Site 5, a soil gas survey was performed during Phase III. The Phase I soil gas survey results, the EPIC aerial photograph analysis, and the findings from previous investigations (e.g., Phase I RI, Phase II RI) were used to focus the soil gas survey on the most likely suspected source locations. The soil gas survey spacing was irregular given the presence of buried utilities (e.g., telephone cable, stormdrains, and electrical lines) in the area. The samples were analyzed for both halogenated and aromatic volatile organic contamination. The soil gas survey was conducted across an irregular grid and consisted of obtaining soil gas readings at each grid node at depths of 2 to 3 feet and 4 to 6 feet (or until refusal) (Figure 2-1). The grid spacing was reduced in areas of elevated soil gas readings to more precisely delineate the soil gas anomalies. Additional soil gas points were added along the length of each trench at Site 5, as determined from the EPIC coordinates.

SITE-5_OU-10\1412gm03.dwg 5/10/00 LDL



0 120 240
SCALE IN FEET

DRAWN BY LDL	DATE 5/10/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

Tetra Tech NUS, Inc.

PHASE III RI
SOIL GAS SURVEY AREA – SITE 5
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412	
OWNER NO. 6010	
APPROVED BY	DATE 12 Jul 00
DRAWING NO. FIGURE 2-1	REV.

1412gm03.dwg

The soil gas survey objective was to measure the concentrations of VOCs in soil gas around suspected source locations. Elevated VOC levels in soil gas could indicate soil and/or groundwater contaminated with VOCs. Information obtained from the Phase III RI soil gas survey was combined with data from the Phase I RI soil gas survey to better locate subsurface soil borings.

Soil gas sampling was performed using the hollow probe method. The probe and probe tip were driven into the ground to a specified depth using an electric hammer drill (Bosch hammer) or a power auger. The sampling depths ranged between 3 and 5 feet. After reaching the target sampling depth, the hollow probe was lifted to retract the probe adapter and expose the lowest 2 to 4 inches of soil at the bottom of the hole. Polyethylene (PE) tubing with a threaded endpiece was tightened to the expendable point adapter at the bottom and connected at the surface to silicon tubing attached to a peristaltic pump. The peristaltic pump was used to purge the assembly before sampling and to extract air from the interstitial soil pore space. At some locations, at least two soil gas samples were extracted and analyzed. A Tedlar bag was connected to the sampling pump, filled with soil vapor, and sealed until analysis. The hollow probe and adapter assembly were removed and decontaminated between samples following standard protocol. A fresh length of PE tubing was used for each hole.

Soil gas analysis was performed in the on-base field trailer using a Hewlett Packard gas chromatograph (GC) equipped with a 30-meter, 0.25 mm inner-diameter (ID). capillary column that was coupled to a photoionization detector (PID) in-series with an electron capture detector (ECD). The GC was optimized for rapid (less than 7.5 minutes per run) analysis for acetone, 2-butanone, benzene, toluene, ethylbenzene, total xylenes, styrene, PCE, TCE, 1,1,1-trichloroethane, carbon tetrachloride, chloroform, 1,1-dichloroethene, 1,2-dichloroethene, 1,2-dichloroethane, and 1,1-dichloroethane.

Calibration standards were diluted from certified methanolic standards into water using 40 ml VOC vials, leaving a 10 ml headspace. 400 µl vapor aliquots were injected after standards were heated to 70°C for 5 minutes and shaken for 30 seconds. An initial 3-point calibration was performed and the practical quantitation limit (PQL) for each compound was established as one-half of the lowest concentration standard. The method achieved PQLs in the range of 0.03 to 0.3 ug/l for trichlorinated and tetrachlorinated compounds, followed by PQLs between 2 and 6 ug/l for compounds with carbon double bonds or aromatic rings, and PQLs between 15 and 50 ug/l for dichlorinated alkanes, acetone, and 2-butanone.

A continuing calibration standard was analyzed at the beginning of each day and repeated after every 15 injections. Subsequent continuing calibrations were assessed to verify stable system response; if response decreased by -60 percent or increased by +100 percent for more than one compound, then new calibration factors were required for all compounds. In the event of calibration error caused by systematic problems (e.g., syringe or detector malfunction), corrective action was taken and followed by a new standard injection and calibration factor update.

Analytical quality control procedures were followed for field blanks, field duplicates, syringe blanks, holding times, and decontamination. Duplicate samples and Tedlar bag blanks were collected at a frequency of one per 20 soil vapor samples. Syringe blanks were run for every 20 injections and after highly contaminated samples. High-level samples were followed by syringe cleaning and bake-out. Tedlar bags were flushed with three volumes of air between each use and were discarded if leaks were found. Syringe performance (plunger resistance, methanol dispensing, and injection spike size) was monitored to ensure the absence of leaks or blockage.

Syringes were repaired/replaced at the first symptom of malfunction. Analyses were generally performed within 8 hours of sample collection.

Results were reported in units of aqueous ug/l, equivalent to the corresponding calibrated headspace concentration. For compounds quantifiable on both detectors, the detector having lower detection limits was consistently reported except when sample levels were above the linear range. A screening-level data validation was performed via electronic linking of sample and associated blank data files, after which results were incorporated into a database.

The Site 5 soil gas survey results (including analytical data) were evaluated and plotted on color contour maps. The data were color contoured such that shades of orange, red, and purple represent high soil vapor data values. Shades of blue were used to represent background conditions as based upon this data set. Site surface features and suspected disposal location boundaries were used to make final interpretations regarding possible soil gas anomalies. An interpretation of the soil gas survey results is provided in Section 4.3 of this report.

A summary of the Site 5 Phase III soil gas sample analyses is included in Appendix B.

2.2.3 Soil Borings

Soil borings were drilled and sampled to gather data about the extent, nature, and depth of contamination. The locations of the borings were determined after data gathered during the soil gas survey were reviewed. Most borings were completed by using a drilling rig with cleaned, decontaminated, hollow-stem augers. The cuttings were inspected for any waste material or VOCs as the auger brought them to the surface. Each boring was drilled until a significant amount of waste was encountered or to about 10 feet below ground surface, unless bedrock or some other impenetrable surface was encountered above 10 feet. The actual depth of each boring was specific to the suspected source being investigated. Upon completion, all boreholes were backfilled with the cuttings.

A PID was primarily utilized at each boring to detect any VOCs that may have been present. The PID has a detection limit of approximately 1 ppm. A majority of the soil borings were sampled continuously using a split-spoon sampler from the ground surface to the top of bedrock. Samples selected for laboratory analysis were based on PID readings and visible evidence of wastes or buried materials. If no evidence of contamination was found, samples from just above the weathered bedrock interface were selected for analysis. Samples were analyzed for various analytes in accordance with the Phase III RI work plan and any addenda to the work plan.

Each boring was logged by a geologist. Information recorded by the geologist included lithology, waste materials encountered, PID concentrations, the depth at which waste was found, and any other pertinent observations. This information was recorded on logs presented in Appendix D. Each boring location was determined in relation to a fixed point so that the exact location of the boring could be determined in the future should the need arise. The locations of all soil boring samples are displayed in Figure 2-2.

All field data were peer reviewed and checked for accuracy upon the completion of the boring survey.

2.2.4 Stream Sampling and Analysis

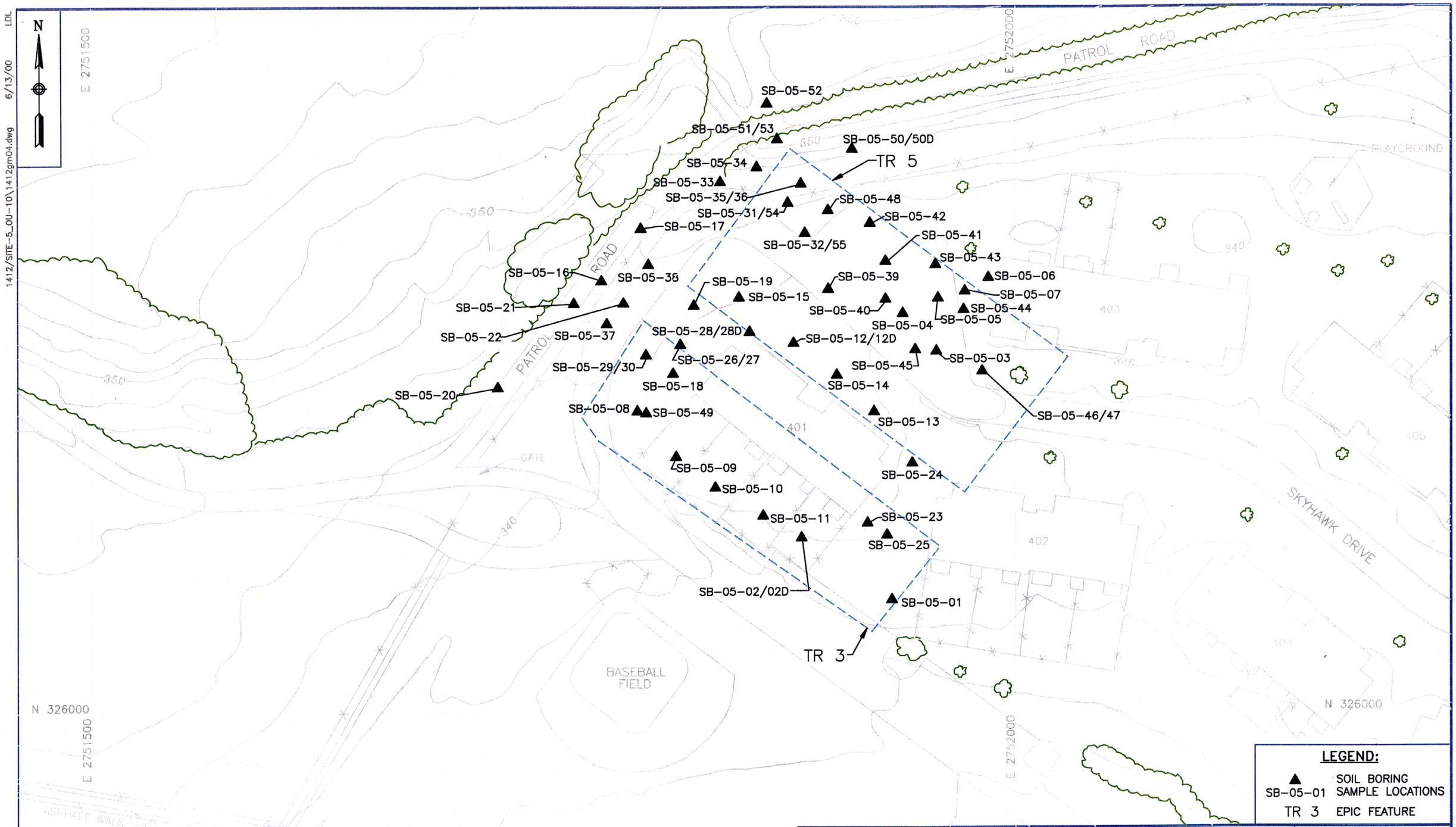
Surface water and sediment samples were collected from the downgradient Area B stream during all three RI phases. Since the headwaters of Southampton Creek originate near the base boundary, no "true" upstream or downstream/background samples could be designated. Sample locations are shown in Figure 2-3. Hydrologic characteristics for Area B are presented in Section 3.2. Surface water and sediment analytical results are discussed in Sections 4.5.3 and 4.5.4, respectively.

2.2.4.1 Surface Water Sampling

Designated site-related surface water samples were collected at one location in Phase I (sample B12), one location in Phase II (sample B10), and two locations in Phase III (samples B1 and B2). Samples were taken from locations in the headwaters of Southampton Creek located south of Area B. Samples B2, B10, and B12 were located downstream of Area B, where the stream flows from a concrete culvert passing under Byron Road. Sample B1 was collected from the location where the storm drain leaves Building 108. Except for sample B2, the surface water samples were analyzed for full TCL organics and TAL inorganics. The Phase III surface water samples were also tested for both total and dissolved inorganics.

Designated background surface water samples were also collected during the RI. These samples were collected in off-base locations (south of Area B) that were considered unaffected by past or current site-related activities. The background samples included B9 (obtained during Phase I), B11 (Phase II), and B4 (Phase III). Samples B9 and B11 were near the first of two small ponds downstream from Parmentier Road, while sample B4 was obtained from a culvert passing under Parmentier Road. Except for sample B4, the

D0190 D B23Y



LEGEND:

▲ SB-05-01 — SOIL BORING SAMPLE LOCATIONS

TR 3 — EPIC FEATURE

DRAWN BY LDL	DATE 7/5/00	Tetra Tech NUS, Inc.	SOIL BORING SAMPLE LOCATION MAP AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 1412

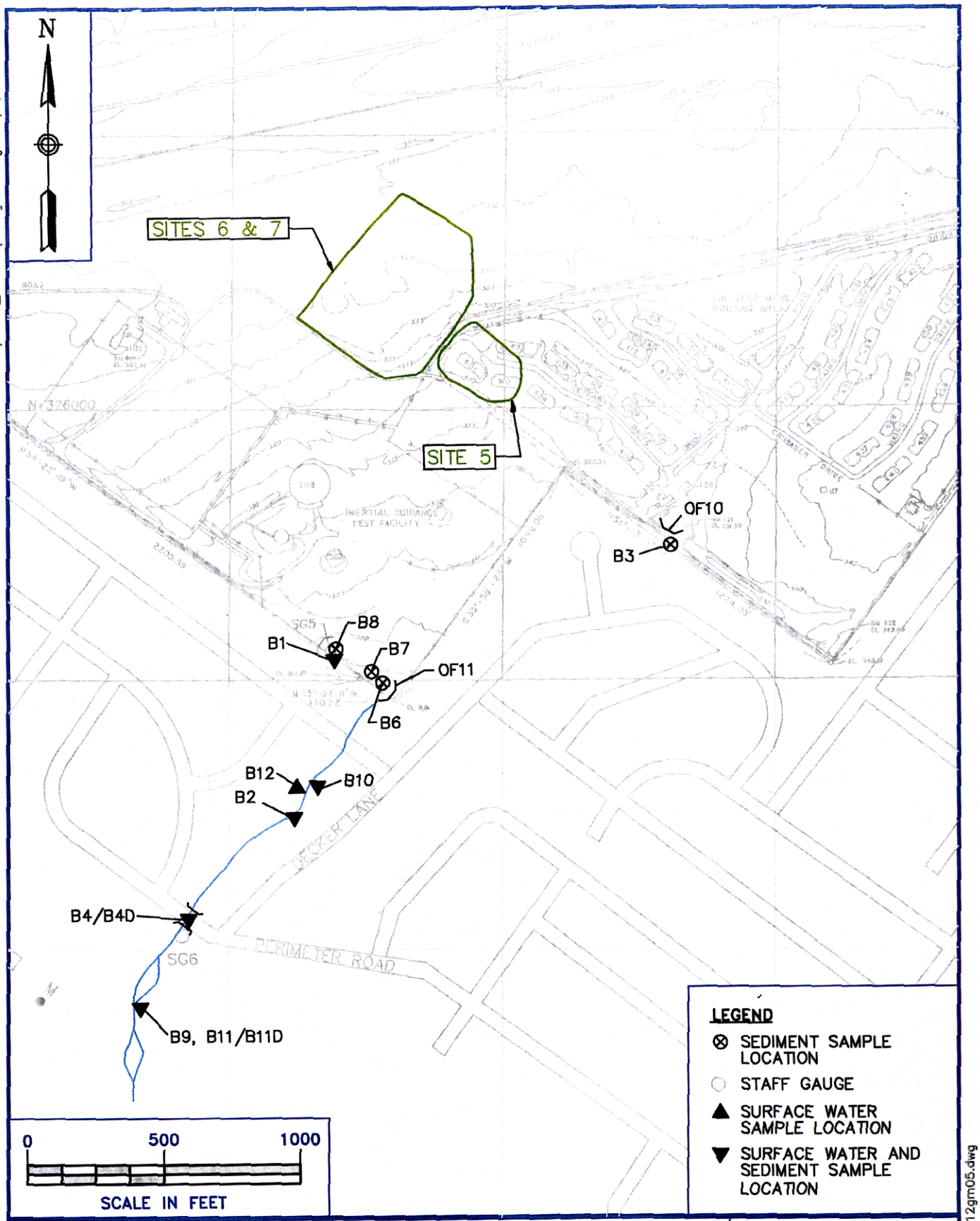
OWNER NO. 6010

APPROVED BY — DATE 14 Jul 00

DRAWING NO. FIGURE 2-2 — REV.

1412/SITE-5_OU-10\1412gm04.dwg 6/13/00 LDL

1412gm04.dwg



DRAWN BY	DATE	Tetra Tech NUS, Inc.	AREA B SURFACE WATER/SEDIMENT SAMPLE LOCATIONS FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
EEH/LDL	7/5/00			OWNER NO. 6010
CHECKED BY	DATE			APPROVED BY / DATE
REVISED BY	DATE			12 Jul 00
SCALE AS NOTED				DRAWING NO. FIGURE 2-3 / REV.

1412/SITES_OU-10\1412gm05.dwg 6/6/00 eeh

1412/SITES_OU-10\1412gm05.dwg

surface water samples were analyzed for full TCL organics and TAL inorganics. The Phase III surface water sample was also tested for both total and dissolved inorganics.

The background occurrence and distribution tables for surface water are shown in Table 2-2 (total inorganics) and Table 2-3 (dissolved inorganics). Two VOCs were detected at low levels in these background surface water samples. Chloroform was found at 12 ug/l in sample B9, and sample B4 contained carbon disulfide at an estimated concentration of 2J ug/l. Diethylphthalate was the only other organic compound detected. An estimated concentration of 0.2J ug/l was detected in sample B9.

2.2.4.2 Sediment Sampling

Potential site-related sediment samples were collected at one location in Phase II (sample B10) and at five locations in Phase III (B1, B2, B3, B6, B7, and B8). Sediment samples B1, B6, B7, and B8 were taken from the drainage channel downgradient from Building 108 and before Outfall No. 11. Sample B3 was obtained from just below Outfall No. 10. Samples B1 and B10 were analyzed for full TCL organics and TAL inorganics, and sample was also tested for both total and dissolved inorganics. Samples B6, B7, and B8 were tested for PCBs only (Figure 2-3).

Designated background sediment samples were also collected during the RI. The background samples included B9 (obtained during Phase I), B11 (Phase II), and B4 (Phase III). Except for sample B4, the background sediment samples were analyzed for full TCL organics and TAL inorganics. The background occurrence and distribution tables for sediment are displayed in Table 2-4 (inorganics) and Table 2-5 (organics).

2.2.5 Surface Soil Sampling

Surface soil sampling was performed at Site 5 during Phase III. Surface soil samples are shown in Figure 2-4. Surface soil samples were collected and analyzed as part of the Phase III RI. A total of 16 surface soil samples (and two duplicate samples) were initially taken in the vicinity of Site 5 (Figure 2-4). All samples were collected from a depth between 6 and 24 inches. The sample locations were chosen based on previous high soil gas readings an confirmation borings and the suspected location of trenches TR3 and TR5. All samples were analyzed for TAL metals, TCL semivolatile organics, TCL pesticides, and PCBs. In addition, 70 percent of the surface soil samples were analyzed for TCL volatile organics. The surface soil samples for Site 5 were obtained in the vicinity of Buildings 401, 402, and 403 and within trenches TR3 and TR5.

TABLE 2-2

OCCURRENCE AND DISTRIBUTION OF TOTAL INORGANICS IN SURFACE WATER IN BACKGROUND - AREA B

WARMINSTER, PENNSYLVANIA

(ug/L)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
BARIUM	147.33	NONPARAMETRIC DIST	2 / 3	92 - 100	100
CALCIUM	28025	NORMAL OVER LOGNORMAL	2 / 2	27950 - 28100	28100
IRON	444.67	NONPARAMETRIC DIST	2 / 3	389 - 895	895
MAGNESIUM	10825	NONPARAMETRIC DIST	2 / 2	10500 - 11150	11150
MANGANESE	82.67	NONPARAMETRIC DIST	2 / 3	44 - 154	154
POTASSIUM	1498	NONPARAMETRIC DIST	2 / 2	1450 - 1545	1545
SODIUM	15375	NONPARAMETRIC DIST	2 / 2	14600 - 16150	16150
ZINC	20.30	NONPARAMETRIC DIST	1 / 2	30.6	30.6

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

OCCURRENCE AND DISTRIBUTION OF DISSOLVED INORGANICS IN SURFACE WATER IN BACKGROUND - AREA B
WARMINSTER, PENNSYLVANIA
(ug/L)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
BARIUM	62.30	NONPARAMETRIC DIST	3 / 3	53 - 74.5	74.50
CALCIUM	18800.00	NONPARAMETRIC DIST	3 / 3	15200 - 22100	22100
COPPER	7.47	NONPARAMETRIC DIST	2 / 3	5.6 - 14.8	14.80
LEAD	0.67	NONPARAMETRIC DIST	1 / 3	1	1
MAGNESIUM	7253.33	NONPARAMETRIC DIST	3 / 3	6230 - 7920	7920
MANGANESE	49.00	NONPARAMETRIC DIST	2 / 2	25 - 73	73
POTASSIUM	1356.67	NONPARAMETRIC DIST	3 / 3	1290 - 1470	1470
SODIUM	12456.67	NORMAL	3 / 3	9440 - 18400	18400
ZINC	6.25	NONPARAMETRIC DIST	1 / 2	10.5 - 10.5	10.50

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 2-4

OCCURRENCE AND DISTRIBUTION OF TOTAL INORGANICS IN SEDIMENT IN BACKGROUND - AREA B

WARMINSTER, PENNSYLVANIA

(mg/kg)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
ALUMINUM	3572	NONPARAMETRIC DIST	3 / 3	500 - 5805	5805
ARSENIC	1.97	NONPARAMETRIC DIST	3 / 3	0.31 - 3.7	3.7
BARIUM	40.90	NONPARAMETRIC DIST	2 / 3	43.9 - 53.8	53.80
BERYLLIUM	0.66	NONPARAMETRIC DIST	2 / 2	0.61 - 0.7	0.70
CADMIUM	1	NONPARAMETRIC DIST	1 / 2	1.4	1.4
CALCIUM	5270	NONPARAMETRIC DIST	2 / 2	2240 - 8300	8300
CHROMIUM	10.53	NONPARAMETRIC DIST	3 / 3	1.2 - 16.6	16.60
COBALT	4.27	NONPARAMETRIC DIST	3 / 3	0.3 - 7.2	7.20
COPPER	17.95	NONPARAMETRIC DIST	2 / 2	17.5 - 18.4	18.40
IRON	9983	NONPARAMETRIC DIST	3 / 3	900 - 15800	15800
LEAD	15.60	NONPARAMETRIC DIST	3 / 3	3.4 - 27.8	27.80
MAGNESIUM	3805	NONPARAMETRIC DIST	2 / 2	2445 - 5165	5165
MANGANESE	171.33	NONPARAMETRIC DIST	2 / 3	225 - 284	284
NICKEL	9.20	NONPARAMETRIC DIST	2 / 3	12.9 - 14.2	14.2
POTASSIUM	686.67	NONPARAMETRIC DIST	2 / 3	710 - 1325	1325
VANADIUM	14.80	NONPARAMETRIC DIST	3 / 3	1.4 - 25.4	25.4
ZINC	89.33	NONPARAMETRIC DIST	3 / 3	26 - 129	3889

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TAL

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT IN BACKGROUND - AREA B

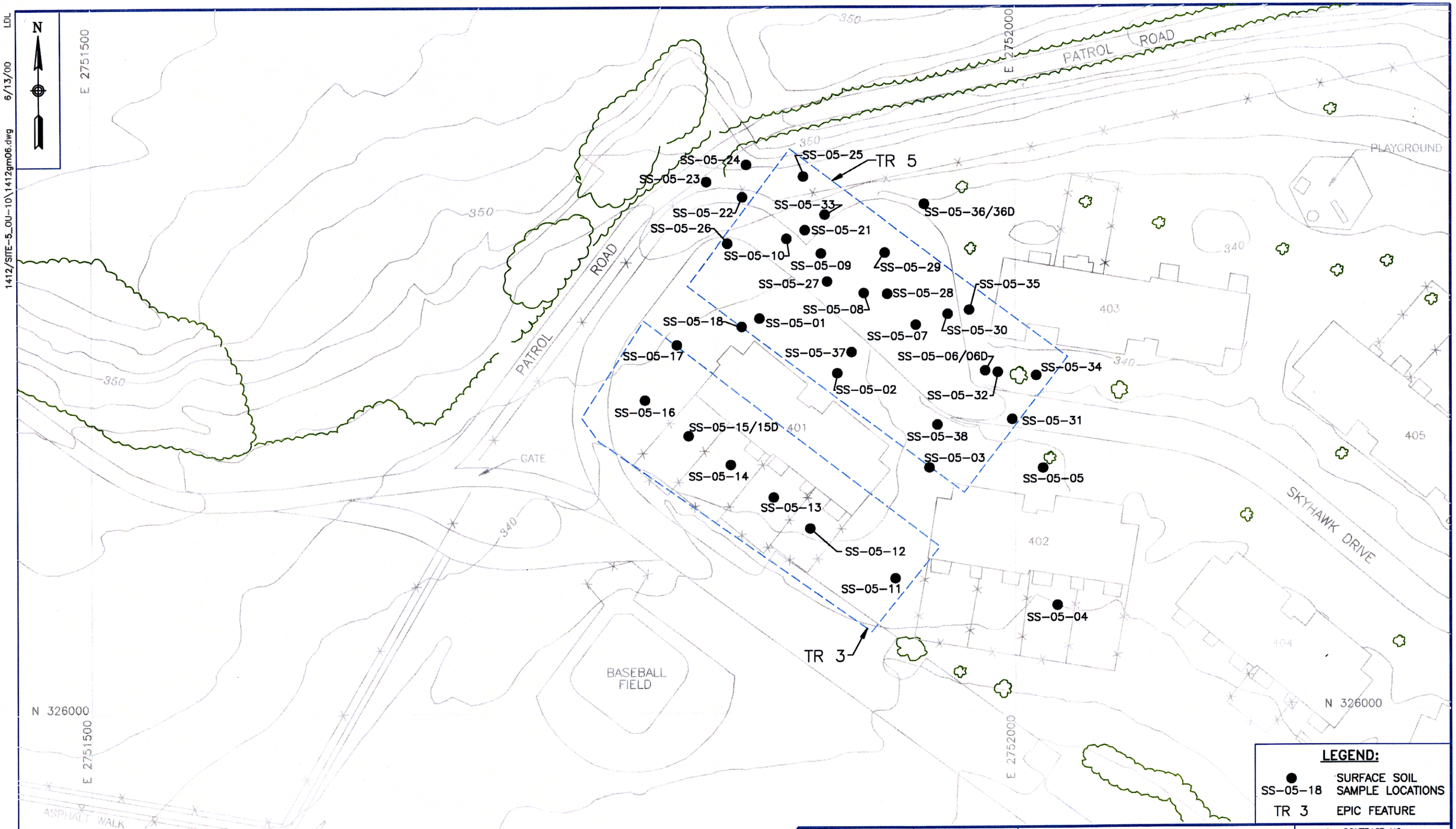
WARMINSTER, PENNSYLVANIA

(ug/kg)

SUBSTANCE	BACKGROUND				
	MEAN	STATISTICAL DISTRIBUTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION*	REPRESENTATIVE CONCENTRATION
ALPHA-CHLORDANE	5.85	NONPARAMETRIC DIST	1 / 1	5.85	5.85
ACENAPHTHENE	105	NONPARAMETRIC DIST	2 / 2	100 - 110	110
ANTHRACENE	291.25	NONPARAMETRIC DIST	2 / 2	252.5 - 330	330
BENZ(A)ANTHRACENE	939.75	NONPARAMETRIC DIST	2 / 2	579.5 - 1300	1300
BENZO(A)PYRENE	684.75	NONPARAMETRIC DIST	2 / 2	489.5 - 880	880
BENZO(B)FLUORANTHENE	1065	NONPARAMETRIC DIST	2 / 2	829.5 - 1300	1300
BENZO(G,H,I)PERYLENE	493.75	NONPARAMETRIC DIST	2 / 2	267.5 - 720	720
BENZO(K)FLUORANTHENE	681.25	NONPARAMETRIC DIST	2 / 2	362.5 - 1000	1000
BIS(2-ETHYLHEXYL)PHTHALAT	995.75	NONPARAMETRIC DIST	2 / 2	91.5 - 1900	1900
CARBAZOLE	287.50	NONPARAMETRIC DIST	1 / 1	287.5	287.5
CHRYSENE	1044	NONPARAMETRIC DIST	2 / 2	587.5 - 1500	1500
DIBENZ(A,H)ANTHRACENE	1298	NONPARAMETRIC DIST	1 / 2	96	96
FLUORANTHENE	2515	NONPARAMETRIC DIST	2 / 2	1630 - 3400	3400
FLUORENE	175	NONPARAMETRIC DIST	2 / 2	160 - 190	190
INDENO(1,2,3-CD)PYRENE	456.25	NONPARAMETRIC DIST	2 / 2	312.5 - 600	600
PYRENE	2140	NONPARAMETRIC DIST	2 / 2	1380 - 2900	2900

* = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

00190 D247



DRAWN BY LDL	DATE 7/7/00	Tetra Tech NUS, Inc.	SURFACE SOIL SAMPLE LOCATION MAP AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 1412
OWNER NO. 6010
APPROVED BY Tea DATE 7 July 00
DRAWING NO. FIGURE 2-4 REV.

LDL 6/13/00 1412/SITE-5_OU-10\1412gm06.dwg

1412gm06.dwg

As part of the December 1999 soil investigation, 20 surface soils were collected from 0 to 2 feet below ground surface or below asphalt and gravel base. The sample locations were chosen based on previous surface soil investigations and the suspected locations of trenches TR3 and TR5. The samples were analyzed for TCL organics, TAL metals, chromium, ferrous, iron, sulfides, pH, and ORP.

2.2.6 Subsurface Soil Sampling

Subsurface soil sampling and analysis was performed during Phase II and Phase III of the RI field work. A total of 10 subsurface soil borings were advanced as confirmation borings during the Phase I RI (Figure 2-5).

During Phase II, three subsurface soil samples were obtained from three locations along the eastern, western, and southern sides of Building 401. These samples were chosen to correspond to areas of high soil gas readings or waste material present in confirmation borings.

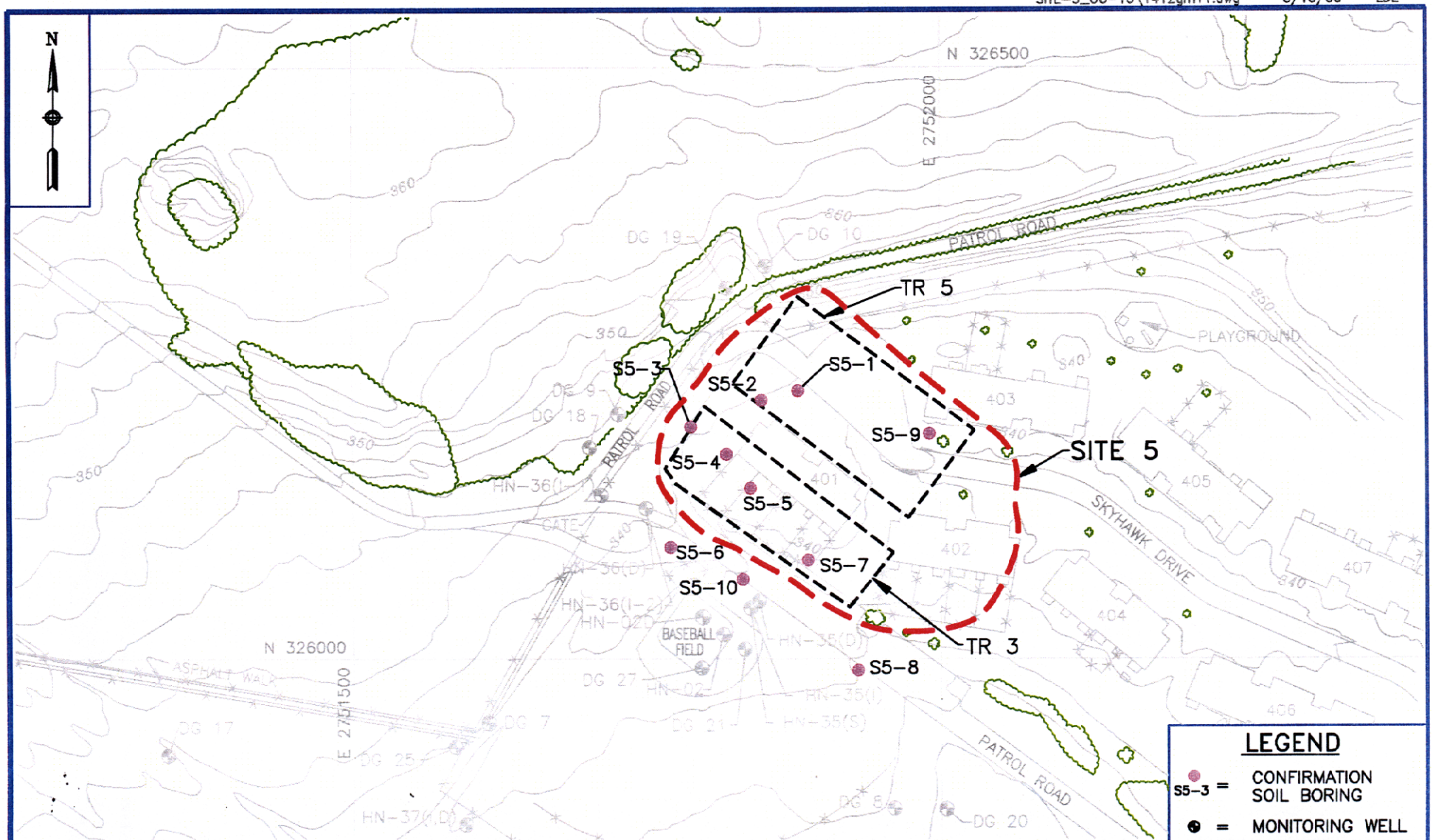
During Phase III, 20 subsurface soil samples (including duplicates were collected (SB-05-01 through SB-05-19). These samples were collected throughout the trenches TR3 and TR5. The locations were based on soil gas hot spots and aerial photographs and were collected to further investigate the nature and extent of subsurface soil contamination at trenches TR3 and TR5. The samples were analyzed for TCL VOA and TAL metals, about 30 percent were also analyzed for TCL semivolatile organic compound (SVOC), pesticides, and PCBs.

As part of the December 1999 soil investigation, 27 soil borings were collected within the area of trenches TR3 and TR5. The locations were chosen based on previous subsurface soil investigations and the suspected locations of the trenches. The samples were analyzed for TCL organics, TAL metals, hexavalent chromium, ferrous iron, sulfides, pH, and ORP. All subsurface soil locations can be found on Figure 2-2.

Most subsurface soil samples were obtained using hollow stem augers and split spoon samples. The samples were collected from the split spoon barrels using stainless steel sample trowels and were placed into sample containers supplied by the laboratory. Some subsurface soil samples were collected using a hand auger. The physical characteristics of the soil were described and recorded based on visual observation and were screened for VOCs using PID/FID equipment. Several soil borings showed evidence of waste and had PID readiings above background. For additional information, Appendix C contains the soil boring logs for the Phase II and Phase III RI work.

Sample logsheets including sample identification, date and time of collection, analytical parameters and other information were completed for each sample and can be found in Appendix F.

SITE-5_OU-10\1412gm11.dwg 5/10/00 LDL



0 120 240

SCALE IN FEET

DRAWN BY LDL	DATE 7/11/00	
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

Tetra Tech NUS, Inc.

CONFIRMATION BORING LOCATIONS
PHASE I – SITE 5
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412

OWNER NO. 6010

APPROVED BY DATE 12 Jul 00

DRAWING NO. FIGURE 2-5

REV.

1412gm11.dwg

00190257

2.2.7 Wetlands Assessment

To supplement the Phase III RI, a wetlands assessment was performed in June 1994 to provide a qualitative appraisal of the plants and animals that could potentially be harmed by the inadvertent release of hazardous substances attributable to NAWC Warminster. As part of this assessment, the approximate wetland boundaries along the unnamed tributary of Little Neshaminy Creek downgradient from Site 5 were identified on United States Geologic Survey (USGS) maps. Plants and animas associated with these wetlands were identified and used to characterize the wetlands according to procedures found in the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, 1979). Wetlands were identified using the routine determination on-site inspection method (United States Army Corps of Engineers, 1987), including swamps, marshes, bogs, and similar areas. This method involves the use of USGS topographic maps, Soil Conservation Service soil surveys, aerial photographs, United States Fish and Wildlife Service National Wetlands Inventory (NWI) maps, and site-specific vegetation, soils, and hydrological information.

The results of the wetlands assessment are provided in Section 3.6. These results were used, along with the Phase I RI biological characterization and the analytical results from surface water and sediment sampling, to help complete the ecological risk assessment for NAWC Warminster. The biological characterization was completed on a qualitative, descriptive level, and it did not involve sampling procedures for area biota.

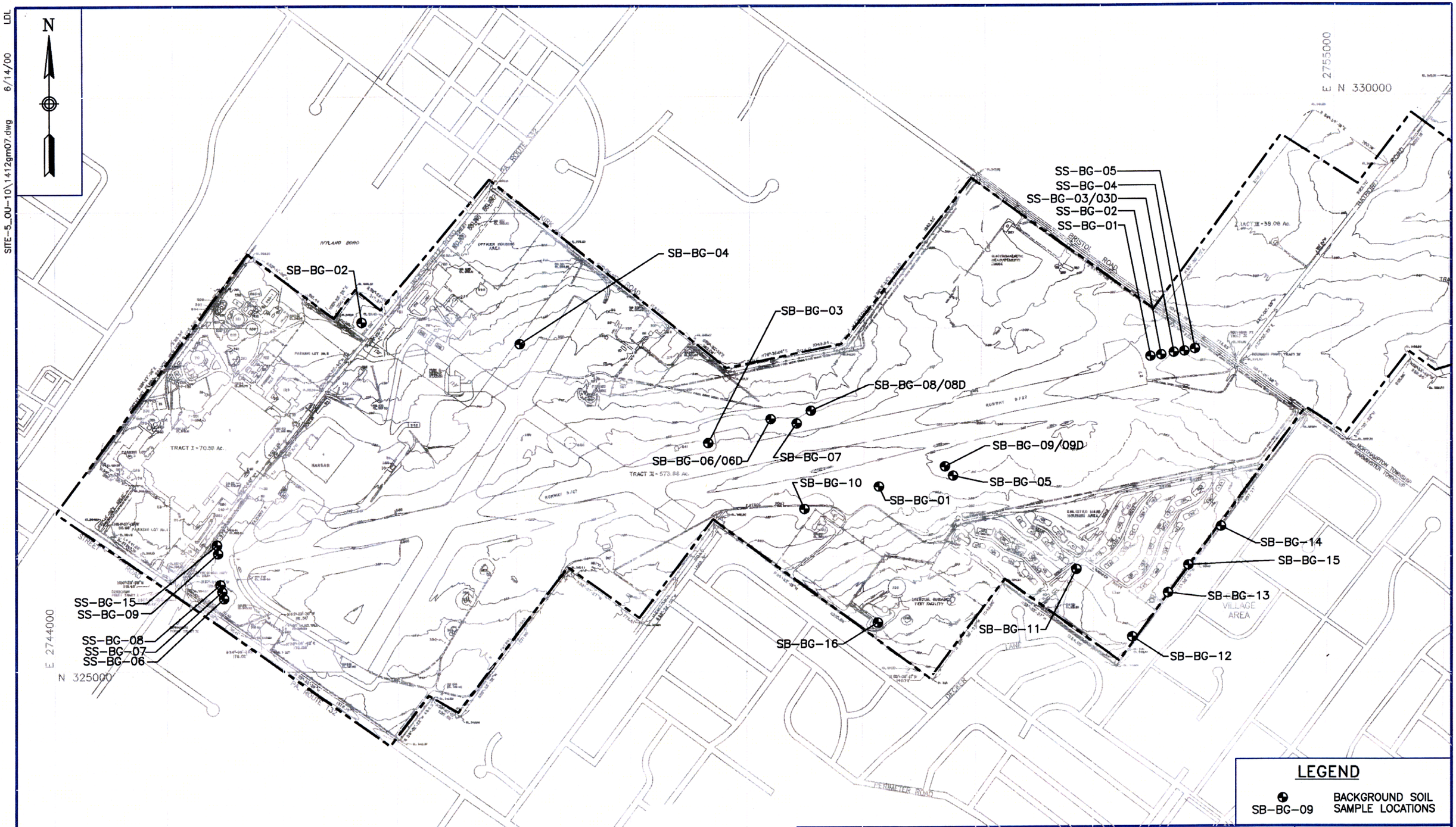
2.2.8 Background Sampling

2.2.8.1 Background Soil Sampling

Background surface soil samples were collected during Phase III. A total of 10 surface soil samples were obtained from both ends of the main runway at the base. The background sample locations are shown in Figure 2-6. These samples were analyzed for TCL pesticides, PCBs, and TAL metals. Samples were not tested for TCL volatile organics or semivolatile organics because these substances were not considered to be naturally occurring or used for pest control/lawn maintenance purposes.

As part of this report, analytical results have also been included for the eight background subsurface soil samples that were taken during the Area B hydrogeologic investigation (HNUS, 1995b). These samples were collected from the soil/bedrock interface during the drilling of monitoring wells in this area. Only those subsurface soil samples from background monitoring well locations or from locations clearly outside suspected source boundaries within Area B were included in the analytical database for background soils. At most locations, hollow-stem augers fitted with a center plus were advanced to near the soil/bedrock

00190 026 Z



DRAWN BY LDL DATE 6/14/00	Tetra Tech NUS, Inc.	BACKGROUND SOIL SAMPLE LOCATIONS FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY DATE			OWNER NO. 6010
REVISED BY DATE			APPROVED BY Tea DATE 5 July 00
SCALE AS NOTED			DRAWING NO. FIGURE 2-6 REV.

LDL 6/14/00 SITE-5_OU-10\1412gm07.dwg

SITE-5_OU-10\1412gm07.dwg

interface (as determined during the installation of well casings). The plug was withdrawn, and the samples were obtained with a standard 2-inch by 24-inch, stainless-steel, split-spoon sampler. One sample was obtained with a hand auger. All samples were tested for TCL volatile organics and TAL metals. Samples were collected at depths ranging from 2.5 to 9 feet.

Analytical results were also incorporated for the background soil samples collected during the Site 4 (EE/CA) field investigation (HNUS, 1995d) and the Site 6 removal action investigation (B&R Environmental, 1996b).

Background soil samples obtained during the Phase II RI (HNUS, 1992) and the associated results have also been included in the analytical database for background soil concentrations.

The analytical results of the RI background soil samples are shown in Table 2-6. The results from all background surface and subsurface soil samples were combined into one data set for data evaluation purposes and to compare background soil levels to site-related soil concentrations.

2.2.9 Surveying

Surveying was conducted as part of the Phase III RI in order to determine the exact location of the grids used for the soil gas survey and to better locate soil sample locations. At least two corners of each survey grid were surveyed for horizontal location or tied into existing site structures (including existing surveyed monitoring well locations) to provide reference points for locating the entire grid.

The horizontal survey utilized survey traverse control established in 1985, 1986, and 1987 during aerial mapping of the entire base and field survey location of all utilities. All coordinates are based on the Pennsylvania State Plane Coordinate System (South Zone, 1927 Datum). The error of closure of all horizontal survey work is better than 1 part in 10,000. All elevations are based on the North American Vertical Datum of 1929.

To determine the survey locations, three horizontal traverses, which began and ended on property corner monuments, were conducted. At least three corner monuments were tied on each traverse. All three traverses closed relative to the Survey Map entitled "Survey Map, U.S. Naval Air Development Center, Warminster Township, Bucks County, Pennsylvania" with a tolerance better than the proposed standard of 1 part in 10,000. Tabulated survey data from Phase III are provided in Appendix F.

TABLE 2-6

OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN BACKGROUND SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Sampling Round and Location of Maximum	Exposure Point Concentration
Aluminum	29/29	4780	18100	BG-12	15100
Antimony	1/21	13.6 J		BG-16	4.45
Arsenic	25/29	0.28	12.1 J	BG-11	11.6
Barium	25/27	34.1	225	BG-28	75.7
Beryllium	25/29	0.31	1.7 K	BG-23-D	0.878
Calcium	23/27	240	1910	BG-24	813
Chromium	29/29	7.9 J	35.3 JK	BG-12	21.6
Cobalt	25/28	1.6	22.1	BG-23-D	10.5
Copper	27/29	3.6 K	30.6	BG-29	14
Iron	29/29	6980	410500	BG-30	34800
Lead	29/29	1.6 J	96.5 J	BG-13	16.3
Magnesium	25/29	518	4960	BG-24	2260
Manganese	29/29	30.9	2010	BG-28	601
Mercury	1/27	0.37		BG-23	0.0483
Nickel	18/25	4.1 J	21.7 J	BG-23-D	11.7
Potassium	25/27	89.1	3050	BG-24	1060
Sodium	4/18	55.2	86.7	BG-25	86.7
Thallium	3/29	0.37	0.42	BG-23-D	0.42
Vanadium	29/29	15.4	45	BG-12	32.1
Zinc	25/27	9	60	BG-13	32.9
4,4'-DDD	1/20	16 JP		BG-12	3.05
4,4'-DDE	1/20	820		BG-12	17.4
4,4'-DDT	1/20	1440 JP		BG-12	25
Aroclor-1254	1/20	51		BG-13	43
1,4-Dichlorobenzene	1/11	43		BG-11	43
Benzo(b)fluoranthene	1/11	58 J		BG-13	58
Benzo(k)fluoranthene	1/11	46 J		BG-13	46
Bis(2-ethylhexyl)phthalate	1/11	50 J		BG-16	50
Chrysene	1/11	51 J		BG-13	51
Fluoranthene	1/11	92 J		BG-13	92
Phenanthrene	1/11	51 J		BG-13	51
Pyrene	1/11	100 J		BG-13	100
Acetone	4/18	8	12 J	BG-24	12
Chloromethane	2/19	3 J		BG-26	3
Toluene	3/19	2 J		BG-17	2

Notes:

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separ
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.

2.3 ANALYTICAL PROCEDURES AND DATA VALIDATION

2.3.1 Analytical Procedures

During Phase I, samples were analyzed as specified by EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition. Samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals. Samples analyzed for TAL metals were not filtered. Data packages were submitted under Naval Energy and Environmental Support Activity (NEESA) Level C requirements.

For Phase II, a subcontracted NEESA-approved laboratory analyzed aqueous and solid matrix samples collected at NAWC Warminster for full TCL organics, TAL inorganics, cyanide, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX), and a variety of physical-chemical parameters (e.g., hardness, alkalinity, total suspended solids, chlorides, grain size). Data packages were submitted under NEESA Level D requirements.

During Phase III, several laboratories analyzed aqueous and solid matrix samples for full TCL organics, TAL inorganics, cyanide, and dioxins/furans. The most frequently used analytical methods selected for these analyses are presented in Table 2-7. Most data packages were submitted under Naval Facilities Engineering Service Center (NFESC) Level D requirements.

For the supplemental Site 5 investigations, organic analysis was performed using SW-846 Methods 8260B, 8270C, and 8081A/8082. Inorganic analysis was performed using SW-846 Methods 6010B and 7471A and Method 3060A/7196A for hexavalent chromium. All data packages were produced using CLP-like reporting protocols.

The complete analytical database is presented in Appendix A.

2.3.2 Data Validation

Most of the Site 5 analytical data were fully validated as part of the scope of RI work. Some data were only reviewed for false positives and false negatives. All Phase III and supplemental sample results underwent full data validation using EPA Headquarters and EPA Region III functional guidelines. The data validation process served three basic functions:

TABLE 2-7
SUMMARY OF ANALYTICAL PARAMETERS
PHASE III RI

MEDIA	ANALYSIS	METHOD	CRQL/CRDL
Surface Water	TCL volatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 ug/l
	TCL semivolatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 to 25 ug/l
	TAL metals	CLP SOW ILMO 2.1	0.2 to 5000 ug/l
	Cyanide	CLP SOW ILMO 2.1	10 ug/l
	TCL pesticides/PCBs	CLP SOW OLMO 1.8 and OLMO 1.9	0.05 to 5.0 ug/l
Soil, Sediment, and Waste	TCL volatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	10 ug/kg
	TCL semivolatile organics	CLP SOW OLMO 1.8 and OLMO 1.9	330 to 830 ug/kg
	Cyanide	CLP SOW ILMO 2.1	2 mg/kg
	TCL pesticides/PCBs	CLP SOW OLMO 1.8 and OLMO 1.9	1.7 to 170 ug/kg
	TAL metals	CLP SOW ILMO 2.1	0.1 to 1000 mg/kg
	Dioxins/Furans	CLP SOW DFLMO 1.1	1.0 - 5.0 ug/kg
	Hexavalent Chromium	SW-846 - 3060/7197	1.0 mg/kg
	Total Organic Carbon	SW-846 - 9060A and EPA Method 415.1	5 mg/kg
	Total Solids	EPA Method 160.3	NA
	Grain Size	ASTM 421-85/D422-63	NA

- An independent quality assurance check of the truthfulness of laboratory results.

- A means of evaluating laboratory performance and determining the impact of noncompliances to the data.

- Through the use of data qualifiers, it lends interpretative guidance as to the proper usage and limitations of the data.

The validation process was a systematic review and evaluation of the analytical data conducted according to applicable and relevant quality control criteria, including

- EPA's National Functional Guidelines for Evaluating Laboratory Analyses
- Method-specific quality control criteria
- Navy-specified technical guidelines
- TtNUS data validation formats and standard operating procedures

Organic data were evaluated based on

- Data completeness
- Holding times
- GC/MS tuning and mass calibration (when applicable)
- Initial and continuing calibrations
- Laboratory blank analyses
- Field blank analyses (when applicable)
- Internal standards performance
- Surrogate spike recoveries
- Matrix spike/matrix spike duplicate results
- Field duplicate precision (when applicable)
- Compound detection limits
- Compound identification
- Compound quantitation
- Tentatively Identified Compound (TIC) evaluation (when applicable)

Inorganic data were evaluated on the basis of

- Data completeness
- Holding times
- Initial and continuing calibrations

- Contract-required detection limit (CRDL) standard analyses
- Laboratory and field blank analyses (when applicable)
- Matrix spike results
- Laboratory control sample results and duplicate analyses
- Field duplicate precision (when applicable)
- Inductively Coupled Plasma (ICP) interference check sample results
- ICP serial dilution analyses
- Furnace atomic absorption results
- Analyte detection limits
- Analyte quantitation

Data validation reports were generated from these results and conclusions drawn from the validation process described above. The specific format of the data validation report varies with the applicable protocol, but all reports address the following:

- Explanation of the findings of the data evaluation process, giving interpretations of actions taken on the data and limits of data usability.

- Presentation of the qualified analytical results.

- A validation worksheet and/or support documentation section depicting the problem areas and noncompliances addressed in the data validation memoranda and supporting the validation actions taken.

The formal data validation process and the supporting documentation is essential for the following reasons:

- To ensure the accuracy and integrity of the analytical data
- To ensure the defensibility of the data
- To provide a platform from which remediation/risk assessment issues can be addressed

2.4 DATA EVALUATION

This section presents various aspects of data evaluation including determining representative concentrations, data reduction and tabulation, and a comparison of data to screening criteria.

2.4.1 Representative Concentrations

To support the data evaluation process, a representative concentration for each chemical in each medium identified at Site 5 was calculated using the latest risk assessment guidance from EPA (EPA, 1989a; EPA, 1992). Pre-removal conditions were evaluated. As discussed later, Exposure Point Concentrations were calculated for post-removal conditions. Usability of results is discussed below.

The validated data were used to calculate representative concentrations. 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. As per EPA Region III guidance, values attributed to blank contamination (B) were eliminated from further consideration. Estimated and biased values (J, K, L) were used at 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.

Phase I data are from the SMC report (SMC Martin, 1991). Phase II and Phase III data were collected by TtNUS. The data were regarded as one set of data for each individual site (surface soil and subsurface soil) or area (surface water and sediment) regardless of the RI phase in which the data were collected. For surface water and sediment samples, there were cases where the same approximate location had been sampled during different phases; therefore, the results were simply treated as individual samples indicating media contamination over time and were not treated as duplicates.

The calculation of the representative concentration was a two-step process. First, the distribution of the data was determined as discussed in the preceding section. Then, based on the distribution of the data, a representative concentration was 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 neutral 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 one-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, as follows:

$$S = [\Sigma (X_i - X_m)_2/(n-1)]^{0.5}$$

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 as follows:

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

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.

The calculation of the representative concentration is a two-step process. First, the standard deviation of the sample set must be determined, as follows:

$$S = \text{sqrt}\ [\text{sum}(Xi-Xm)^2/(n-1)]$$

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

The two-sided upper 95 percent confidence limit (UCL) is then calculated as follows:

$$UCL = Xm + tS/\text{sqrt}\ n$$

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

The representative concentration is then selected as the lesser value of the one-sided 95 percent UCL and the maximum positive value in the data set. Upper confidence limits (UCLs) for all contaminants, from which the representative concentrations are derived, are presented in Section 6 of this report.

2.4.2 Data Reduction/Tabulation

The data sets were reduced by selected only those chemicals with positive detections at a suspected source concern. The results of sampling analysis at a site or area were summarized in an occurrence and distribution table. These tables contain representative concentrations (See Section 2.4.1) and summary statistics including frequency of detection, range of positive detection, and statistical distribution of the data sets. Background occurrence and distribution tables contain for each chemical a mean, statistical distribution of the data set, frequency of detection, range of positive detection, and representative concentration. Site or area occurrence and distribution tables contain for each chemical a representative concentration for background (if applicable) and frequency of detection, range of positive detection, statistical distribution, and a representative concentration for site- or area-related data.

Background samples for surface and subsurface soils were collected from various locations at NAWC Warminster (Figure 2-6) that were considered unaffected by past site-related activities. All surface and subsurface background samples were pooled together and used as background for any site-specific surface or subsurface data set. The background occurrence and distribution for soils are presented in Table 2-6.

For Area A, surface water and sediment samples were collected in off-base locations that were considered unaffected by past site-related activities. See Figure 2-3 for surface water and sediment sampling locations. These locations were used as the background sample set for Area A surface water and sediment data sets.

2.4.3 Comparison of Data to Screening Criteria

Each site-related soil data set was compared to appropriate screening criteria for the purposes of identifying areas of soil contamination, identifying possible sources or portions of sources where response actions may be necessary, and identifying sites that may require a risk assessment. The screening criteria used for these comparisons were from federal and state sources. Federal sources included EPA Region III Risk Based Concentration (RBC) Tables (EPA, 1996a) and Soil Screening Levels (SSLs) (EPA, 1999b). Commonwealth of Pennsylvania criteria were obtained from the Statewide Health Standard Tables, Subchapter C, Section 250.312 of the PA Land Recycling Program Regulations. This includes the medium-specific concentrations (MSCs) for soils. For purposes of this report, residential exposure scenario criteria were used. The future intended use of Site 5 is residential. The results of these comparisons are in the form of appropriate tables and figures provided in the site-specific sections of this report. If a chemical had a detection greater than the most stringent screening criterion and not considered to be in the range of background range of detection (inorganics only), this result was shown on a site-related figure.

Screening Criteria

The criteria used to screen contaminant levels in surface and subsurface soils, surface water, and sediments are not regulatory enforceable standards; rather, they serve as a guideline for determining whether a chemical may have a deleterious effect on potential receptor populations. Federal and Pennsylvania criteria were used in this document; the following paragraphs describe each criteria.

Risk-Based Concentrations (RBCS) And Soil Screening Levels

RBCs are non-enforceable standards derived from standard EPA equations used for EPA Region III risk assessments. The SSLs are non-enforceable standards set by EPA for use in risk assessments in all EPA regions. The RBCs and SSLs used in this report are based on direct ingestion of soil. Additionally, the criteria used in the screening are based on a residential use scenario and are derived based on a 1E-06 carcinogenic risk or hazard quotation (HQ) of 1.0 (for noncarcinogenic) risk. Soil concentrations were also compared to a soil-to-groundwater pathway SSL using a dilution and attenuation factor (DAF). A DAF of 20 was used to account for natural processes that reduce contaminant concentrations in the subsurface. The purpose of this comparison was to identify and screen those hazardous substance concentrations in soil that might have the potential to contaminate groundwater.

Medium-Specific Concentrations (MSCs)

MSCs are non-enforceable standards derived from standard EPA equations used for risk assessments in Pennsylvania. The MSCs used in this risk assessment are based on direct ingestion of soil. Additionally, these standards are based on a residential scenario and are derived based on a 1E-05 carcinogenic risk or an HQ of 1.0 (for noncarcinogenic effects).

Values of the available TBCs for chemicals positively detected in Site 5 soils are presented in Table 2-8. This table presents values for chemicals having only carcinogenic or noncarcinogenic effects, and for chemicals having both carcinogenic and noncarcinogenic effects.

Ambient Water Quality Criteria (AWQCs)

AWQCs were developed under the Clean Water Act and are non-enforceable federal regulatory guidelines; they are of primary utility in assessing the potential for toxic effects in aquatic organisms. Surface water concentrations were compared to AWQCs to evaluate impacts to aquatic receptors.

TABLE 2-8 (PAGE 1 OF 2)
SOIL CRITERIA FOR CHEMICALS DETECTED IN SITE 5 SOILS
NAWC WARMINSTER, PENNSYLVANIA

SUBSTANCE	PADEP MSC INDUSTRIAL SOIL	PADEP MSC NON RES. SOIL	EPA RBC INDUSTRIAL SOIL	EPA RBC RESIDENTIAL SOIL	EPA DAF 20 SOIL TO GROUNDWATER
PESTICIDES/PCBs (ug/kg)					
4,4'-DDD	7.50E+04	3.30E+05	2.40E+04	3.00E+03	1.60E+04
4,4'-DDE	5.30E+04	2.30E+05	1.70E+04	2.00E+03	5.40E+04
4,4'-DDT	5.30E+04	2.30E+05	1.70E+04	2.00E+03	3.20E+04
ALPHA-CHLORDANE	1.30E+04	6.10E+04	1.60E+04	5.00E+02	1.00E+04
AROCLOR-1242	3.60E+04	1.60E+05	2.90E+03	3.20E+02	NL
AROCLOR-1248	9.90E+03	4.40E+04	2.90E+03	3.20E+02	NL
AROCLOR-1254	4.40E+03	4.40E+04	2.90E+03	3.20E+02	NL
DELTA-BHC	NL	NL	NL	NL	NL
DIELDRIN	1.10E+03	5.00E+03	3.60E+02	4.00E+01	4.00E+00
ENDOSULFAN SULFATE***	1.30E+06	1.70E+07	1.20E+07	4.70E+05	1.80E+04
ENDRIN	6.60E+04	8.40E+05	6.10E+05	2.30E+04	1.00E+03
ENDRIN ALDEHYDE	6.60E+04	8.40E+05	6.10E+05	2.30E+04	NL
GAMMA-CHLORDANE	1.30E+04	6.10E+04	1.60E+04	1.80E+03	1.00E+04
METHOXYCHLOR	1.10E+06	1.40E+07	1.00E+07	3.90E+05	1.60E+05
SEMIVOLATILES (ug/kg)					
1,4-DICHLOROBENZENE	7.50E+05	3.30E+06	2.00E+07	2.70E+04	2.00E+03
2-METHYLNAPHTHALENE	8.80E+06	1.00E+07	NL	NL	NL
4-METHYL-2-PENTANONE	NL	NL	6.30E+06	NL	NL
BENZ(A)ANTHRACENE	2.50E+04	1.10E+05	7.80E+03	9.00E+02	2.00E+03
BENZO(A)PYRENE	2.50E+03	1.10E+04	7.80E+02	9.00E+01	8.00E+03
BENZO(B)FLUORANTHENE	2.50E+04	1.10E+05	7.80E+03	9.00E+02	5.00E+03
BENZO(G,H,I)PERYLENE	1.30E+07	1.70E+08	NL	NL	NL
BENZO(K)FLUORANTHENE	2.50E+05	1.10E+06	7.80E+05	9.00E+03	5.00E+03
BIS(2-ETHYLHEXYL)PHTHALATE	1.30E+06	5.70E+06	4.10E+05	4.60E+04	3.60E+06
CHRYSENE	2.50E+06	1.10E+07	7.80E+05	8.80E+04	1.60E+05
DI-N-BUTYL PHTHALATE	1.00E+07	1.00E+07	NL	7.80E+06	2.30E+06
DIBENZ(A,H)ANTHRACENE	2.50E+03	1.10E+04	7.80E+02	9.00E+01	2.00E+03
FLUORANTHENE	8.80E+06	1.10E+08	8.20E+07	3.10E+06	4.30E+06
INDENO(1,2,3-CD)PYRENE	2.50E+04	1.10E+05	7.80E+03	9.00E+02	1.40E+04
NAPHTHALENE	8.80E+06	1.10E+08	4.10E+07	3.10E+06	8.40E+04
PHENANTHRENE	6.60E+07	1.90E+08	NL	NL	NL
PHENOL	1.30E+08	1.90E+08	1.20E+09	4.70E+07	1.00E+05
PYRENE	6.60E+06	8.40E+07	6.10E+07	2.30E+06	4.20E+06

NL = NOT LISTED

References:

PADEP, 1996. Statewide Health Standard Tables; Subchapter C Section 250.312 of the PA Land Recycling Program Regulations.

EPA, 2000. EPA Region III Risk-Based Concentration (RBC) Table. Philadelphia, Pennsylvania. April 13.

EPA, 1996e. Soil Screening Guidance (Appendix A). EPA/540/R-95-128. Washington, DC. May.

TABLE 2-8 (PAGE 2 OF 2)
SOIL CRITERIA FOR CHEMICALS DETECTED IN SITE 5 SOILS
NAWC WARMINSTER, PENNSYLVANIA

SUBSTANCE	PADEP MSC RESIDENTIAL SOIL	PADEP MSC NON RES. SOIL	EPA RBC INDUSTRIAL SOIL	EPA RBC RESIDENTIAL SOIL	EPA DAF 20 SOIL TO GROUNDWATER
VOLATILES (ug/kg)					
1,1-DICHLOROETHENE					
2-BUTANONE	NL	NL	4.70E+07	NL	NL
2-HEXANONE					
ACETONE	1.00E+07	1.00E+07	2.00E+08	7.80E+06	1.60E+04
BENZENE	3.80E+04	2.00E+05	1.00E+05	1.20E+04	3.00E+01
CARBON DISULFIDE	1.00E+07	1.00E+07	2.00E+08	7.80E+06	3.20E+04
CHLOROETHANE	1.00E+07	1.00E+07	2.00E+06	2.20E+05	NL
CHLOROMETHANE	NL	NL	4.40E+06	NL	NL
ETHYLBENZENE	1.00E+07	1.00E+07	2.00E+08	7.80E+06	1.30E+04
METHYLENE CHLORIDE	1.80E+05	9.20E+05	7.60E+05	8.50E+04	2.00E+01
TETRACHLOROETHENE	3.40E+05	1.50E+06	1.10E+05	1.20E+04	6.00E+01
TOLUENE	7.60E+06	1.00E+07	4.10E+08	1.60E+07	1.20E+04
TRICHLOROETHENE	1.90E+05	9.70E+05	5.20E+05	5.80E+04	6.00E+01
XYLENES (TOTAL)	1.00E+07	1.00E+07	4.10E+09	1.60E+08	1.90E+05
VINYL CHLORIDE					
INORGANICS (mg/kg)					
ALUMINUM	1.90E+05	1.90E+05	2.00E+06	7.80E+04	NL
ANTIMONY	8.80E+01	1.10E+03	8.20E+02	3.10E+01	5.00E+00
ARSENIC	1.20E+01	5.30E+01	3.80E+00	4.30E-01	2.90E+01
BARIUM	1.50E+04	1.90E+05	1.40E+05	5.50E+03	1.60E+03
BERYLLIUM	4.20E+00	1.80E+01	4.10E+03	1.60E+02	6.30E+01
CADMIUM	1.10E+02	1.40E+02	1.00E+03	7.80E+01	8.00E+00
CALCIUM	NL	NL	NL	NL	NL
CHROMIUM (+3)	1.90E+05	1.90E+05	3.10E+06	7.80E+04	NL
COBALT	1.30E+04	1.70E+05	1.20E+05	NL	NL
COPPER	8.10E+03	1.90E+05	8.20E+04	NL	NL
CYANIDE	4.40E+03	5.60E+04	4.10E+04	1.60E+03	4.00E+01
HEXAVALENT CHROMIUM	1.10E+03	1.40E+04	6.10E+03	3.90E+02	3.80E+01
IRON	6.60E+04	1.90E+05	6.10E+05	NL	NL
LEAD	5.00E+02	1.00E+03	NL	4.00E+02	NL
MAGNESIUM	NL	NL	NL	NL	NL
MANGANESE	1.00E+04	1.30E+05	4.10E+04	NL	NL
MERCURY	1.90E+01	2.40E+02	6.10E+02	NL	NL
NICKEL	4.40E+03	5.60E+04	4.10E+04	1.60E+03	1.30E+02
POTASSIUM	NL	NL	NL	NL	NL
SELENIUM	1.10E+03	1.40E+04	1.00E+04	3.90E+02	5.00E+00
SILVER	1.10E+03	1.40E+04	1.00E+04	3.90E+02	3.40E+01
SODIUM	NL	NL	NL	NL	NL
THALLIUM	1.80E+01	2.20E+02	1.40E+02	NL	7.00E-01
VANADIUM	1.30E+01	1.60E+02	1.40E+04	5.50E+02	6.00E+03
ZINC	6.60E+04	1.90E+05	6.10E+05	2.30E+04	1.20E+04

NL = NOT LISTED

References:

PADEP, 1996. Statewide Health Standard Tables; Subchapter C Section 250.312 of the PA Land Recycling Program Regulations.
EPA, 2000. EPA Region III Risk-Based Concentration (RBC) Table. Philadelphia, Pennsylvania. April 13.
EPA, 1996e. Soil Screening Guidance (Appendix A). EPA/540/R-95-128. Washington, DC. May.

Effects Range-Low (ERLs)

NOAA ER-L sediment screening criteria and EPA Region III Biological Technical Assistance Group (BTAG) screening levels for sediment were used to evaluate sediment quality. The ER-Ls for flora/fauna were used.

3.0 PHYSICAL CHARACTERISTICS

Several environmental studies applicable to NAWC Warminster sites have been completed over the last 10 years. A number of these studies, including JRB Associates (1981 and 1983), Sloto and Davis (1983), Satterthwaite (1984), and Earth Technology Corporation (1985), have provided information on local surface features, soils, meteorology, surface water hydrology, demography and land use, and hydrogeology.

A description of the physical characteristics of NAWC Warminster has been prepared on the basis of published information, reports of previous site studies, and information obtained and interpreted during the course of the RI. Section 3.0 provides a brief, general overview of the overall physical characteristics of the facility and specific physical characteristics for both Area B and Site 5.

3.1 METEOROLOGY

The climate of the area is humid continental and is modified by the Atlantic Ocean. Temperatures range between an average of 76°F (24.4°C) in July and 32°F (0°C) in January. The average daily temperature for the NAWC location is 53.3°F (11.8°C). Precipitation averages 42.5 inches per year (106.25 cm per year), and snowfall averages 22 inches per year (55 cm per year). The distribution of precipitation is fairly even throughout the year. The relative humidity for the site averages 70 percent. The mean wind speed for this area is 9.6 mph with a prevailing direction of west-southwest (NAWC Warminster Emergency Response Plan, August 13, 1990).

3.2 SURFACE WATER HYDROLOGY AND TOPOGRAPHY

NAWC Warminster is situated on an upland area divided between two local drainage basins, the Little Neshaminy Creek Basin to the north and the Southampton Creek Basin to the south. The northern 65 percent of the facility drains toward the north through several swales and storm sewers into small-unnamed tributaries of Little Neshaminy Creek. The southern 35 percent of the facility (including Area B Sites 5, 6, and 7) drains toward the south to the headwaters of Southampton Creek, a tributary of Pennypack Creek. Both local drainage basins lie within the regional drainage basin of the Delaware River. Various studies conducted on the site have revealed that no areas within NAWC Warminster are included in the 100-year or 500-year floodplain.

NAWC Warminster is located on a local topographic high. The crest of the hilltop trends east-west within the facility and is roughly coincident with the location of the main runway. Surface topography across Area B slopes away from the main runway to the north, precluding surface water flow onto Area B in general from surrounding properties. Slopes range from nearly level to 15 percent and average 3 to 5 percent. The slope

across Site 5 is approximately 3 percent. The surface elevation of Site 5 ranges from a high of approximately 344 feet mean sea level (msl) to low of approximately 336 feet msl.

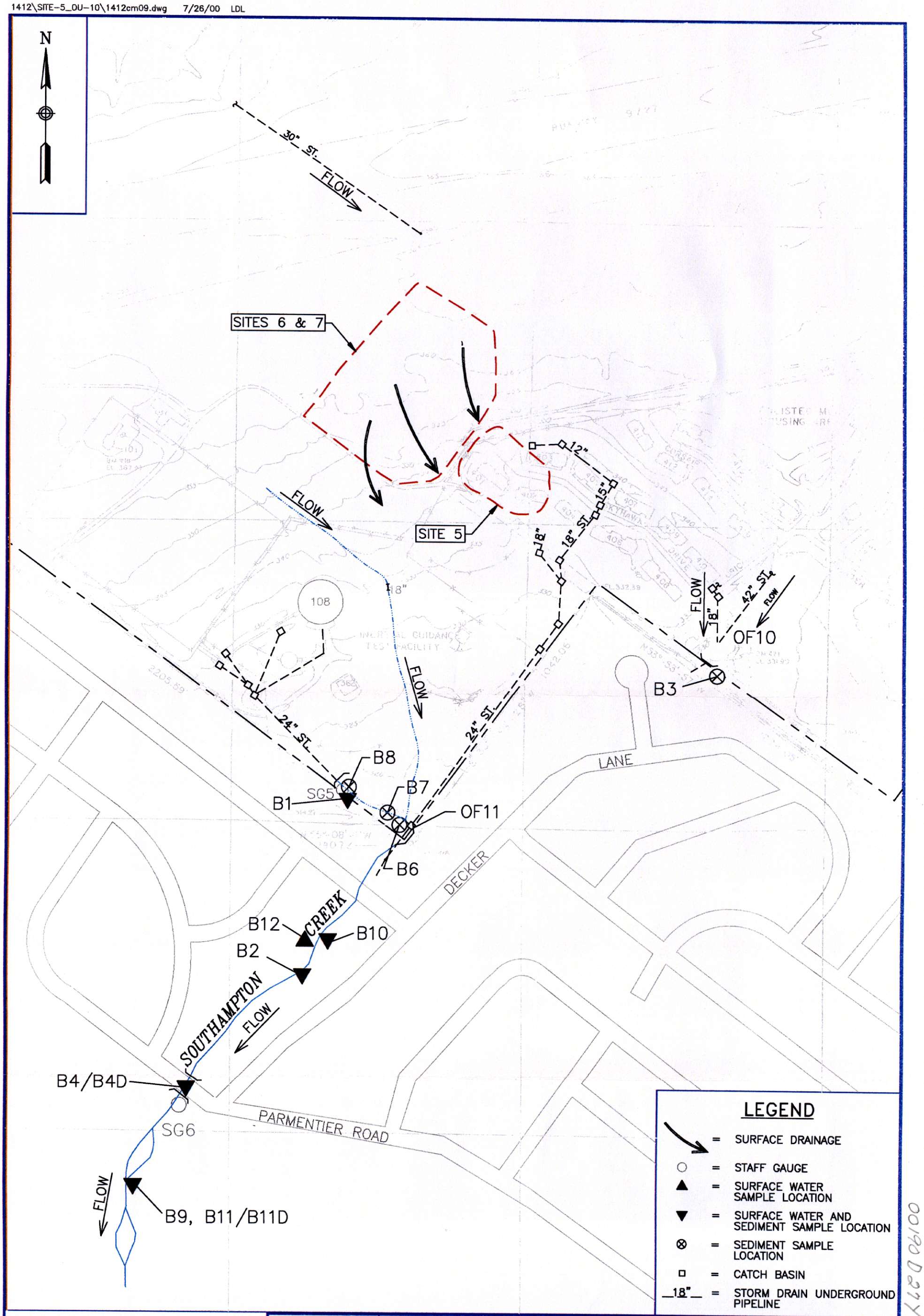
A series of storm drains is present in the vicinity of Area B, including Site 5 (Figure 3-1). Stormwater that collects near Site 5 is piped underground (via Outfall No. 10) from the south-central NAWC Warminster property boundary to a point approximately 500 feet to the south, where it flows through a residential area in a concrete channel. The channel flows through the residential subdivision for approximately 1,000 feet and travels through a road culvert before flowing into a natural streambed. This stream flows through a shaded 250 feet reach before entering a small and shallow off-base pond, which overflows into a second small pond, which in turn flows into Southampton Creek (Figure 2-4). At this location, the creek is less than 4 feet wide and 6 inches deep with a rocky substrate; there are mowed and maintained lawns at this point to the water's edge. The base flow rate is 98 gpm, as measured in an area where the creek is contained within a cement culvert (SMC Martin, 1991). Southampton Creek continues south under County Line Road, the Pennsylvania Turnpike, and Byberry Road to Pennypack Creek.

The elevations at Sites 6 and 7, which are topographically higher and northwest of Site 5, range from about 360 feet msl closest to the main runway to approximately 345 feet msl adjacent to Site 5. Surface topography across a majority of Sites 6 and 7 is relatively flat, except for steeper slopes just west of Patrol Road, which separates Site 5 from the other Area B sites. The land at Sites 6 and 7 consists of open fields and woodlots that generally act to retard surface runoff toward the south. Some runoff from the steeper slopes is directed toward Site 5, while the majority of the runoff flows to a recharge area between Site 5 and Building 108.

A second drainage channel exists near Building 108, located west of Site 5. This channel collects water from the vicinity of Building 108. The channel discharges through Outfall No. 11, before being discharged through the same residential neighborhood described above. A stormwater drain running parallel to the base property boundary east of Building 108 also drains water from the vicinity of Area B and northeast of Outfall No. 11 (Figure 3-1).

Based on historic aerial photography, Southampton Creek and associated drainage pathways may have extended north to Navy property east of Building 108 prior to the 1950s. The area lying between Building 108 and Site 5 and downgradient of both Sites 6 and 7 is relatively flat and serves as a recharge area for surface runoff. Ponding of water in this general area was observed during RI work. The distance from Sites 5, 6, and 7 (i.e., greater than 1,000 feet) to the current headwaters of Southampton Creek near Outfall No. 11, along with the relatively flat terrain between the sites and the creek, suggests that surface runoff from Area B to Southampton Creek is not a significant transport process.

1412\SITE-5_OU-10\1412cm09.dwg 7/26/00 LDL



0 300 600
SCALE IN FEET

DRAWN BY	DATE
LDL/EEH	7/27/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

Tetra Tech NUS, Inc.

DRAINAGE PATTERNS AREA B

FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO.	
1412	
OWNER NO. 5020	
APPROVED BY	DATE
	29 Jul 00
DRAWING NO. FIGURE 3-1	REV.

1412cm09.dwg

00190 D 27 Y

3.3 SOILS

Soil thicknesses observed during the Phase I subsurface investigations at this area were between 4 and 14 feet. The soil thicknesses are generally uniform across the sites, with only local areas of variation. SCS has mapped the soils at Site 5 as Doylestown silt loam with slow permeability, Lawrenceville silt loam with moderately slow permeability, and the Duncannon silt loam with moderate permeability.

3.4 GEOLOGY

3.4.1 Regional Geology

NAWC Warminster is located in the Piedmont physiographic province, and Triassic Lowlands section of southeastern Pennsylvania. The province is extensive and gently undulating and generally slopes to the southeast. The land forms have been modified by erosion to form moderate slopes and gently rounded hills with a dendritic drainage pattern.

The bedrock underlying NAWC Warminster belongs to the late Triassic age Stockton Formation. The Stockton Formation is unconformably underlain by basement rocks of Ordovician to PreCambrian age that crop out approximately 2 miles south of the facility. The Stockton Formation is conformably overlain by the shale- and argillite-rich Lockatong Formation, also of late Triassic age, that outcrops approximately 2.5 miles north of the facility.

Within the general area surrounding NAWC Warminster, the beds of the Stockton are reported to strike to the northeast and dip from 7 to 16 degrees to the northwest, with an average regional dip of about 12 degrees (Rima, et al., 1962). Based on its outcrop width and this regional dip, the Stockton Formation is estimated to be approximately 2,200 feet thick beneath NAWC Warminster.

The Stockton Formation is extensively faulted by small displacement normal faults and is cut by well-developed joint systems. The joint sets occur in a discernible and predictable pattern. The most frequently occurring joint sets trend perpendicular and parallel to the strike of the bedding. Another commonly occurring joint set trends to the northwest at an angle of about 50 degrees from strike (Rima, et al., 1962).

The Stockton Formation is composed of fine- to coarse-grained arkosic sandstone and conglomerate interbedded with shale and siltstone. These rocks are interpreted to have been deposited by coalescing alluvial fans that deposited sediment eroded from highlands to the south (Sloto and Davis, 1983). Throughout the Stockton Formation, units of varying lithology are irregularly interbedded, with coarse-grained units commonly overlying fine-grained units. Beds commonly pinch out or form gradational contacts

with overlying or underlying beds over lateral distances greater than several hundred feet (Rima, et al., 1962).

The Stockton Formation is divided into the lower arkose, middle arkose, and upper shale members. Detailed geologic mapping of these three members is not available within Bucks County. However, projections from geologic maps for the area 1 mile west of the NAWC Warminster indicate that the facility is underlain by the middle arkose member of the Stockton Formation (Rima, et al., 1962).

The middle arkose member of the Stockton Formation consists of beds of fine- and medium-grained arkosic sandstone with interbedded red shale, siltstone, and very fine-grained red sandstone and a few beds of coarse-grained arkose. Beds of shale and siltstone are more common in the upper portion of the member, and coarser-grained units are more common in the lower portion. Many of the beds in the middle arkose member are well sorted and weakly cemented, which creates a relatively high porosity compared to the lower and upper members (Rima, et al., 1962). The thickness of the middle arkose member beneath NAWC Warminster is unknown but is estimated to range from approximately 500 feet thick near the southeastern boundary of the facility to about 1,500 to 2,000 feet thick near the northwestern boundary.

The lower arkose member of the Stockton Formation underlies the middle arkose member and is projected to outcrop approximately 2,000 feet or more southeast of the base. The lower arkose member is dominated by coarse-grained arkosic sandstone and conglomerate. Beds of medium-grained arkosic sandstone are common, though less abundant than the coarser-grained units. The lower arkose member is estimated to be approximately 1,700 to 1,800 feet thick in the vicinity of NAWC Warminster (Rima, et al., 1962).

The upper shale member of the Stockton Formation is not present in the vicinity of the base, but it overlies the middle arkose member several miles northwest of the facility. The upper shale member consists of shale, siltstone, and fine-grained arkosic sandstone. The sandstone is most common in the lower portion of this member.

3.4.2 Geology of Site 5

The geology within Area B consists of a thin veneer of residual soils overlying the sedimentary bedrock of the Stockton Formation. The soils primarily consist of silt and clay with minor amounts of sand and extend to an average depth of about 10 feet below ground surface. The transition from soils to weathered bedrock to competent bedrock occurs gradually over a distance of about 5 to 10 feet due to the effects of weathering on the bedrock surface.

The bedrock within Area B consists of alternating sequences of fine- and coarse-grained, gently dipping rock units. Lithologic units vary in thickness from less than a foot to a maximum observed thickness of about 60 feet. The fine-grained units consist primarily of reddish-brown siltstones and shales. The coarse-

grained units consist primarily of fine- to coarse-grained arkosic sandstones that range in color from reddish to brown to gray-green. Well-defined, gradational fining-upward sequences were encountered in some areas; in other areas, fairly sharp transitions between sandstones and mudstones were identified.

Individual rock units vary both in thickness and in areal extent, with some lithologies extending for significant distances across Area B and others pinching out within relatively short distances. Thicker beds typically extend laterally for greater distances than the thinner beds, which tend to be localized in areal extent. Finer grained beds tend to be more laterally extensive than coarser-grained beds, although coalescing sandstone beds may form laterally (and vertically) extensive packages of coarse grained rock units, which is typical for sedimentary units deposited in an alluvial fan environment.

Bedding within the Stockton Formation strikes approximately north 71 degrees east and dips approximately 5 to 8 degrees to the northwest. The dip of the rock units is approximately opposite to the overall topographic slope of the ground surface within Area B. Bedrock fractures were encountered at varying depths within the Area B boreholes. Based on geophysical and boring log information, the fractures included both bedding plane fractures and cross-cutting fractures. Fractures were observed within both the coarser- and finer-grained units; the fractures in the sandstone typically yielded greater quantities of water.

3.5 HYDROGEOLOGY

3.5.1 Regional Hydrogeology

The fractured bedrock of the Stockton Formation is the major source of groundwater in the vicinity of NAWC Warminster. The middle arkose member of the Stockton Formation is considered to be the most productive bedrock aquifer in Bucks County.

Within the water-bearing zones in the fine- and medium-grained sandstones of the Stockton Formation, groundwater is transmitted chiefly through fractures, joints, and bedding planes (secondary permeability and porosity). Primary porosity is generally minimal in these rock units. The shale and siltstone beds are commonly too fine grained to transmit large amounts of groundwater through primary porosity, and the fractures are typically not as well developed compared to the coarser-grained units. Consequently, the shale and siltstone beds often act as confining layers to groundwater. The bulk of the groundwater is transmitted through the fractures and, to a lesser extent, the primary porosity of the sandstones.

The Stockton Formation in the vicinity of NAWC Warminster forms a complex, multi-aquifer system. The individual water-bearing zones of the Stockton Formation may belong to one of three different aquifer types which, in descending subsurface order, include

- Overburden (weathered bedrock) aquifer
- Shallow bedrock aquifer
- Deeper bedrock aquifer

The overburden aquifer consists of soil and saprolite (weathered bedrock) derived from the erosion of the truncated edges of the inclined bedrock layers. The overburden aquifer (where present) generally extends to an average depth of about 20 feet.

The shallow bedrock aquifer may extend to depths of about 75 to 120 feet below the ground surface. The shallow bedrock aquifer is recharged by vertical percolation through the overburden and is the primary reservoir for groundwater storage in the Stockton Formation. The shallow bedrock aquifer occurs within the weathered and unweathered shallow bedrock and is generally under water-table or unconfined conditions. The shallow bedrock aquifer may consist of numerous discrete water-bearing fracture zones. Horizontal groundwater migration in response to regional gradients (controlled by topography or long-term well pumping) is significant in the shallow bedrock aquifer.

The deeper bedrock aquifers underlie the shallow bedrock aquifer and typically occur at depths greater than about 75 to 120 feet below the ground surface. Water within the deeper bedrock occurs under semi-confined or confined conditions. Leakage from one water-bearing unit to another occurs when there is a difference in the hydraulic head between the units. Groundwater flow is from the unit with a higher hydraulic head to the unit with a lower hydraulic head and can be either upward or downward. Pumping effects may either amplify or reduce the leakage rate, depending on whether the pumping increases or decreases the difference in hydraulic head.

Groundwater flow directions within the Stockton Formation are variable and are controlled by topography, bedrock structure, and the locations of groundwater discharge points such as streams and wells.

3.5.2 Hydrogeology of Site 5

Groundwater within Area B is primarily encountered within the bedrock of the Stockton Formation. The overlying residual soils contain minor amounts of water in some places, but the saturated thickness is generally limited to a few feet or less. The majority of the groundwater within the bedrock primarily moves through interconnected networks of fractures that, on a local scale, represent discrete flow zones but are regionally part of a complex, hydraulically interconnected groundwater flow system. The primary porosity also contributes some (but significantly less) groundwater to the wells, especially in the coarser-grained units.

In general, the groundwater flow directions within the bedrock beneath Area B mimic the ground surface topography and are controlled by the topography and locations of streams in the area. The overall direction of groundwater flow across Site 5 is to the south (opposite to the dip of the bedrock), although local variations to this flow pattern do exist (TtNUS, 2000a).

Based on the vertical distribution of hydraulic head within Site 5(as measured in clusters of wells completed at different depths), the overall vertical groundwater flow gradient is downward. Hydraulic heads within the shallow bedrock wells are generally higher than the heads in the deeper wells, with a few exceptions. This pattern of vertical flow indicates that the source of water to the deeper groundwater flow zones within the bedrock primarily is leakage from overlying flow zones.

More detailed information on the geology and hydrogeology of Area B (including Site 5) is provided in the RI Report for Area B Groundwater (TtNUS, 2000a).

3.6 ECOLOGY

During the Phase I RI, a biological characterization was conducted to support the evaluation of ecological risks (SMC Martin, 1991). The characterization identified and described the types of ecosystems (e.g., terrestrial, aquatic, and semi-aquatic) and ecological components associated with Area B. The biological characterization also helped to identify any ecologically significant effects that might be apparent and which could be attributable to the base. These types of effects include, but were not limited to, reductions in organism populations, changes in community structure, and changes in ecosystem structure function.

The biological characterization was completed on a qualitative, descriptive level, and did not include the collection of any biological samples. Biotic and abiotic components were described for habitats in the vicinity of Area B and nearby Southampton Creek, and these habitats were classified based on hydrological, soil, and vegetative characteristics (e.g., forested riparian wetlands). Specific characteristics of drainage features were also described. The relative abundance of specific vegetation was noted and observations made regarding the occurrence of aquatic and terrestrial animals, including benthic invertebrates, amphibians; reptiles, fish, birds, and mammals. Based on these observations, representative upper-level receptors were selected to evaluate potential risks via the food web. Specifically, literature-derived values for food and water ingestion rates and body weights of representative receptors were used together with stream analytical data to characterize exposure and ecological risks associated with Area B.

The Area B biological characterization indicated that there was very little flow and virtually no biotic component within the approximately 1,000-foot length of the concrete-lined ditch draining stormwater

from the base boundary to Southampton Creek. Amphipods were observed at the point where this channel flows through the road culvert and into the natural streambed. Midge larvae were found in the fine (i.e., silt) sediments at the head end of the first pond. Fish were not observed, but mallard ducks and Canada geese were active in and around each of the ponds. Raccoon tracks were observed along the shore of the pond as well (SMC Martin, 1991).

Wetlands were evaluated during Phase III along Southampton Creek, which begins outside the southeastern corner of the base and flows south under Street Road at its junction with Davisville Road. Approximately 1,000 feet south of the base boundary, Southampton Creek exits a storm sewer and flows an additional 500 to 1,000 feet through a subdivision. Nine locations (Points 12 through 20) along Southampton Creek were evaluated for the wetlands assessment south of Area B (Figure 3-2). With the exception of Points 12 and 13, all other points were considered to be too far away from the base to draw any conclusions about the potential influence of base property on wetlands quality.

Wetlands along Southampton Creek are primarily palustrine, forested, broad-leaved deciduous, temporary (PFO1A) and are characterized by green ash, silver maple, box elder, black cherry, and spicebush in the canopy and sub-canopy. Blackberry, Japanese honeysuckle, jewelweed, poison ivy, and skunk cabbage are the dominant species in the herbaceous layer.

While the PFO1A wetland type dominates the wetlands along Southampton Creek, palustrine emergent (PEM) wetlands are also common between the streambank and the wetland hardwood forest. These emergent wetlands may have a small open water area in the center surrounded by a marsh dominated by cattails. A strip of alder, spicebush, jewelweed, skunk cabbage, and black willow surrounds the marsh and grades into the surrounding PFO1A forested wetland.

Two types of soils were encountered along Southampton Creek. Bowmansville silt loam was the dominant soil type, and Hatboro silt loam was also found at the intersection of Southampton and Pennypack Creeks. Both soils are considered to be hydric soils in both Bucks and Montgomery Counties; however, the Bowmanville silt loam was found in both wetland and non-wetland areas of the floodplain. The non-hydric Hatboro silt loam was found only at the mouth of Southampton Creek .

Specific descriptions of the points evaluated during the wetlands assessment, which were within a 0.5 mile of the base boundary and Outfall No. 11 (i.e., Points 12, 13, 14, and 15), are provided below. With the exception of Points 12 and 13, all other points were considered to be too far away from the base to draw any conclusions about the potential influence of base property on wetlands quality.

00190D287

DRAWN BY LDL	DATE 6/14/00	Tetra Tech NUS, Inc.	WETLANDS ALONG SOUTHAMPTON CREEK SOUTH OF NAWC WARMINSTER FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY	DATE			OWNER NO. 6010
REVISED BY	DATE			APPROVED BY Tea DATE 29 Jul 00
SCALE 1 IN.= 2000 FT.				DRAWING NO. FIGURE 3-2 REV.

SOURCE: (7.5 MINUTE SERIES) U.S.G.S. HATBORO, PA QUADRANGLE

LDL 6/14/00 1412\SITE-5_OU-10\1412cm01.dwg

1412cm01.dwg

Point 12, located 500 feet of Joseph Avenue, was the closest point to Area B. The creek consisted of storm sewers flowing under streets and through yards in a developed subdivision. All drainage between this point to the base is below ground through storm sewers.

At Point 13, downstream from Point 12, the creek was 4 feet wide and 6 inches deep and had a rocky bottom. This point was the first readily accessible surface water downstream from the base property boundary. The creek collects stormwater runoff from the subdivision in this neighborhood. The banks were 3 feet high and the Bowmansville silt loam floodplain soils were classified as hydric. The NWI map indicated no wetlands in this area; however, the field inspection indicated a PFO1A wetland adjacent to the creek. The floodplain was characterized by green ash, silver maple, black willow, and box elder, and the understory consisted of green ash saplings and spicebush with an herbaceous layer of jewelweed. Evidence of children playing in the creek was common along. Fish up to 6 inches long were seen and gray squirrels, blue jays, and American robins were observed near the creek.

Downstream of the road crossing at Point 13, the stream flows through a wooded wetland corridor before flowing through a channeled portion adjacent to a shopping center parking lot at the intersection of Street and Davisville Roads. Downstream of Street Road to the junction with Pennypack Creek, Southampton Creek widens from 10 to 20 feet and deepens to 3 feet in holes. The stream flows through a wooded wetland corridor up to 1,000 feet wide that separates subdivisions, apartment complexes, shopping centers, and several industrial areas. The downstream portions of the stream are characterized by sandy bottoms with 4- to 7-foot-high cut banks. Downstream of County Line Road, the stream shows evidence of episodic flooding following storm events. Brush, leaves, and trash were observed piled into wrack lines in the floodplain and suspended from trees more than 2 feet above the top of the bank.

North of Street Road (Point 14), Southampton Creek was wider (8 feet) and still had a rocky bottom. The banks were 4 feet high. The NWI map indicated that the streambed and banks were classified as a PFO1A wetland. Mature silver maple, tulip poplar, and sycamore shaded the banks. The dense subcanopy was dominated by black cherry saplings and spicebush with an herbaceous layer of poison ivy, Virginia creeper, and daylilies. The Bowmansville silt loam soil was hydric with saturated conditions located 6 inches below the surface. Much of the floodplain and wetlands downstream from the road crossing were filled and only a 20-foot wide vegetation fringe remained. Maintained lawns extended to the edge of the floodplain, but a 20- to 40-foot buffer zone existed throughout much of this area. A green-backed heron was observed near Point 14.

At the intersection of Davisville and Street Roads (Point 15), the creek was 10 feet wide and up to 24 inches deep in holes. The creek had a rocky bottom and the banks were 4 feet high. The NWI map indicated the streambed and banks were classified as a PFO1A wetland at this location. Mature silver maple and black cherry dominated the overstory with an herbaceous layer of Virginia creeper. The Bowmansville silt loam soil was not hydric, mottled, or saturated within 18 inches of the surface. Fish up to 6 inches long were

observed in the creek, and the wide upland corridor provided fairly good wildlife habitat in this area. Upstream of the intersection, the creek was a channeled ditch flowing beside a supermarket parking lot and collecting stormwater runoff from a large paved area.

A wooded wetland corridor approximately 1,000 feet wide occurs along the lower reaches of Southampton Creek and provides some of the best wildlife habitat observed in the highly urbanized landscape. Mammals such as the white-tailed deer, raccoon, and gray squirrel are common here. Commonly observed birds included the American robin, gray catbird, northern cardinal, black-capped chickadee, mourning dove, common crow, wood thrush, and common grackle. No reptiles and few amphibians were located on the stream, although an unidentified frog was observed near the mouth of Southampton Creek. Unidentified fish more than 6 inches long were observed in the creek. Crawfish and aquatic insect larvae were also observed.

In general, Southampton Creek and associated wetlands appear to be fairly healthy, and some forested areas provide good wildlife habitat within an urbanized landscape. While no evidence of pollution, fish kills, or stressed vegetation was observed and aquatic invertebrates and fish inhabit the creek, urban trash and litter were very common. Tires, boards, bottles, cans, paper, and plastic were common in the creek and scattered throughout the floodplain.

3.7 GROUNDWATER USE

Residents near Area B rely exclusively on groundwater sources for their water supply. Most of the domestic wells immediately southeast of Site 5 were decommissioned when public water connections were made in the Casey Village area as part of the OU-2 removal action. The nearest active well is about 2,000 feet southeast of Site 5along Davisville Road.

The nearest municipal water-supply well is owned by Northampton, Bucks County Municipal Authority (NBCMA). This well (NBCMA Well No. 1) is a least 1 mile east of Area B. Well No. 1 is an 8-inch diameter well and is 590 feet deep.

The largest concentration of off-base domestic wells is in the Flying Heels neighborhood, approximately 3,000 feet southwest of Site 5. The enlisted housing area and other nearby buildings and residences (e.g., inertial guidance facility and Quarters B) are now served by municipal water from Warminster Municipal Authority. Before 1998, these structures were served by the base water-supply system, primarily base supply well SW-10.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

The nature and extent of environmental soil contamination at Site 5 and for the nearby Area B stream are discussed in this section. The discussion summarizes the distribution and concentration of contaminants detected in site soils as well as nearby surface water and sediment. The validated data generated during the RI work and subsequent investigations provide the basis for this information. The complete analytical database is included in Appendix A.

For purposes of interpretation, the two general trench locations at Site 5 (i.e., the estimated locations of trenches TR3 and TR5) were used to focus the data evaluation process. As described in Section 1.0, several trenches may be present in each of the general trench locations.

4.2 GEOPHYSICAL SURVEY

Because of the proximity and large number of cultural sources of interference (e.g., buildings, fences utility lines, and parked vehicles), a geophysical survey of reasonable quality could not be conducted at Site 5.

4.3 SOIL GAS SURVEY RESULTS

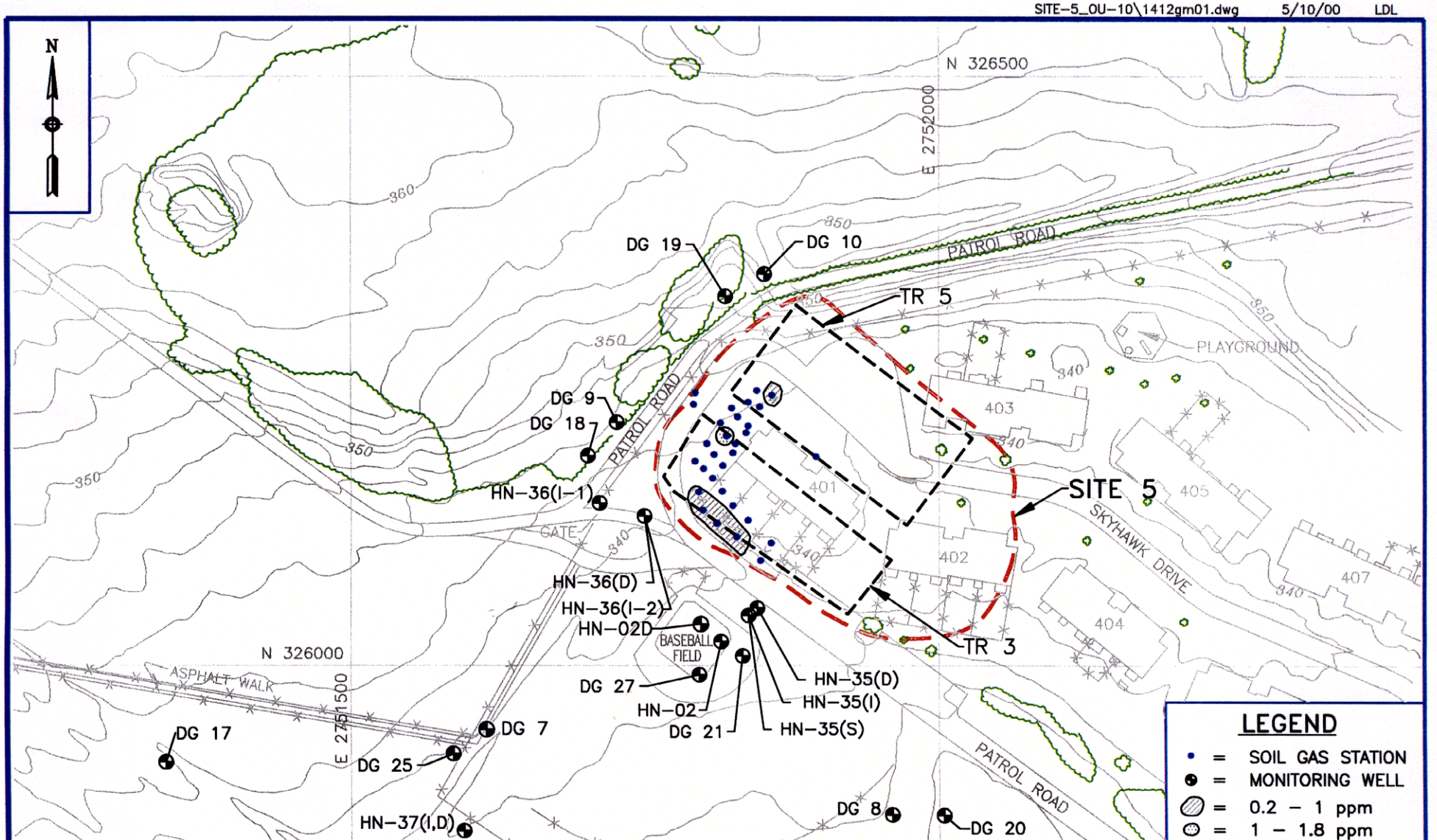
4.3.1 Phase I RI

Soil gas surveys were performed as part of both Phase I and Phase III RI work. The Phase I soil gas survey results for Site 5 are shown on Figure 4-1. The soil gas survey indicated VOC concentrations of 1 - 1.8 parts per million (ppm) at one survey point east of Site 6 and the Patrol Road and west of Building 401. Four survey points had slightly elevated readings of between 0.2 - 1 ppm. Three of the points were located south and east of Building 401 and one point was located west of Building 401 and northeast of Site 6. The three locations south and east of Building 401 were intended to delineate the southeastern border of trench TR3 and the one soil gas location east of Building 401 were used to delineate the farthest southwestern point of trench TR5.

4.3.2 Phase III RI

During the Phase III soil gas survey, no real pattern of subsurface contamination was identified based on the soil gas results (Figures 4-2, 4-3, and 4-4). The Phase III soil gas survey results are

SITE-5_OU-10\1412gm01.dwg 5/10/00 LDL



0 120 240

SCALE IN FEET

DRAWN BY	DATE
LDL	7/12/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

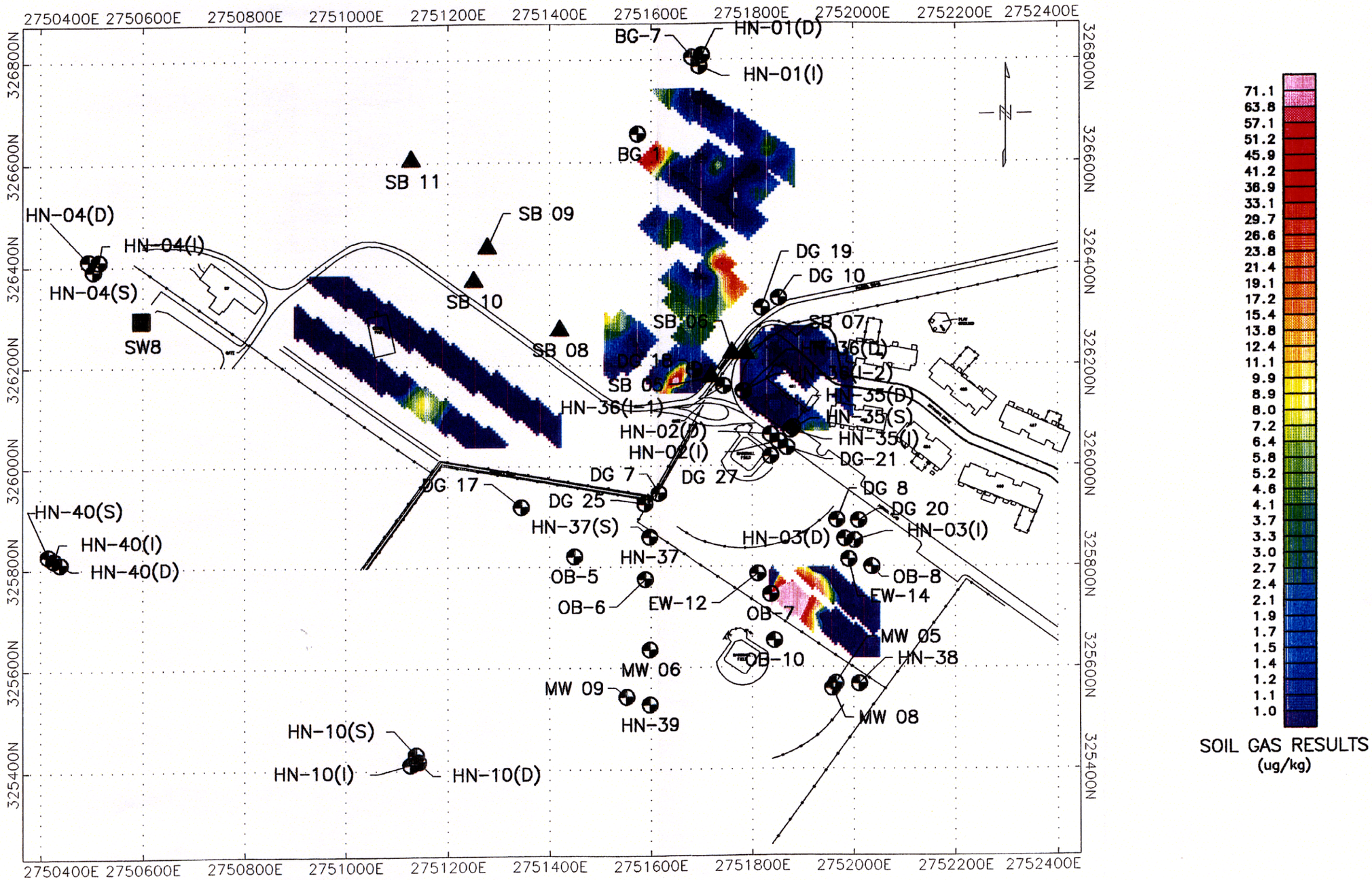
Tetra Tech NUS, Inc.

SOIL GAS SURVEY RESULTS
PHASE I – SITE 5
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412
OWNER NO. 6010
APPROVED BY Tea DATE 13 Jul 00
DRAWING NO. FIGURE 4-1
REV.

1412gm01.dwg

00190 D829Y



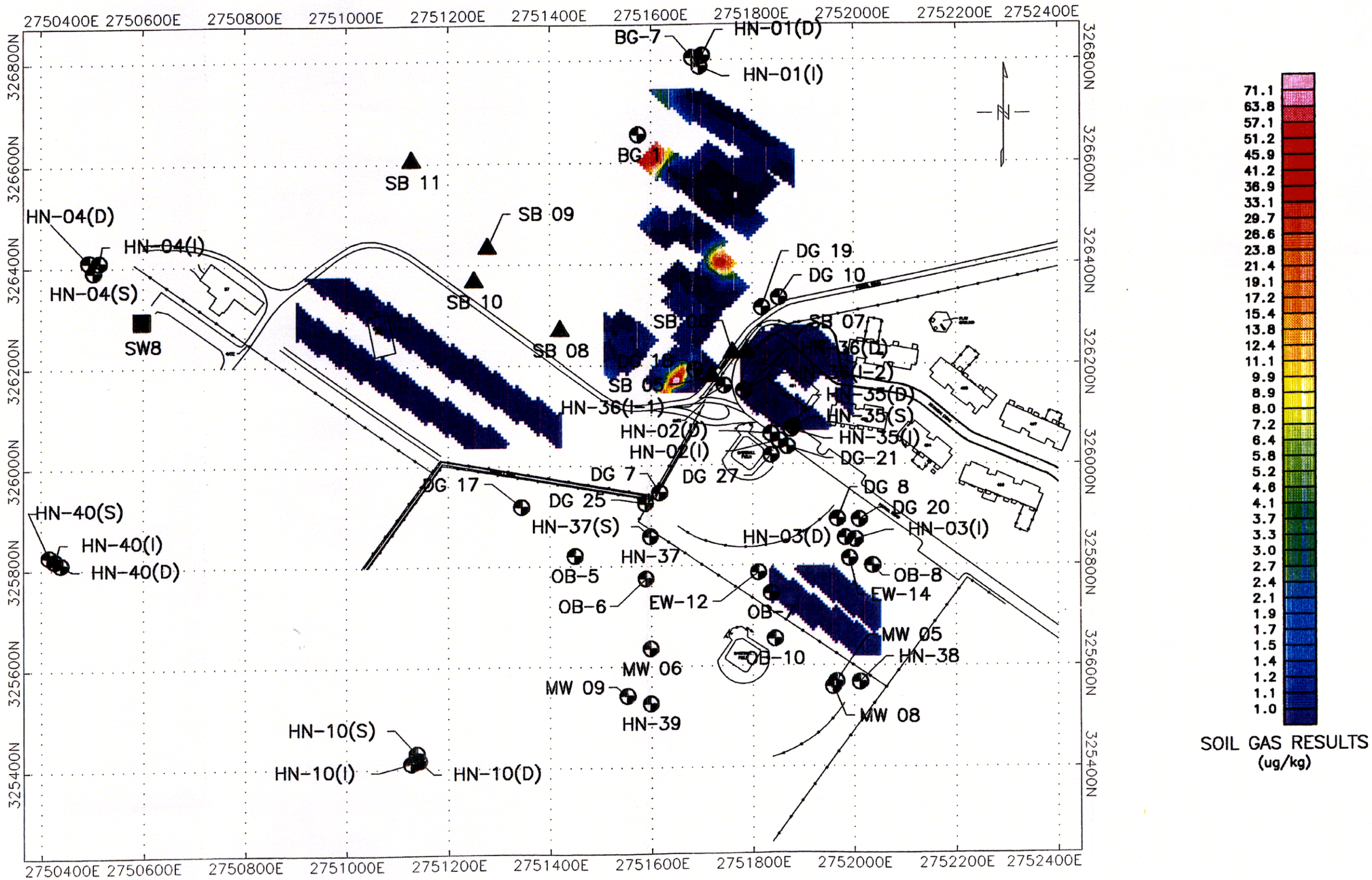
0 200 400
SCALE IN FEET

DRAWN BY EEH	DATE 7/11/00	Tetra Tech NUS, Inc.	TOTAL VOC SOIL GAS RESULTS AREA B FORMER NAWC WARMINSTER WARMINSTER, PA
CHECKED BY	DATE		
REVISED BY	DATE		
SCALE AS NOTED			

CONTRACT NO. 7606
OWNER NO. 0203
APPROVED BY RPa DATE 13 Jul 00
DRAWING NO. FIGURE 4-2 REV.

EEH 7/11/00 7606\7606gm06.dwg

7606gm06.dwg



0 200 400
SCALE IN FEET

DRAWN BY EEH	DATE 7/11/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

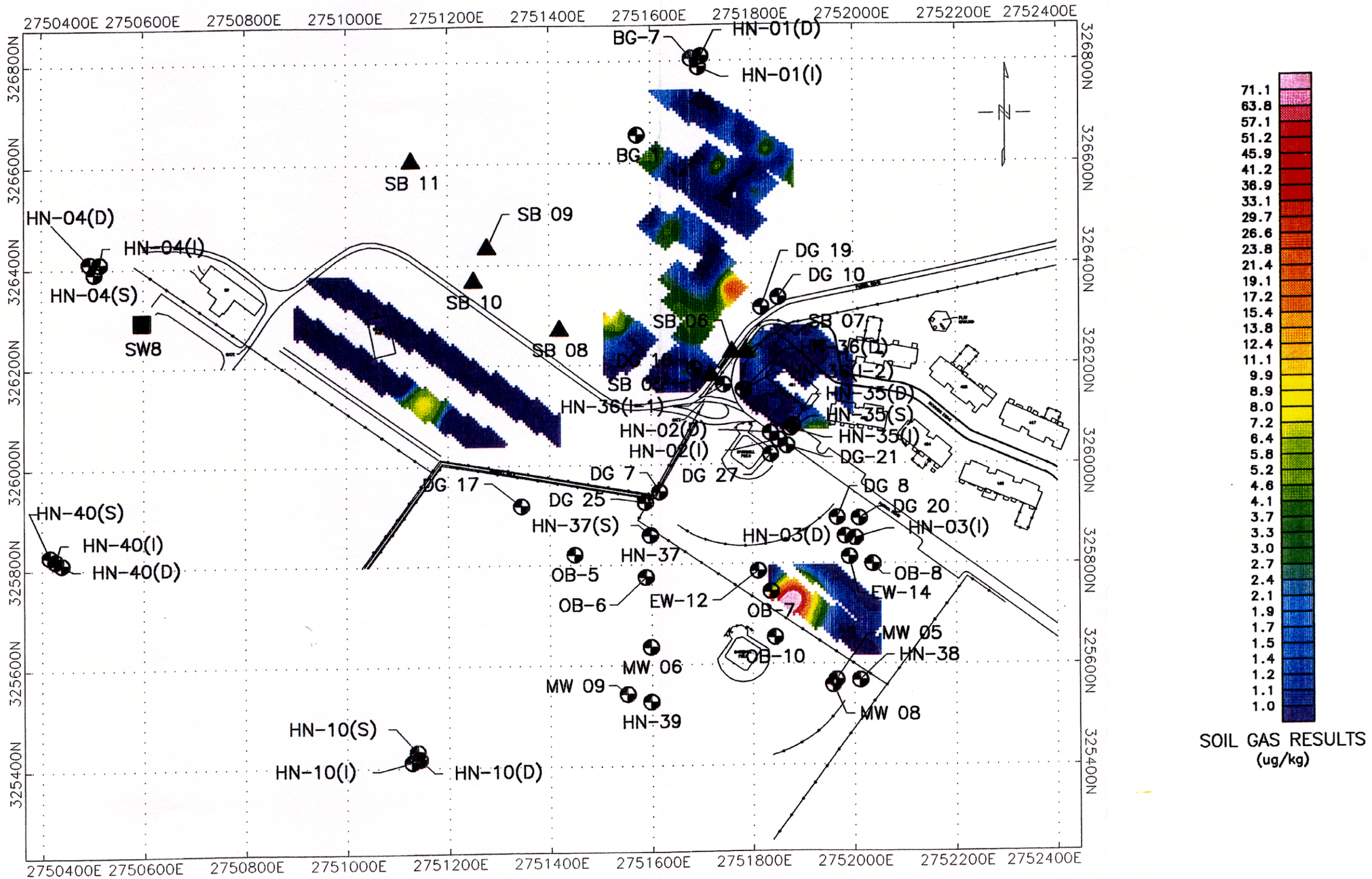
Tetra Tech NUS, Inc.

TOTAL HALOGENATED ORGANICS
SOIL GAS RESULTS
AREA B
FORMER NAWC WARMINSTER
WARMINSTER, PA

CONTRACT NO. 7606	
OWNER NO. 0203	
APPROVED BY RA	DATE 13 Jul 00
DRAWING NO. FIGURE 4-3	REV.

7606\7606gm08.dwg 7/11/00 EEH

7606gm08.dwg



0 200 400
SCALE IN FEET

DRAWN BY EEH DATE 7/11/00	Tetra Tech NUS, Inc.	BTEX SOIL GAS RESULTS AREA B FORMER NAWC WARMINSTER WARMINSTER, PA	CONTRACT NO. 7606
CHECKED BY DATE			OWNER NO. 0203
REVISED BY DATE			APPROVED BY DATE 13 Jul 00
SCALE AS NOTED			DRAWING NO. FIGURE 4-4 REV.

7606\7606gm07.dwg 7/11/00 EEH

7606gm07.dwg

presented in Appendix B. Most soil gas samples contained non-detects. A few scattered detections were observed at two locations to the south and southwest of Building 401 with PCE at 0.26 ppm and benzene, toluene, ethylbenzene, and xylene (BTEX) at 3.6 ppm. Four locations west of Building 401 contained elevated soil gas readings; three were for BTEX ranging from 1.7 to 3.6 ppm and one sample location detected TCE at 0.09 ppm. The two samples showing PCE and TCE may represent the estimated edges of trench TR3. The BTEX compounds might be associated with runoff from the driveway and parking areas and may not be associated with disposal trenches.

4.4 AIR MONITORING RESULTS

Air monitoring was performed as part of the Phase I RI work. Air sampling locations are shown on Figure 4-5. The air monitoring samples were collected using Tenax and charcoal tubes. Samples were collected inside Building 401 and from a back porch south of Building 401 that was reportedly built over top of trench TR3. Sample numbers and locations can be found in Table 4-1. The results of Tenax tube analysis are found in Table 4-2 and the charcoal tube analysis results are shown in Table 4-3.

The results of GC/MS analysis of Tenax indicated the presence of organic compounds at 10 ppb or less (Table 4-2). The Tenax concentrations were only estimates of concentrations due to spectra comparisons. Charcoal tubes were used to provide specific concentrations of contaminants.

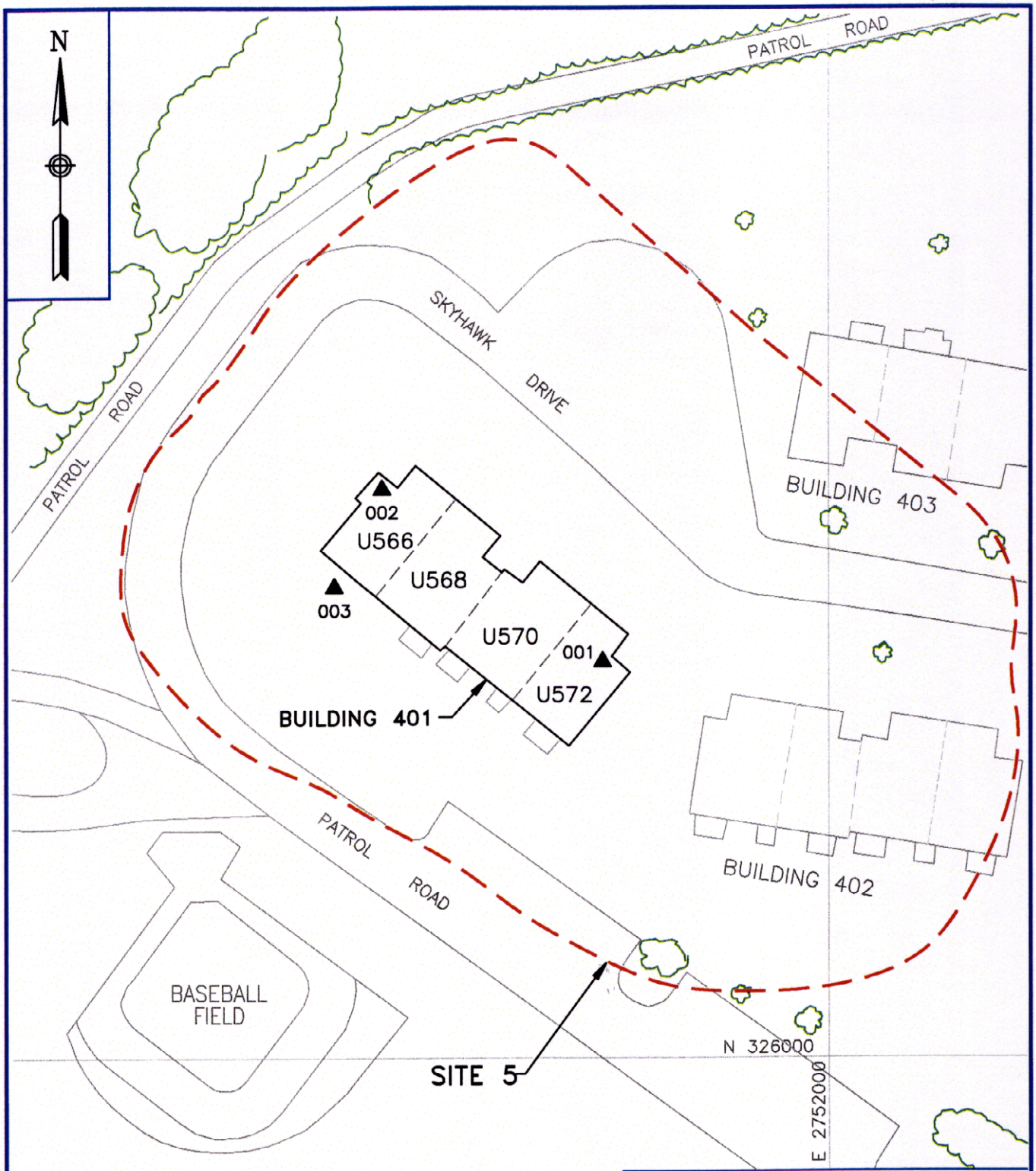
The results of the charcoal tube analysis indicated concentrations less than the detection limits in all but one sample (i.e., sample 89-12-14-C-002) (Table 4-3). This sample had an elevated concentration of toluene at 9 ppb. The level of toluene presents no known human health risks and did not appear to be associated with any disposal operations at Site 5.

4.5 EXTENT OF POTENTIAL BURIED WASTES

The results of the Phase I RI soil confirmation borings (Figure 4-6) and the Phase II and Phase III RI soil borings were used to estimate locations within Site 5 that might contain potential waste materials or non-native soils. A total of 10 soil borings were advanced during the Phase I RI. These borings were used to confirm waste material at Site 5 and were based on soil gas readings. No samples were collected from the borings. Five borings encountered waste and the remaining five found non-native clean fill or native soil. However, the boring locations were relatively far apart and may not accurately reflect the actual presence of waste material. The thickness of the waste material averaged 4 to 5 feet. The average thickness of non-native clean fill was 5 to 6 feet.

00190D30Y

1412/SITE-5_OU-10/1412km01.dwg 6/14/00 LDL



0 50 100

SCALE IN FEET

LEGEND

▲001 – AIR SAMPLING LOCATION

U570 – UNIT IDENTIFICATION

DRAWN BY LDL	DATE 6/14/00	Tetra Tech NUS, Inc.	AIR SAMPLING LOCATIONS BUILDING 401 AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY	DATE			OWNER NO. 6010
REVISED BY	DATE			APPROVED BY Tea DATE 5 July 00
SCALE AS NOTED				DRAWING NO. FIGURE 4-5 REV.

1412km01.dwg

TABLE 4-1
SITE 5 AIR SAMPLING LOCATIONS
NAWC WARMINSTER, PENNSYLVANIA

SAMPLE NUMBER	ADDRESS	LOCATION
89-12-14-T-001	572 Skyhawk Drive	Living Room – Front Wall
89-12-14-C-001	572 Skyhawk Drive	Living Room – Front Wall
89-12-14-SG-001	572 Skyhawk Drive	Living Room – Front Wall
89-12-14-T-002	566 Skyhawk Drive	Living Room – Rear Wall
89-12-14-C-002	566 Skyhawk Drive	Living Room – Rear Wall
89-12-14-SG-002	566 Skyhawk Drive	Living Room – Rear Wall
89-12-14-T-003	566 Skyhawk Drive	Outside – On Patio
89-12-14-C-003	566 Skyhawk Drive	Outside – On Patio
89-12-14-SG-003	566 Skyhawk Drive	Outside – On Patio

TABLE 4-2
AIR MONITORING
GAS CHROMATOGRAPHY - MASS SPECTROMETRY RESULTS
SAMPLE MATRIX: TENAX^R TUBE

Volatile Compounds	89-12-14-T-001 Concentration		89-12-14-T-002 Concentration		89-12-14-T-003 Concentration		Blank Concentration	Limit of Detection
	(ug)	(ug/m^3)	(ug)	(ug/m^3)	(ug)	(ug/m^3)	(ug)	(ug)
Benzene	0.06	0.7	0.1	1	0.6	4	<0.01	0.01
2-Butanone					0.2	1	<0.1	0.1
1,2-Dichloroethane					0.6	0.4	<0.01	0.01
Ethyl Benzene	0.01	1	0.2	3	0.2	1	0.04	0.01
2-Hexanone	0.01	1	0.1	1	0.08	0.06	<0.05	0.05
4-Methyl-2-Pentanone					0.06	0.04	<0.05	0.05
Styrene	0.1	1	0.2	3	0.1	0.7	0.01	0.01
Tetrachloroethylene	0.1	1	0.05	0.7	0.2	1	<0.01	0.01
1,1,1-Trichloroethane	0.03	0.3	0.05	0.7	0.2	1	<0.01	0.01
Trichloroethylene	0.01	0.1	0.01	0.1	0.1	0.7	0.01	0.01
Toluene	0.5	6	0.8	10	1	7	0.1	0.01
Xylenes	0.7	8	1	10	1	7	0.1	0.01

Please note that the results are semi-quantitative and the collection efficiencies of many compounds on Tenax have not been validated.

Results have been blank corrected.

ug = micrograms = 1 X 10^{-4} grams
m^3 = cubic meter

TABLE 4-3
AIR MONITORING
SAMPLE MATRIX: CHARCOAL TUBE

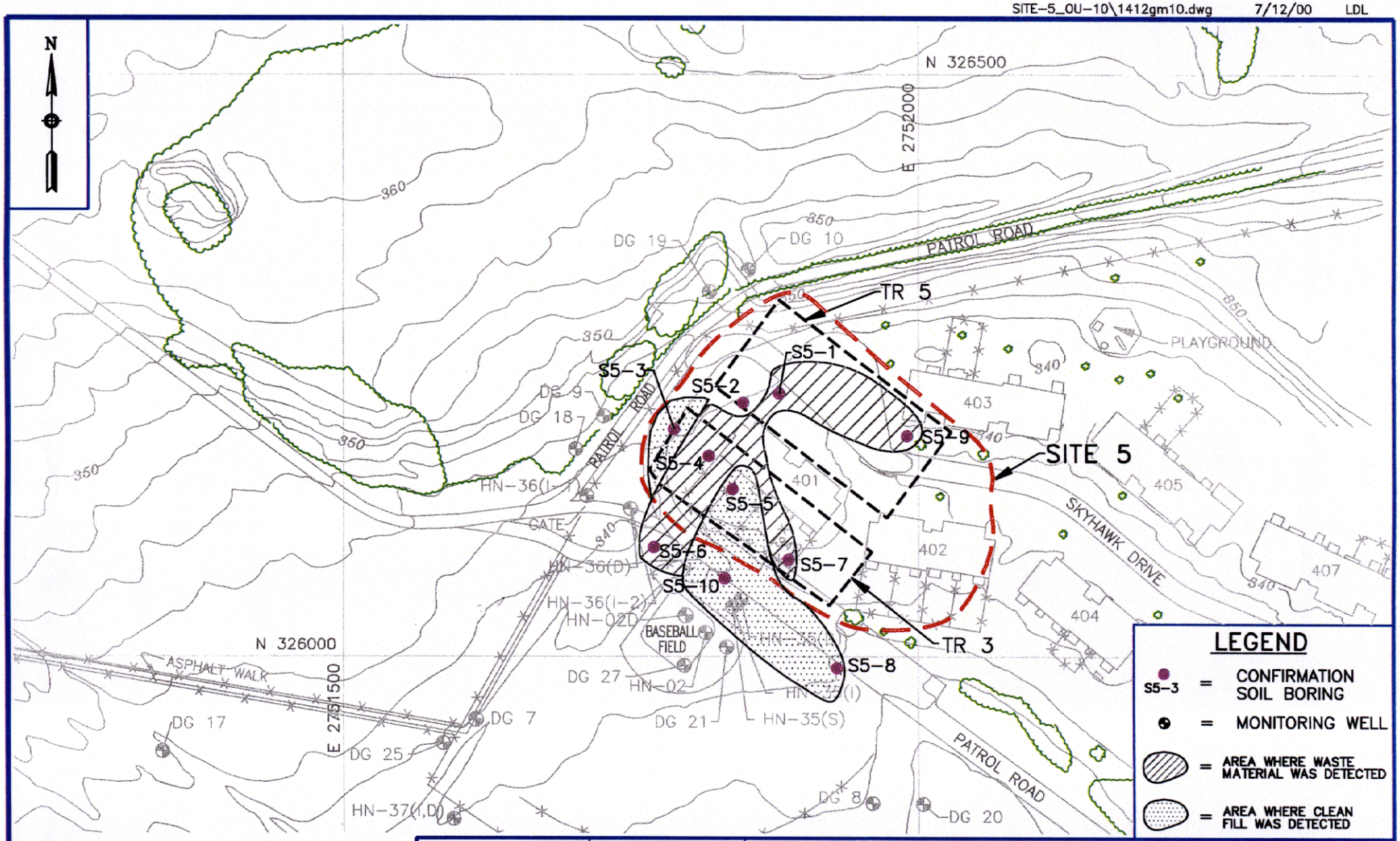
Volatile Compounds	89-12-14-c-001 Concentration (mg)	(ppm)	89-12-14-c-002 Concentration (mg)	(ppm)	89-12-14-c-003 Concentration (mg)	(ppm)	Blank Concentration (mg)	Limit of Detection (mg)	NIOSH Method Number
Benzene	<0.002	<0.01	<0.002	<0.005	<0.002	<0.005	<0.002	0.003	1500
2-Butanone[1]	<0.003	<0.008	<0.003	<0.009	<0.003	<0.008	<0.003	0.002	S3
Ethyl Benzene	<0.002	<0.006	<0.002	<0.004	<0.002	<0.004	<0.002	0.002	1501
2-Hexanone[2]	<0.003	<0.009	<0.003	<0.006	<0.003	<0.006	<0.003	0.003	1300
4-Methyl-2-Pentanone[3]	<0.002	<0.006	<0.002	<0.004	<0.002	<0.004	<0.002	0.002	1300
Styrene[4]	<0.005	<0.01	<0.005	<0.01	<0.005	<0.01	<0.005	0.005	1501
Tetrachloroethylene	<0.004	<0.007	<0.004	<0.005	<0.004	<0.005	<0.002	0.004	1003
1,1,1-Trichloroethane	<0.003	<0.007	<0.003	<0.005	<0.003	<0.004	<0.005	0.003	1003
Trichloroethylene	<0.004	<0.009	<0.004	<0.006	<0.004	<0.006	<0.004	0.004	1022
Toluene	<0.004	<0.01	0.004	0.009	<0.002	<0.004	<0.002	0.002	1500
Xylenes	<0.004	<0.01	<0.004	<0.084	<0.004	<0.008	<0.004	0.004	1501

Ppm = Parts per million

[1]The results for 2-butanone have been corrected for a desorption efficiency of 74%.
[2]The results for 2-hexanone have been corrected for a desorption efficiency of 81%.
[3]The results for 4-methyl-2-pentanone have been corrected for a desorption efficiency of 88%.
[4]The results for styrene have been corrected for a desorption efficiency of 37%.

Note: Other significant peaks were present in the chromatograms of the charcoal tube samples.

SITE-5_OU-10\1412gm10.dwg 7/12/00 LDL



LEGEND

- S5-3 = CONFIRMATION SOIL BORING
- = MONITORING WELL
- = AREA WHERE WASTE MATERIAL WAS DETECTED
- = AREA WHERE CLEAN FILL WAS DETECTED

0 120 240

SCALE IN FEET

DRAWN BY LDL	DATE 7/12/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

Tetra Tech NUS, Inc.

CONFIRMATION BORING RESULTS
PHASE I – SITE 5
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412	
OWNER NO. 6010	
APPROVED BY pen	DATE 14 Jul 00
DRAWING NO. FIGURE 4-6	REV.

1412gm10.dwg

00196 D 31Y

Based on the results of all borings, Figure 4-7 shows the four general locations that exhibited the presence of waste materials. For trench TR3, this figure may be inaccurate since borings were not advanced beneath Building 401. However, the absence of waste materials south of Building 401 near subsurface soil sample locations SB-05-09 and SB-05-10 as well as east of Building 401 (i.e., sample locations SB-05-01 and SB-05-25) suggests that these materials might not have been uniformly distributed beneath the entire length of the existing building and that these materials are probably not present under Buildings 402 and 403.

For trench TR5, waste materials were found in the western end of the estimated location of trench TR5 and beneath the parking area along Skyhawk Drive (Figure 4-7). The absence of waste materials in the eastern end of trench TR5 suggests that these materials might not be present beneath Building 403.

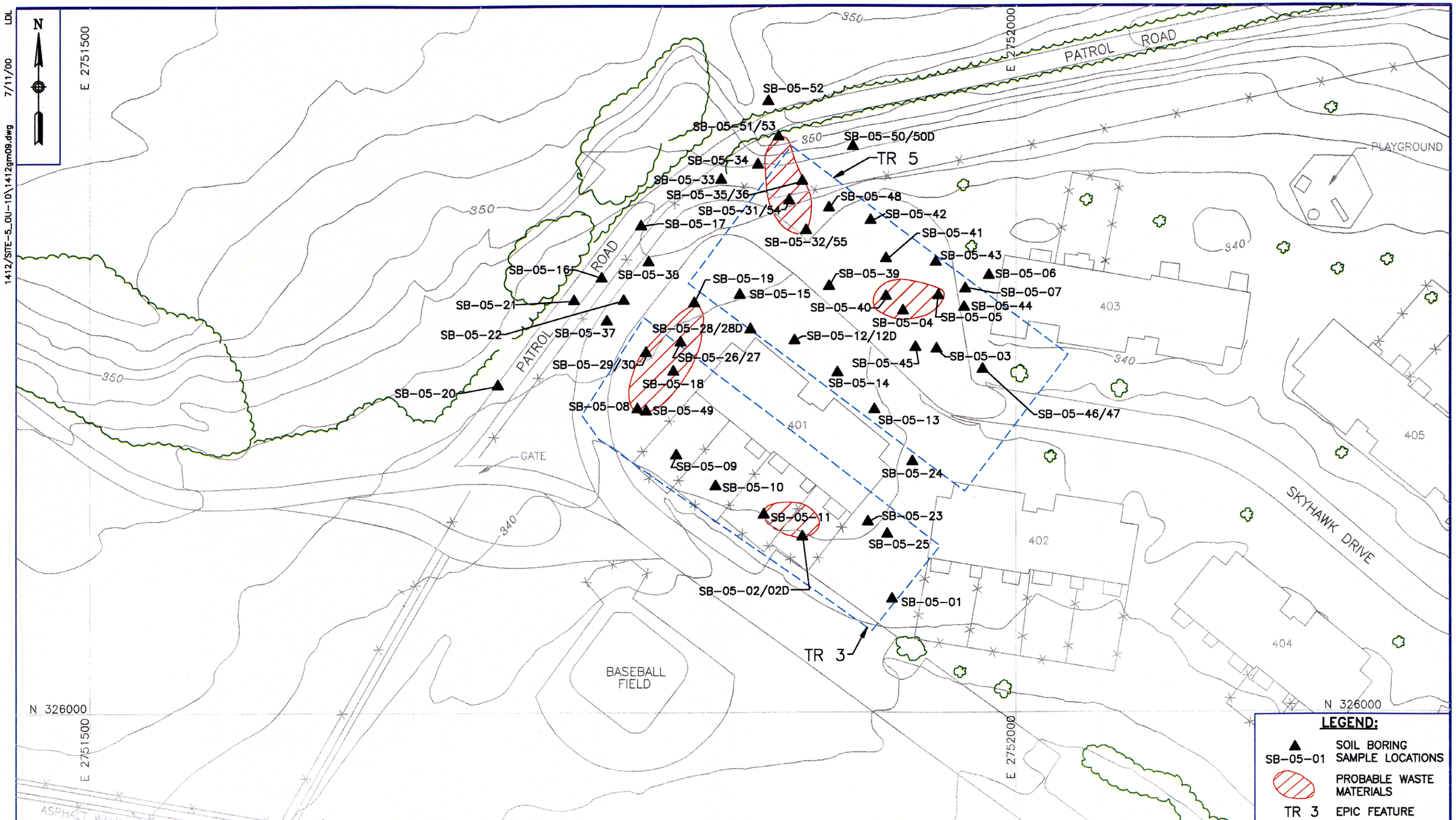
The estimation and delineation of potential buried materials at Site 5 are inherently hypothetical and should be viewed with caution, given the presence of housing units and the inability to excavate test pits to better determine the limits of the buried waste materials.

4.6 SURFACE SOIL RESULTS

Following the majority of Phase III RI work at Site 5, additional surface and subsurface soil sampling and analysis were conducted to better delineate the areal extent of trenches TR3 and TR5 and to evaluate potential new trenches (i.e., trenches TR5B and TR5C) based on newer EPA aerial photographic interpretation (EPA, July 1999). Surface soils were defined as those generally within 2 feet of the ground surface. The average depth of the Site 5 surface soil samples ranged from 6 to 36 inches after accounting for topsoil or asphalt and roadbed material.

A total of 39 surface soil samples were collected in the vicinity of Site 5. In three samples (i.e., SS-05-17, SS-05-36, and SS-05-37), surficial waste was encountered and consisted of glass, ash, wood, cinders, wire, or brick fragments. For purposes of interpretation, the two general trench locations at Site 5 (i.e., the estimated locations of trenches TR3 and TR5) were used to focus the data evaluation process. However, several trenches may be present in each of the general trench locations.

Table 4-4 provides the occurrence and distribution of organics and inorganic compounds in background and Site 5 surface soil samples. Figure 4-8 details those surface soil sample locations



DRAWN BY	DATE
LDL	7/11/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

Tetra Tech NUS, Inc.

PROBABLE LOCATIONS OF WASTE MATERIALS

AREA B – SITE 5

FORMER NAWC WARMINSTER

WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412

OWNER NO. 6010

APPROVED BY: Tea DATE: 14 Jul 00

DRAWING NO. FIGURE 4-7 REV.

LDL 7/11/00 1412/SITE-5_OU-10\1412gm09.dwg

1412gm09.dwg

TABLE 4-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data					Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Representative Concentration
Aluminum	29/29	4780	18100	13200	BG-12	36/36	8590	18500	12500	SS-05-33	13200
Antimony	1/29	13.6 J	13.6 J	3.69	BG-16	21/31	0.27 L	8.8 L	2.89	SS-05-16	4.9
Arsenic	25/29	0.28	12.1 J	3.92	BG-11	35/36	0.39 K	7.9 L	4.23	SS-05-01	4.76
Barium	25/29	34.1	225	58.6	BG-28	36/36	40 K	311 K	103	SS-05-36-D	118
Beryllium	25/29	0.31	1.7 J	0.78	BG-23-DUP	36/36	0.59	1.6	0.925	SS-05-28	0.991
Cadmium	0/29	-				18/34	0.63 K	10.5	1.88	SS-05-08	4.05
Calcium	23/29	240	1910	655	BG-24	36/36	644 J	35400	2780	SS-05-09	3000
Chromium	29/29	7.9 J	35.3 J	19.3	BG-12	36/36	12.4	49.2 K	23.4	SS-05-36-D	25.4
Cobalt	25/29	1.6	22.1	8.27	BG-23-DUP	36/36	5	21.3 K	9.78	SS-05-27	10.7
Copper	27/29	3.6 J	30.6	11.7	BG-29	36/36	6.8	875	133	SS-05-07	297
Cyanide	0/20	-				1/16	0.56 L	0.56 L	0.459	SS-05-16	0.519
Iron	29/29	6980	410500	33700	BG-04	36/36	12900	48300	23100	SS-05-01	25500
Lead	29/29	1.6 J	96.5 J	12	BG-13	36/36	7.5	1020	85.1	SS-05-36-D	130
Magnesium	25/29	518	4960	1960	BG-24	36/36	1290	16000	2770	SS-05-09	3070
Manganese	29/29	30.9	2010	425	BG-28	36/36	130	2550 J	640	SS-05-37	785
Mercury	1/29	0.37	0.37	0.0413	BG-23	20/28	0.07	12	0.688	SS-05-08	1.63
Nickel	18/29	4.1 J	21.7 J	9.34	BG-23-DUP	36/36	6.3 K	83.2	18.7	SS-05-08	21.7
Potassium	25/29	89.1	3050	679	BG-24	36/36	307	4660	1130	SS-05-09	1380
Selenium	0/29	-				3/13	0.96 K	2.6 L	0.663	SS-05-37	1.09
Silver	0/29	-				27/29	0.73	87.2 K	12.2	SS-05-36	29.2
Sodium	4/29	55.2	86.7	80.9	BG-25	14/15	85.7 L	831	184	SS-05-10	269
Thallium	3/29	0.37	0.42	0.374	BG-23-DUP	7/36	0.47 K	2 K	0.694	SS-05-01	0.818
Vanadium	29/29	15.4	45	29.4	BG-12	36/36	19.5	60.9	32.6	SS-05-09	35.3
Zinc	25/29	9	60	25.7	BG-13	36/36	18.4	4180 L	273	SS-05-37	371
4,4'-DDD	1/21	16 J	16 J	2.66	BG-12	6/30	4.1 J	27 L	4.23	SS-05-29	5.07
4,4'-DDE	1/21	820	820	40.9	BG-12	6/35	4 K	9.5 J	3.3	SS-05-26	3.77
4,4'-DDT	1/21	1440 J	1440 J	70.5	BG-12	5/35	4.7 J	14	3.22	SS-05-35	3.6
Alpha-Chlordane	0/21	-				3/32	2.3	2.9 J	1.46	SS-05-08	1.59
Aroclor-1242	0/21	-				3/36	16 J	260	31.8	SS-05-30	32.9
Aroclor-1254	1/21	51	51	38.6	BG-13	19/36	20 J	24000	754	SS-05-07	312
Beta-BHC	0/21	-				1/36	5.6 L	5.6 L	1.4	SS-05-28	1.48
Dieldrin	0/21	-				1/33	25 L	25 L	3.21	SS-05-29	3.36
Endosulfan Sulfate	0/21	-				2/35	4.3 J	10 J	2.77	SS-05-21	2.97

TABLE 4-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Background Data					Site-Related Data				
	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Representative Concentration
Endrin	0/21	-				4/36	4.1 J	810 J	24.7	SS-05-07	6.57
Endrin Aldehyde	0/21	-				2/33	5.7 L	6.7 L	2.77	SS-05-37	3
Gamma-Chlordane	0/21	-				3/31	3.5 J	6.1	1.36	SS-05-38	1.53
2-Methylnaphthalene	0/11	-				1/29	160 J	160 J	317	SS-05-08	160
Benz(a)anthracene	0/11	-				3/29	74 J	330 J	321	SS-05-06-DUP	293
Benzo(a)pyrene	0/11	-				3/29	67 J	270 J	318	SS-05-06-DUP	270
Benzo(b)fluoranthene	1/11	58 J	58 J	185	BG-13	3/29	50 J	120 J	313	SS-05-06-DUP	120
Benzo(g,h,i)perylene	0/11	-				3/29	52 J	100 J	313	SS-05-06-DUP	100
Benzo(k)fluoranthene	1/11	46 J	46 J	184	BG-13	2/29	48 J	90 J	314	SS-05-22	90
Bis(2-ethylhexyl)phthalate	1/11	50 J	50 J	154	BG-16	6/17	39 J	270 J	408	SS-05-08	270
Chrysene	1/11	51 J	51 J	185	BG-13	3/29	100 J	450	326	SS-05-06-DUP	301
Di-n-butylphthalate	0/11	-				1/24	48 J	48 J	359	SS-05-06-DUP	48
Dibenz(a,h)anthracene	0/11	-				1/29	40 J	40 J	317	SS-05-38	40
Fluoranthene	1/11	92 J	92 J	188	BG-13	5/29	42 J	170 J	306	SS-05-22	170
Indeno(1,2,3-cd)pyrene	0/11	-				2/29	41 J	60 J	316	SS-05-22	60
Naphthalene	0/11	-				1/29	47 J	47 J	314	SS-05-08	47
Phenanthrene	1/11	51 J	51 J	185	BG-13	4/29	42 J	120 J	310	SS-05-06-DUP	120
Pyrene	1/11	100 J	100 J	189	BG-13	6/29	46 J	310 J	313	SS-05-06-DUP	290
2-Butanone	0/19	-				2/18	35	42 J	9.19	SS-05-28	11.6
2-Hexanone	0/19	-				2/29	31	51	7.93	SS-05-21	8.72
4-Methyl-2-pentanone	0/19	-				1/31	6 J	6 J	5.63	SS-05-28	5.84
Acetone	4/19	8 J	12 J	45.7	BG-24	10/18	94	170	70	SS-05-07	95.5
Benzene	0/19	-				4/31	1 J	2 J	3.6	SS-05-08	2
Carbon Disulfide	0/19	-				1/31	1 J	1 J	3.77	SS-05-28	1
Chloroethane	0/19	-				1/31	2 J	2 J	3.82	SS-05-37	2
Chloromethane	2/19	3 J	3 J	44.8	BG-26	2/31	1 J	5 J	3.87	SS-05-37	4.53
Ethylbenzene	0/19	-				1/31	3 J	3 J	3.84	SS-05-21	3
Methylene Chloride	0/19	-				3/5	2 J	320	67.2	SS-05-12	320
Toluene	3/19	2 J	2 J	44.6	BG-17	16/31	1 J	40	4.97	SS-05-21	6.5
Trichloroethene	0/19	-				5/31	5 J	33	5.29	SS-05-06-DUP	6.19
Xylene (Total)	0/19	-				4/31	1 J	19 J	7.31	SS-05-21	8.21

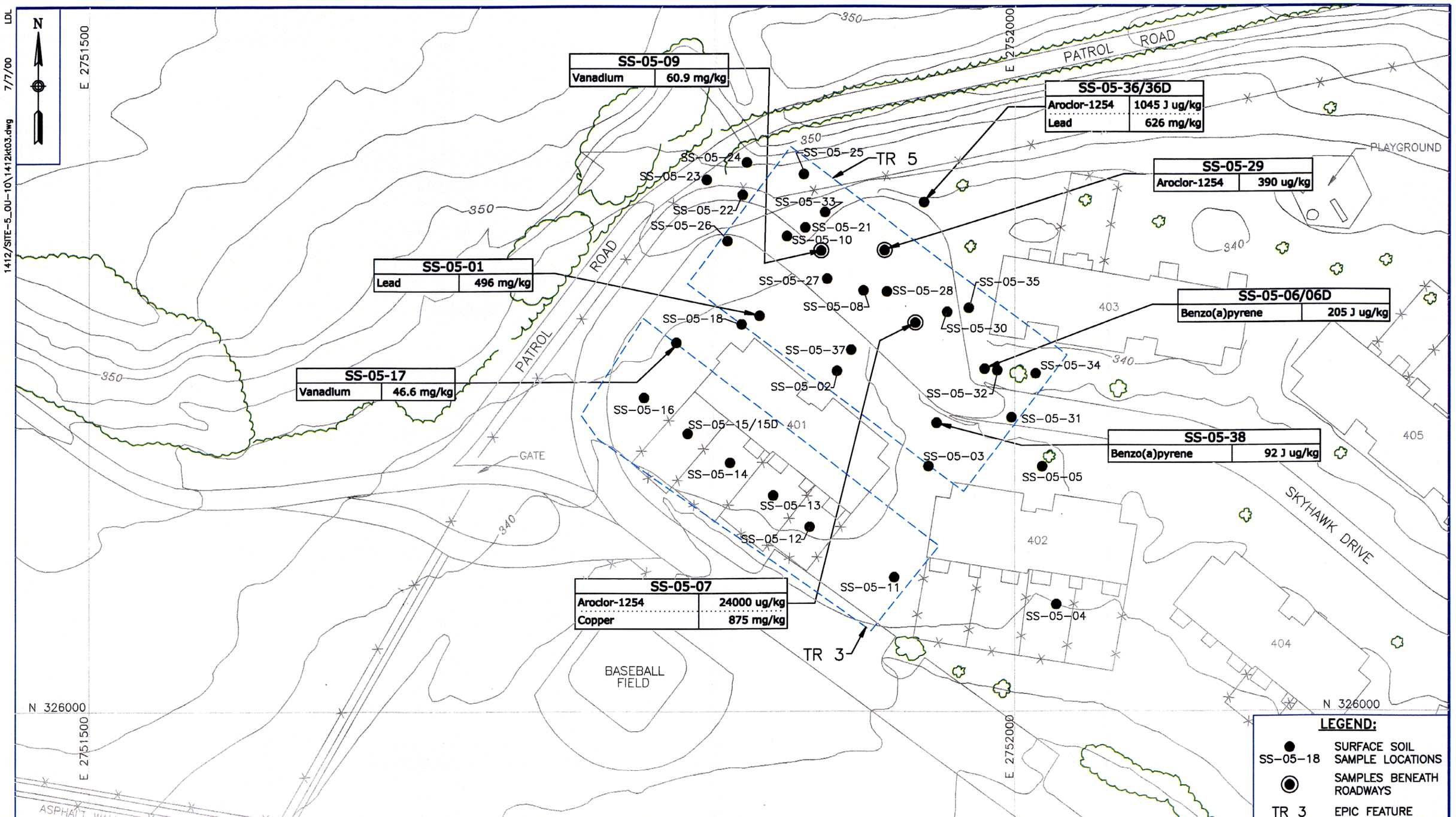
Notes:

TABLE 4-4
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data					Site-Related Data				
	Freq.	Range of Positive Detection		Mean of	Sampling Round and	Freq.	Range of Positive Detection		Mean of	Sampling Round and	Representative
Substance	of Detection	Min.	Max.	All Data	Location of Maximum	of Detection	Min.	Max.	All Data	Location of Maximum	Concentration

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
Mean of all data includes positive detections and non-detected results. Detection limits are divided by two.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separate table.
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.
Number of samples may vary based on the number of usable results.

00190D 33Y



DRAWN BY	DATE
LDL	7/7/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE	
AS NOTED	

Tetra Tech NUS, Inc.

SURFACE SOIL EXCEEDANCES SAMPLE LOCATION MAP

AREA B – SITE 5

FORMER NAWC WARMINSTER

WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412

OWNER NO. 6010

APPROVED BY: Lea DATE: 13 Jul 00

DRAWING NO. FIGURE 4-8 REV.

LDL 7/7/00 1412/SITE-5_OU-10\1412kt03.dwg

1412kt03.dwg

where contaminant concentrations exceeded both the highest observed background concentration for that contaminant and one of the soil screening criteria for residential land use, as shown on the analytical summary tables contained in Appendix A.

Several VOCs were contained in the Site 5 surface soil samples for trench TR5. 2-Butanone was detected at 35.0 ug/kg (sample SS-05-07) and 42 ug/kg (sample SS-05-28) located in the central eastern portion of estimated trench TR5 location. 2-Hexanone was contained at concentrations of 51 ug/kg (sample SS-05-21) and 31 ug/kg (sample SS-05-22) located in the western end of trench TR5. 4-Methyl-2-Pentanone was also detected at 6 ug/kg (sample SS-05-28) located in the central eastern portion of this trench.

Benzene was detected at concentrations less than or equal to 2 ug/kg in samples SS-05-17, SS-05-26, SS-05-33, and SS-05-08. Carbon disulfide was detected at 1 ug/kg in sample SS-05-28 in the central portion of trench TR5. Chloroethene and chloromethane were detected at 2 and 5 ug/kg, respectively, in sample SS-05-37. Sample SS-05-34 contained chloromethane at 1 ug/kg. Sample SS-05-37 was located in the south-central portion of trench TR5 and sample SS-05-34 was located in the northeastern corner of TR5. Ethylbenzene was detected at 3 ug/kg in sample SS-05-21 located along the northeastern end of trench TR5. Methylene chloride, a common laboratory contaminant, was detected at 2, 2, and 320 ug/kg in samples SS-05-02, SS-05-04, and SS-05-11, respectively, located near the northcentral and the central eastern sections of trench TR3. Toluene was detected at concentrations ranging from 1 to 40 ug/kg in several samples throughout Site 5. Xylene was contained at levels ranging from 1 to 19 ug/kg in samples SS-05-02, SS-05-21, SS-05-26, and SS-05-35. TCE was contained in samples SS-05-02, SS-05-04, SS-05-06, SS-05-05-07, and SS-05-08; the maximum level was 33 ug/kg in sample SS-05-06. No VOC was present in any surface soil sample at levels greater than the residential RBCs.

Several semivolatile organic compounds (including PAHs and phthalates) were detected in surface soil samples collected at Site 5. The PAHs were found within the estimated location of trench TR5 and may be associated with disposal practices at the site. PAHs are generally associated with incomplete combustion of materials or runoff from asphalt surfaces. PAHs present in the surface soils were located throughout the estimated trench locations of TR3 and TR5 and may be associated with runoff or leaching from asphalt surfaces. However, only benzo(a)pyrene was identified at a level (90 ug/kg) greater than the residential RBCs. Sample SS-05-38 contained benzo(a)pyrene at 92 ug/kg and sample SS-05-06 contained 205 ug/kg (270 ug/kg in the duplicate sample).

Phthalates [including bis (2-ethyhexyl) and di-n-butyl] were detected in samples to the north and east of trench TR3 and to the east and central portions of trench TR5. The phthalate concentrations ranged from 39 to 270 ug/kg. These compounds may be associated with disposal activities, the burning of trash, or runoff or leaching of asphalt materials. However, all phthalate detections were below residential RBCs.

Aroclor-1254 was detected in 19 of 36 samples at Site 5. The samples may be associated with dust suppression techniques used during construction of the housing units. Sample concentrations ranged from 20 to 24,000 ug/kg with the majority of samples being twice the background concentration of Aroclor-1254. However, only three samples (see Figure 4-8) contained Aroclor-1254 at levels in excess of residential RBCs. Several pesticides (e.g., 4,4'-DDD, 4,4'-DDE, 4-4'DDT, Beta-BHC, dieldrin, endosulfan sulfate, endrin aldehyde, gamma chlordane, and heptachlor epoxide) were detected throughout the general Site 5 area and might be associated with disposal and spreading of material or by past or present application of pesticides around the housing area. No pesticide levels exceeded RBCs.

Among surface soil inorganic results, a variety of metals were detected at levels above background soil concentrations. The highest inorganic results were contained in samples SS-05-36 and SS-05-37 located north and south of the estimated location of trench TR5. The highest cadmium, lead, mercury, and zinc levels were at these two locations. Figure 4-8 depicts surface soil samples with inorganic contaminant levels greater than residential RBCs.

4.7 SUBSURFACE SOIL

The nature and extent of subsurface soil contamination at Site 5 are discussed in this section. Subsurface soils were defined as those at depths generally greater than 2 feet from below ground surface. All subsurface soil samples were collected at depths between 3 and 10 feet below ground surface during the RI. Additional subsurface soil sampling was conducted to further delineate the nature and extent of contamination.

A total of 32 soil borings were drilled at Site 5, and 51 subsurface soil samples (plus duplicates) were collected at Site 5 during the Phase II and III RI work. Table 4-5 provides the occurrence and distribution of organics and inorganic compounds in background and Site 5 subsurface soil samples. Figure 4-9 details those subsurface soil sample locations where contaminant concentrations exceeded both the highest observed background concentration for that contaminant and one of the soil screening criteria for residential land use, as shown on the analytical summary tables contained in Appendix A.

TABLE 4-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data					Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Representative Concentration
Aluminum	29/29	4780	18100	13200	BG-12	55/55	3490	20700	12600	SB-05-29	13400
Antimony	1/29	13.6 J	13.6 J	3.69	BG-16	28/36	0.26 L	50.4 J	3.95	SB-05-21	7.94
Arsenic	25/29	0.28	12.1 J	3.92	BG-11	46/53	0.37 K	12.9	2.22	SB-05-20	3.06
Barium	25/29	34.1	225	58.6	BG-28	54/54	27.7	1030	182	SB-05-29	217
Beryllium	25/29	0.31	1.7 J	0.78	BG-23-DUP	53/53	0.42	3.7	1.32	SB-05-08	1.5
Cadmium	0/29	0	0	0		13/54	0.31 K	137	4.65	SB-05-29	5.5
Calcium	23/29	240	1910	655	BG-24	53/53	361 K	22000	2800	SB-05-20	3300
Chromium	29/29	7.9 J	35.3 J	19.3	BG-12	55/55	1.9 K	305	28.8	SB-05-20	32.2
Cobalt	25/29	1.6	22.1	8.27	BG-23-DUP	54/54	3.1	30.1	13.4	SB-05-14	15
Copper	27/29	3.6 J	30.6	11.7	BG-29	42/42	2.5 L	19300 J	636	SB-05-21	802
Cyanide	0/20	0	0	0		1/3	1.5	1.5	1.15	SB-05-22	1.5
Iron	29/29	6980	410500	33700	BG-04	55/55	2690	92600	28600	SB-05-51	33700
Lead	29/29	1.6 J	96.5 J	12	BG-13	54/54	2.4 K	2400 K	138	SB-05-26	142
Magnesium	25/29	518	4960	1960	BG-24	53/53	639	8660 J	3950	SB-05-43	4420
Manganese	29/29	30.9	2010	425	BG-28	55/55	42.9	9240 J	740	SB-05-08	937
Mercury	1/29	0.37	0.37	0.0413	BG-23	22/50	0.05 L	2.6	0.248	SB-05-51	0.347
Nickel	18/29	4.1 J	21.7 J	9.34	BG-23-DUP	55/55	4.5 K	625	39	SB-05-20	39.3
Potassium	25/29	89.1	3050	679	BG-24	54/54	229	6950	2110	SB-05-43	2840
Selenium	0/29	0	0	0		4/30	0.45	1.3 K	0.375	SB-05-05	0.426
Silver	0/29	0	0	0		33/52	2.4	111	13.6	SB-05-55	38.3
Sodium	4/29	55.2	86.7	80.9	BG-25	38/38	46.1	677	190	SB-05-22	226
Thallium	3/29	0.37	0.42	0.374	BG-23-DUP	7/52	0.45	1.1 K	0.622	SB-05-18	0.703
Vanadium	29/29	15.4	45	29.4	BG-12	54/54	13	6510	160	SB-05-20	61.6
Zinc	25/29	9	60	25.7	BG-13	52/52	12.7	4760 L	265	SB-05-29	286
4,4'-DDD	1/21	16 J	16 J	2.66	BG-12	5/41	9.6 J	12000	297	SB-05-54	19.4
4,4'-DDE	1/21	820	820	40.9	BG-12	5/40	5.6	2600 K	68.3	SB-05-54	11.1
4,4'-DDT	1/21	1440 J	1440 J	70.5	BG-12	4/41	6.2	6300	157	SB-05-54	13.3
Alpha-Chlordane	0/21	0	0	0		2/40	4.6 J	5.7 J	1.85	SB-05-40	1.85
Aroclor-1242	0/21	0	0	0		1/41	100 J	100 J	33.8	SB-05-51	32.7
Aroclor-1248	0/21	0	0	0		1/41	315	315	37	SB-05-14	34
Aroclor-1254	1/21	51	51	38.6	BG-13	9/41	22 J	395	59	SB-05-14	63
Beta-BHC	0/21	0	0	0		1/41	1.9 J	1.9 J	1.65	SB-05-21	1.57
Dieldrin	0/21	0	0	0		1/41	8.8	8.8	3.35	SB-05-51	3.24
Endosulfan Sulfate	0/21	0	0	0		2/41	5.5 J	25 J	3.82	SB-05-40	3.72

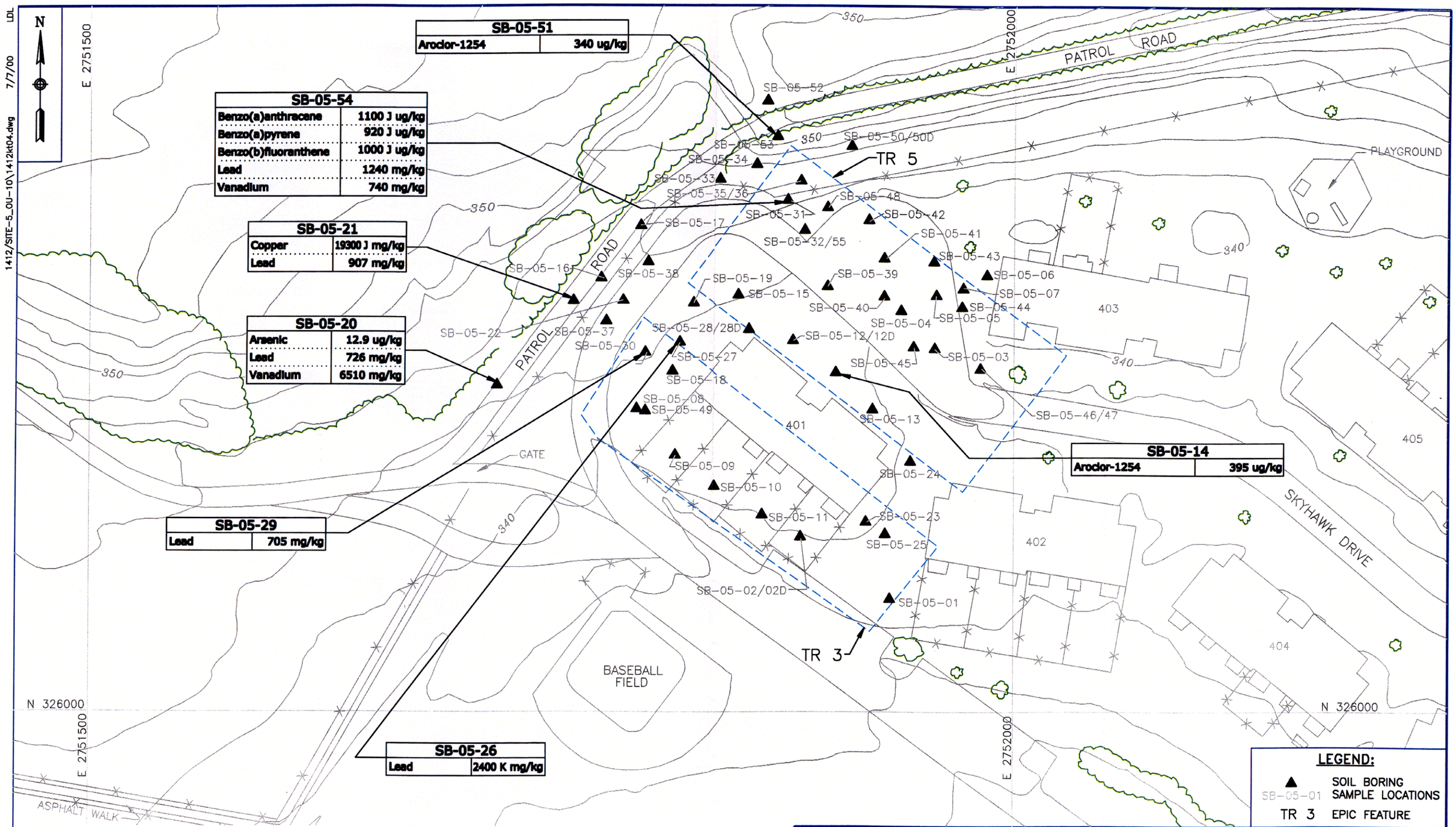
TABLE 4-5
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

	Background Data					Site-Related Data				
Substance	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Freq. of Detection	Range of Positive Detection Min.	Range of Positive Detection Max.	Mean of All Data	Sampling Round and Location of Maximum	Representative Concentration
Gamma-Chlordane	0/21	0	0	0		2/41	4.7 J	6.8 J	1.86	SB-05-40	1.85
Methoxychlor	0/21	0	0	0		1/41	70 L	70 L	17.8	SB-05-35	17.2
1,4-Dichlorobenzene	1/11	43 J	43 J	184	BG-11	1/32	220 J	220 J	332	SB-05-51	220
Benz(a)anthracene	0/11	0	0	0		1/32	1100 J	1100 J	316	SB-05-54	384
Benzo(a)pyrene	0/11	0	0	0		1/32	920 J	920 J	310	SB-05-54	375
Benzo(b)fluoranthene	1/11	58 J	58 J	185	BG-13	3/32	38 J	1000 J	302	SB-05-54	371
Benzo(g,h,i)perylene	0/11	0	0	0		1/32	960 J	960 J	311	SB-05-54	377
Bis(2-ethylhexyl)phthalate	1/11	50 J	50 J	154	BG-16	4/26	48 J	180 J	239	SB-05-51	180
Chrysene	1/11	51 J	51 J	185	BG-13	2/32	77 J	2000 J	336	SB-05-54	403
Di-n-butylphthalate	0/11	0	0	0		2/25	41 J	57 J	390	SB-05-38	57
Fluoranthene	1/11	92 J	92 J	188	BG-13	5/33	36 L	1500 J	305	SB-05-54	378
Naphthalene	0/11	0	0	0		1/32	120 J	120 J	347	SB-05-14	120
Phenanthrene	1/11	51 J	51 J	185	BG-13	3/32	86 J	1800 J	326	SB-05-54	389
Pyrene	1/11	100 J	100 J	189	BG-13	4/32	37 J	2500 J	344	SB-05-54	417
1,1-Dichloroethene	0/19	0	0	0		2/53	2 J	2 J	4.11	SB-05-51	2
2-Butanone	0/19	0	0	0		8/41	2 J	91	8.83	SB-05-05	9.27
2-Hexanone	0/19	0	0	0		2/51	1 J	2 J	5.49	SB-05-29	2
4-Methyl-2-pentanone	0/19	0	0	0		6/52	1 J	4 J	5.26	SB-05-27	4
Acetone	4/19	8 J	12 J	45.7	BG-24	4/20	94	300 J	39.4	SB-05-29	76.7
Benzene	0/19	0	0	0		3/53	2 J	16 J	4.31	SB-05-29	4.84
Carbon Disulfide	0/19	0	0	0		4/53	3 J	13	4.37	SB-05-26	4.91
Ethylbenzene	0/19	0	0	0		2/53	2 J	3 J	4.08	SB-05-29	3
Tetrachloroethene	0/19	0	0	0		1/52	4 J	14	4.15	SB-05-02-DUP	4.65
Toluene	3/19	2 J	2 J	44.6	BG-17	13/53	1 J	15	4.23	SB-05-04	4.89
Vinyl Chloride	0/19	0	0	0		1/53	7 J	7 J	4.18	SB-05-54	4.69
Xylene (Total)	0/19	0	0	0		6/53	1 J	34 J	7.39	SB-05-35	8.17

Notes:

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result.
Mean of all data includes positive detections and non-detected results. Detection limits are divided by two.
The determination of representative concentrations is based on comparison of maximum to the 95 % UCL, which is presented in a separate table.
Frequency of detection refers to number of times compound was detected among all samples versus total number of samples.

00190 D 34 Y



DRAWN BY LDL	DATE 7/7/00	Tetra Tech NUS, Inc.	SUBSURFACE SOIL EXCEEDANCES SAMPLE LOCATION MAP AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		CONTRACT NO. 1412
REVISED BY	DATE		OWNER NO. 6010
SCALE AS NOTED			APPROVED BY Pea DATE 13 Jul 00
			DRAWING NO. FIGURE 4-9 REV.

1412kt04.dwg

Several VOCs were contained in the RI soil boring samples. 1,1-Dichlorothene (1,1-DCE) was detected in one soil boring location at two separate depths in samples SB-05-51 and SB-05-53 at 2 ug/kg. The sample location was located on the northeastern border of trench TR5. 2-Hexanone was detected in two sample locations (SB-05-29 and SB-05-34) at concentrations of 2 and 1 ug/kg respectively. Sample SB-05-29 was located in the northeastern corner of trench TR3 and sample SB-05-34 was on the eastern border of trench TR5. All VOC detections were well below residential RBCs.

4-Methyl-2-Pentanone was detected in six sample locations with concentrations ranging from 1 to 4 ug/kg. These samples were collected in the northeastern section of trench TR3 and the northeastern, southeastern, and central western potions of trench TR5. Acetone was detected in four sample locations SB-05-29, SB-05-40, SB-05-48, and SB-05-49 at concentrations ranging from 94 to 300 ug/kg from the eastern end of trench TR3 and the eastern central portion of trench TR5.

BTEX compounds were contained in boring samples SB-05-29 and SB-05-35 with concentrations ranging from 2 to 24 ug/kg. The boring locations were on the eastern sides of trenches TR3 and TR5 adjacent to Patrol Road. Carbon disulfide was detected in four boring samples ranging from 5 to 13 ug/kg. Three samples (SB-05-26, SB-05-29, and SB-05-49) were located on the eastern border of trench TR3 and the fourth was located in the central portion of trench TR5.

Toluene was detected in 13 boring samples. Concentrations ranged from 1 to 13 ug/kg, orders of magnitude below the residential RBC. Xylene was detected in five borings plus one duplicate sample (SB-05-03, SB-05-04, SB-05-24, SB-05-29, and SB-05-35) ranging in concentrations from 1 to 34 ug/kg. Concentrations were highest in the area of trench TR5 with samples being located in the central and eastern portion of that trench. Two samples (SB-05-29 and SB-05-24) were located on the eastern and western ends of trench TR3. All concentrations were below the residential RBC. Tetrachloroethene (PCE) was contained in one soil boring sample (SB-05-02) at 9 ug/kg (4 ug/kg in SS-05-02 and 14 ug/kg in the duplicate sample) located on the southwestern corner of what appeared to be trench TR3. This level is well below all screening criteria.

Several semivolatile organic compounds (including PAHs, phthalates, and 1,4-dichlorobenzene) were detected in subsurface soil samples. However, only four boring samples contained these compounds (samples SB-05-29, SB-05-21, SB-05-32, and SB-05-51). PAHs were generally contained in those samples adjacent to or just downgradient of paved surfaces at Site 5. This may be an indication that the presence of these compounds is associated with paving materials used in the roadways.

A few phthalates [bis(2-ethylhexyl)phthalate and di-n-butylphthalate] were detected in samples adjacent to or under roadway or asphalt surfaces. The phthalate concentrations ranged from 41 to 170 ug/kg. 1,4-dichlorobenzene was also contained in sample SB-05-51, located on the downgradient side of Patrol Road. These semivolatile organics may be present due to runoff or leaching of asphalt materials.

Pesticides were detected in four subsurface soil samples. All sample locations were adjacent to or under roadway surfaces and may indicate that pesticides are present due to application of storage of materials rather than disposal. Aroclor-1254 was contained in nine samples. Concentrations varied from 22 to 395 ug/kg. Two samples, SB-05-51 and SB-05-14 (see Figure 4-9), contained levels above screening criteria.

Three subsurface soil samples (SB-05-03, SB-05-14, and SB-05-22) at Site 5 were tested for BTEX via Method 8020 as part of Phase II RI work. The results agreed with the TCL results; only toluene, of the BTEX compounds, was detected at 3 ug/kg in sample SB-05-14. The concentration varied only by 1 ug/kg. The BTEX results are presented for comparison only; TCL results were used for the risk assessment.

The same three samples were also analyzed for total petroleum hydrocarbons (TPH) during the Phase II RI. Sample SB-05-14 contained TPH at 430 mg/kg; the other two samples did not exhibit the presence of TPH. These results are presented for comparison only; the risk assessment was performed using the TCL results, in which individual petroleum hydrocarbons were identified and quantified.

4.8 COMPARISON OF SOIL CONCENTRATIONS TO OTHER SCREENING LEVELS

The exposure point concentrations (EPCs) for surface and subsurface soils associated with Site 5 were compared to the generic soil screening levels (SSLs) for the migration to groundwater pathway. The SSLs were selected based on a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface (EPA, 1996a). The SSLs assume that a receptor well is at the edge of a contaminated source, which implies that there is no dilution from recharge downgradient of the site being evaluated. In the case of Site 5, there are no receptor wells within 1,000 feet of the site.

The purpose of the comparison was to identify and screen those hazardous substance concentrations in soil that might have the potential to contaminate groundwater. Table 4-6 shows

OCCURRENCE AND COMPARISON OF SOIL EPCs TO SOIL GROUNDWATER SOIL SCREENING LEVELS FOR SITE 5 SOILS
NAWC WARMINSTER, PENNSYLVANIA

Substance	Maximum Soil Background Level	SSL DAF 20	Site 5*		Detected in On-Base Area B Groundwater (ug/L)
			Surface Soil	Subsurface Soil	
ALUMINUM	18100	--	13200	13400	YES
ANTIMONY	13.6 J	5	4.9	7.94	NO
ARSENIC	12.1 J	29	4.76	3.06	YES
BARIUM	225	1,600	118	217	YES
BERYLLIUM	1.7 J	63	0.991	1.5	YES
CADMIUM	--	8	4.05	5.5	YES
CALCIUM	1910	--	3000	3300	YES
CHROMIUM	35.3 J	38	25.4	32.2	YES
COBALT	22.1	--	10.7	15	YES
COPPER	30.6	--	297	802	NO
CYANIDE	--	40	0.519	1.5	NO
IRON	410500	--	25500	33700	YES
LEAD	96.5 J	400	77.5	72.7	YES
MAGNESIUM	4960	--	3070	4420	YES
MANGANESE	2,010	--	785	937	YES
MERCURY	0.37	--	1.63	0.347	NO
NICKEL	21.7 J	130	21.7	39.3	YES
POTASSIUM	3050	--	1380	2840	YES
SELENIUM	--	5	1.09	0.426	YES
SILVER	--	34	29.2	38.3	NO
SODIUM	86.7	--	269	226	YES
THALLIUM	0.42	0.7	0.82	0.703	NO
VANADIUM	45	6,000	35.3	61.6	NO
ZINC	60	12,000	371	286	NO
1,1-DICHLOROETHENE	--	23,000	--	2	NO
2-BUTANONE	--	--	11.6	9.27	NO
2-HEXANONE	--	--	8.72	2	NO
4-METHYL-2-PENTANONE	--	--	5.84	4	NO
ACETONE	12 J	16,000	95.5	76.7	NO
BENZENE	--	30	2	4.84	YES
CARBON DISULFIDE	--	32,000	1	4.91	YES
CHLOROETHANE	--	1,000	2	--	NO
CHLOROMETHANE	3 J	--	4.53	--	NO
ETHYLBENZENE	--	13,000	3	3	NO
METHYLENE CHLORIDE	--	20	320	--	NO
TETRACHLOROETHENE	--	60	--	4.65	YES
TOLUENE	2 J	12,000	6.5	4.89	NO
TRICHLOROETHENE	--	20	6.19	--	YES
VINYL CHLORIDE	--	10	--	4.69	NO
XYLENES	--	200,000	8.21	8.17	NO
1,4-DICHLOROBENZENE	43 J	2,000	--	220	NO

OCCURRENCE AND COMPARISON OF SOIL EPCs TO SOIL-TO-GROUNDWATER SOIL SCREENING LEVELS FOR SITE 5 SOILS
NAWC WARMINSTER, PENNSYLVANIA

Substance	Maximum Soil Background Level	SSL DAF 20	Site 5*		Detected In On-Base Area B Groundwater (ug/L)
			Surface Soil	Subsurface Soil	
2-METHYLNAPHTHALENE	--	--	160	--	NO
BENZ(A)ANTHRACENE	--	2,000	293	384	NO
BENZO(A)PYRENE	--	8,000	270	375	NO
BENZO(B)FLUORANTHENE	58 J	5,000	120	371	NO
BENZO(G,H,I)PERYLENE	--	--	100	377	NO
BENZO(K)FLUORANTHENE	46 J	49,000	90	--	NO
BIS(2-ETHYLHEXYL)PHTHALATE	50 J	3,600,000	270	180	NO
CHRYSENE	51 J	160,000	301	403	NO
DIBENZ(A,H)ANTHRACENE	--	2,000	40	--	NO
DI-N-BUTYL PHTHALATE	--	2,300,000	48	57	NO
FLUORANTHENE	92 J	4,300,000	170	378	NO
INDENO(1,2,3-CD)PYRENE	--	14,000	60	--	NO
NAPHTHALENE	--	84,000	47	120	NO
PHENANTHRENE	51 J	--	120	389	NO
PYRENE	100 J	4,200,000	290	417	NO
4,4'-DDD	16 J	16,000	5.1	19.4	NO
4,4'-DDE	820	54,000	3.8	11.1	NO
4,4'-DDT	1440 J	32,000	3.6	13.3	NO
ALPHA-CHLORDANE	--	10,000	1.59	1.85	NO
AROCLOR-1242	--	1,000	32.9	32.7	NO
AROCLOR-1248	--	1,000	--	34	NO
AROCLOR-1254	51	1,000	312	63	NO
BETA-BHC	--	--	1.48	1.57	NO
DIELDRIN	--	4	3.36	3.24	NO
ENDOSULFAN SULFATE	--	--	2.97	3.72	NO
ENDRIN	--	1,000	6.57	--	NO
ENDRIN ALDEHYDE	--	--	3	--	NO
GAMMA-CHLORDANE	--	10,000	1.53	1.85	NO
METHOXYCHLOR	--	160,000	--	17.2	NO

Notes:
* - Exposure point concentrations (EPCs).
Units are mg/kg for inorganics, ug/kg for organics.
Shaded blocks indicate EPC values > SSL and > maximum soil background level.
Reference: EPA, Soil Screening Technical Guidance Document, Appendix A, Table A-1 (assuming DAF = 20). May 1996.
References: RI Report for Area B Groundwater, Tetra Tech NUS. April 2000.
Summary Report for Area B Groundwater Monitoring, Tetra Tech NUS. December 1999

the results of the comparison. If the EPC for a particular medium was greater than the SSL, and if the value for an inorganic substance was greater than the maximum soil background level, the analytical database for that medium was evaluated to identify specific sample concentrations that were greater than the respective SSL. This approach does not necessarily identify all SSL exceedances for Site 5 soils because the EPC value for a specific contaminant may not be greater than the SSL. However, the EPC was assumed to be the most representative contaminant level at the soil-to-groundwater interface, after accounting for fate and transport processes that might attenuate, biodegrade, or otherwise retard the mobility of soil contaminants migrating through the unsaturated zone.

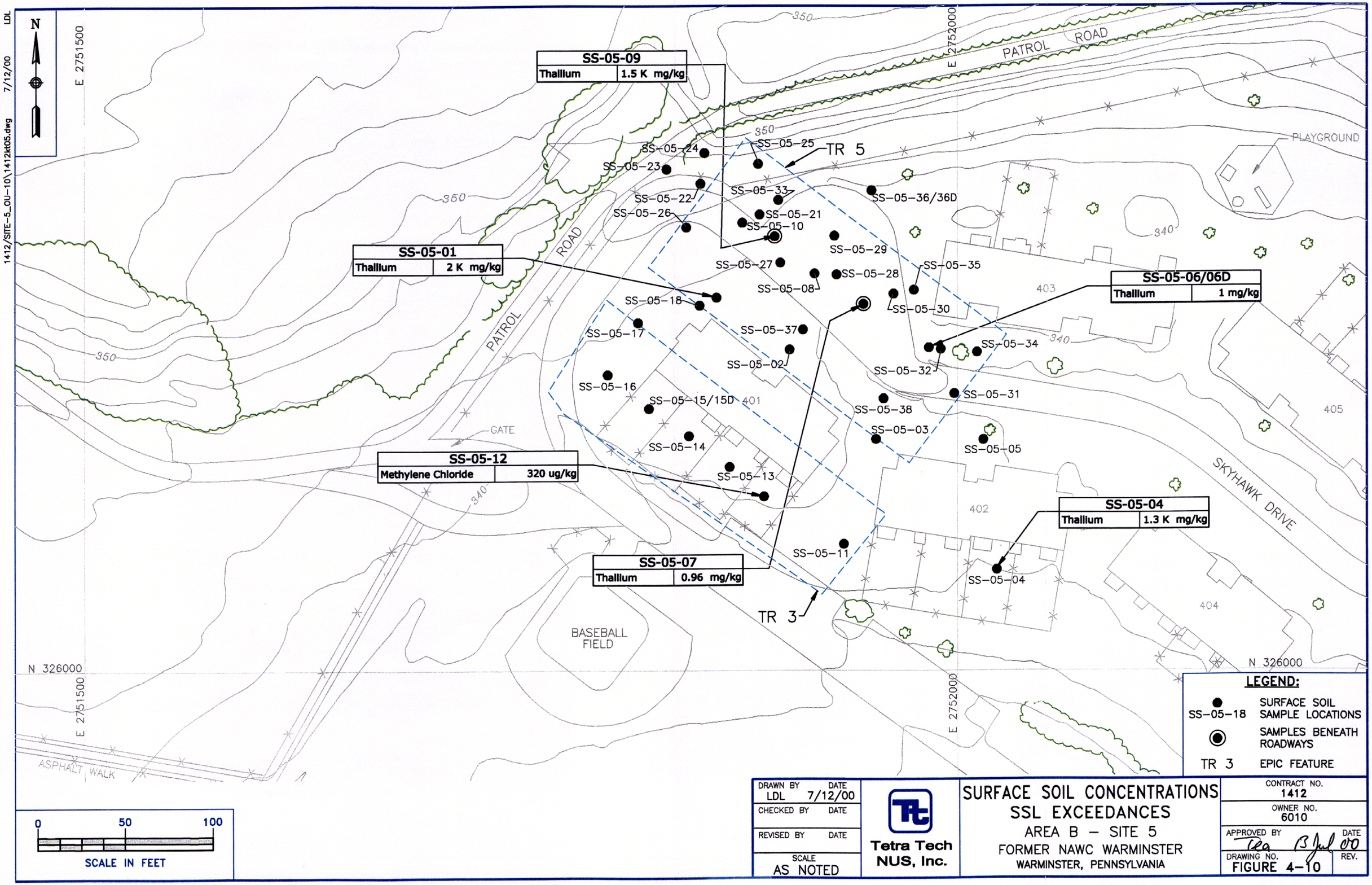
The SSLs for thallium and methylene chloride were exceeded for Site 5 surface soil EPCs (Figure 4-10). Thallium was detected in several surface soil samples above the SSL of 0.7 mg/kg. The maximum background concentration for thallium was 0.42 mg/kg which is near the SSL for this contaminant. The range of thallium detections varied from 0.47 to 2.0 mg/kg. Methylene chloride was not present in the background samples, but it was detected in one surface soil sample (SS-05-12). The value detected was 320 ug/kg, which is above the SSL of 20 ug/kg for methylene chloride. The evaluation of Area B groundwater sampling results did not identify these contaminants as contaminants of concern (TtNUS, 2000a). It should also be noted, as indicated in Section 4.6, that methylene chloride is a common laboratory contaminant.

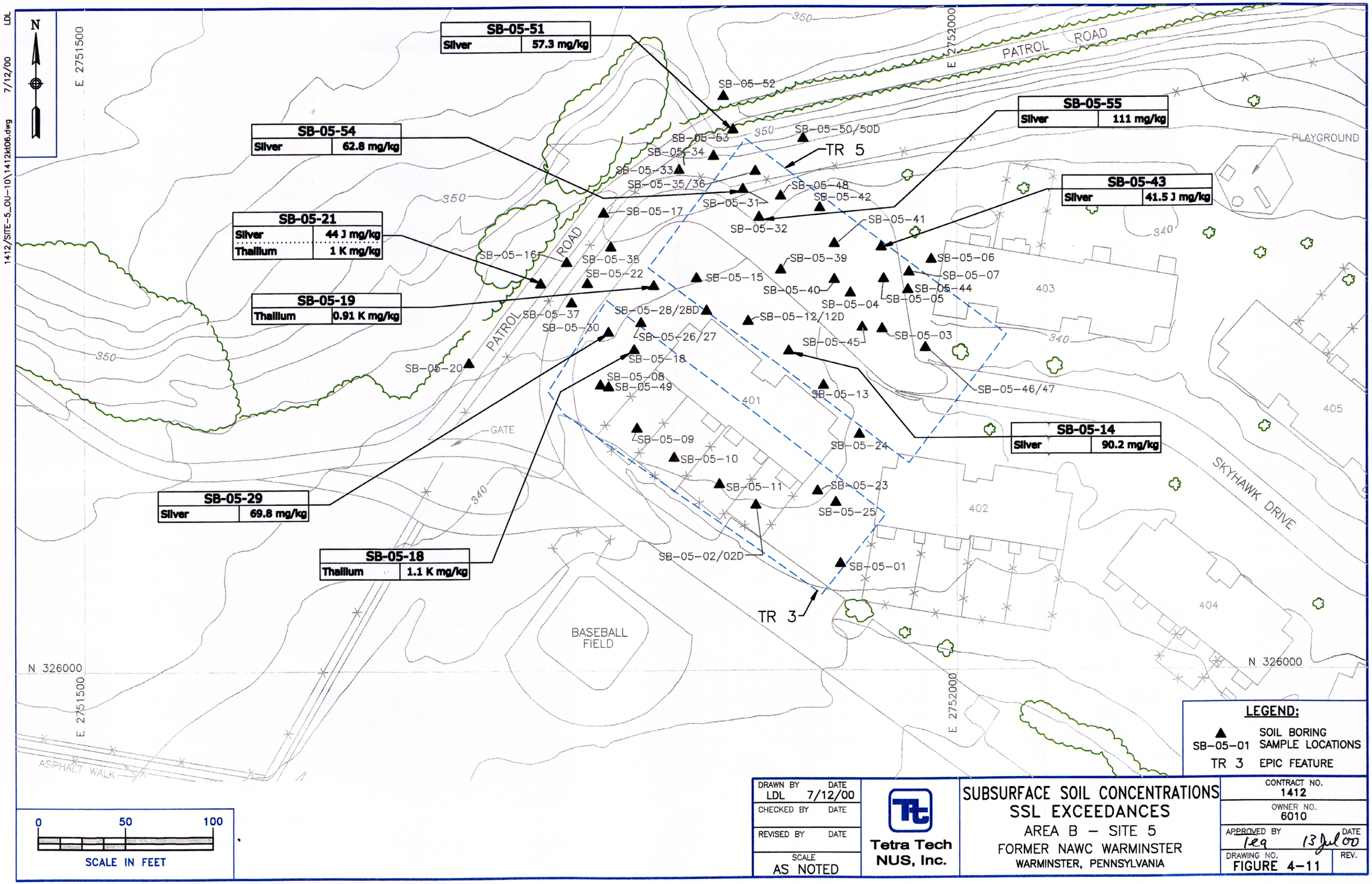
The SSLs for silver and thallium were exceeded for Site 5 subsurface soil EPCs (Figure 4-11). Neither of these contaminants were identified at levels of concern in Area B groundwater (TtNUS, 2000a). No organic contaminant SSLs were exceeded for the subsurface soil samples. Silver was detected in several subsurface soil samples above the SSL of 34 mg/kg. Silver was not detected in the background samples. The range of silver detections varied from 44 to 111 mg/kg. Thallium was detected in several subsurface soil samples above the SSL of 0.7 mg/kg. The maximum background concentration for thallium was 0.42 mg/kg which is near the SSL for this contaminant. The range of thallium detections varied from 0.45 to 1.1 mg/kg. Note that silver and thallium have not been detected in Area B groundwater (Tetra Tech NUS, 2000a).

4.9 SURFACE WATER RESULTS

The Area B surface water sample locations are shown on Figure 4-12. During Phase I, two surface water samples (B9 and B12) were collected in Area B; the Phase II surface water samples (B10 and B11) were collected in approximately the same locations as Phase I samples. During Phase III, three surface water samples (B1, B2, and B4) were taken. The designated background surface water samples were collected in Southampton Creek (samples B4, B9, and

00190 0B35 Y


N
E 2751500
E 2752000
N 326000
PATROL ROAD
PLAYGROUND
SKYHAWK DRIVE
BASEBALL FIELD
ASPHALT WALK
GATE
TR 5
TR 3
SS-05-09
Thallium 1.5 K mg/kg
SS-05-01
Thallium 2 K mg/kg
SS-05-12
Methylene Chloride 320 ug/kg
SS-05-07
Thallium 0.96 mg/kg
SS-05-06/06D
Thallium 1 mg/kg
SS-05-04
Thallium 1.3 K mg/kg
SS-05-24
SS-05-25
SS-05-23
SS-05-22
SS-05-26
SS-05-33
SS-05-36/36D
SS-05-21
SS-05-10
SS-05-29
SS-05-27
SS-05-28
SS-05-35
SS-05-08
SS-05-18
SS-05-30
SS-05-17
SS-05-37
SS-05-34
SS-05-02
SS-05-32
SS-05-16
SS-05-15/15D
SS-05-31
SS-05-38
SS-05-03
SS-05-14
SS-05-05
SS-05-13
SS-05-11
SS-05-04
350
340
403
401
405
402
404
LEGEND:
SS-05-18 SURFACE SOIL SAMPLE LOCATIONS
SAMPLES BENEATH ROADWAYS
TR 3 EPIC FEATURE
0 50 100
SCALE IN FEET
DRAWN BY LDL DATE 7/12/00
CHECKED BY DATE
REVISED BY DATE
SCALE AS NOTED
Tetra Tech NUS, Inc.
SURFACE SOIL CONCENTRATIONS
SSL EXCEEDANCES
AREA B – SITE 5
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA
CONTRACT NO. 1412
OWNER NO. 6010
APPROVED BY DATE
DRAWING NO. FIGURE 4-10
REV.
1412/SITE-5_OU-10\1412kt05.dwg
LDL 7/12/00
1412kt05.dwg



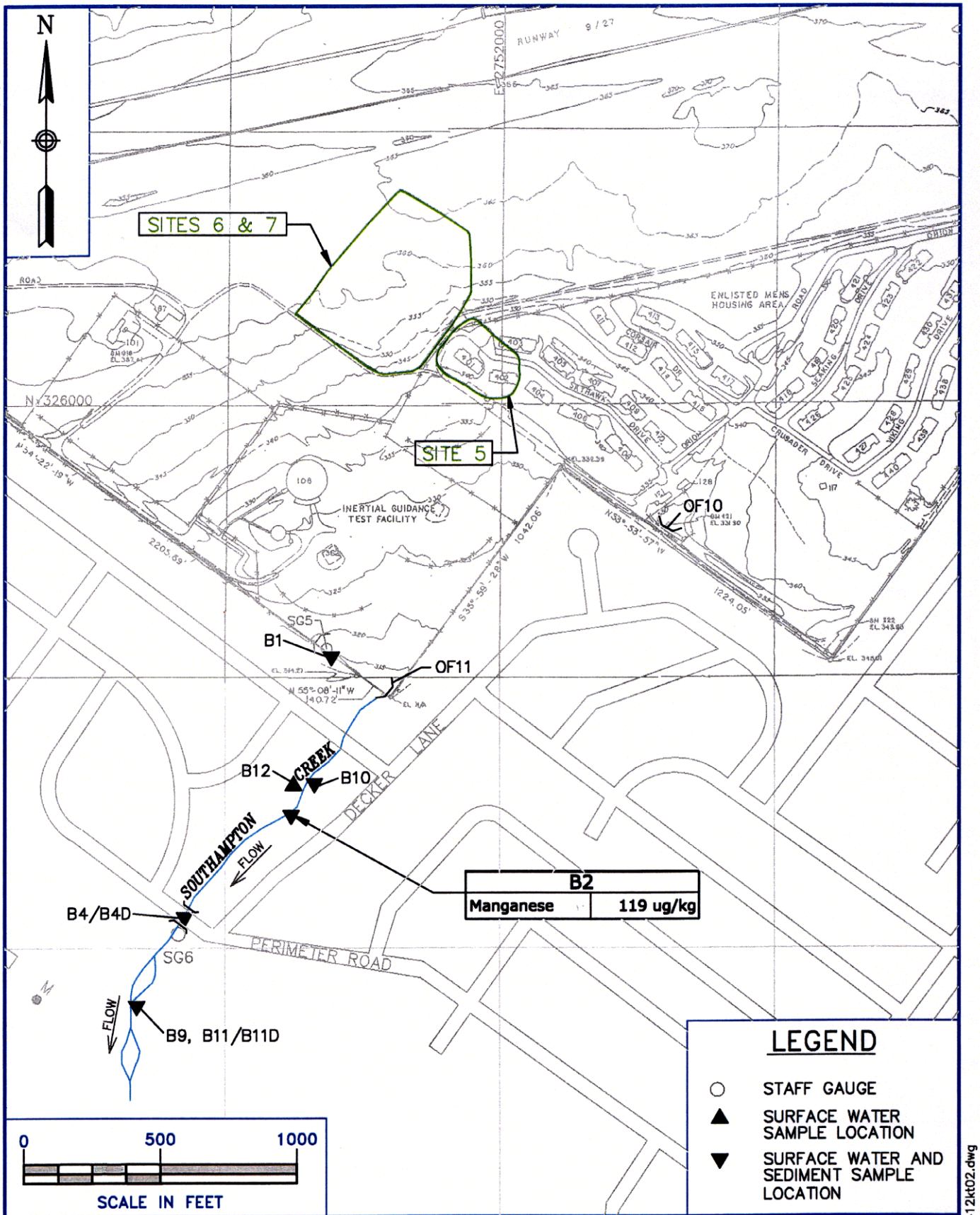
LEGEND:

▲ SB-05-01	SOIL BORING SAMPLE LOCATIONS
TR 3	EPIC FEATURE

DRAWN BY LDL	DATE 7/12/00	Tetra Tech NUS, Inc.	SUBSURFACE SOIL CONCENTRATIONS SSL EXCEEDANCES AREA B – SITE 5 FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA
CHECKED BY	DATE		CONTRACT NO. 1412
REVISED BY	DATE		OWNER NO. 6010
SCALE AS NOTED			APPROVED BY leg DATE 13 Jul 00
			DRAWING NO. FIGURE 4-11 REV.

LDL 7/12/00 1412/SITE-5_OU-10\1412kt06.dwg

1412kt06.dwg



DRAWN BY LDL	DATE 7/7/00	Tetra Tech NUS, Inc.	SURFACE WATER EXCEEDANCES AREA B STREAM FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 1412
CHECKED BY	DATE			OWNER NO. 6010
REVISED BY	DATE			APPROVED BY lea DATE 13 Jul 00
SCALE AS NOTED				DRAWING NO. FIGURE 4-12 REV.

1412/SITE5_OU-10\1412kt02.dwg 7/7/00 ldl

1412/SITE5_OU-10\1412kt02.dwg

B11), which were south of Area B. These three background samples showed lower chemical concentrations than all other Area B samples. All other samples collected near Area B were considered to be impacted by NAWC Warminster with B2 considered the farthest downstream sample. No "true" upstream samples could be collected in the vicinity of Area B.

Table 4-7 presents the occurrence and distribution of organics in surface water samples collected immediately downstream of the Navy property. Two VOCs were detected at low levels in the background Area B surface water samples (see Section 2.2.4.1). Chloroform (12 ug/l) was detected in sample B9 and carbon disulfide (2J ug/l) was found in sample B4. VOCs were not detected in any other Area B surface water samples. Two semivolatile organics at low concentrations were detected among the Area B surface water samples. Diethyl phthalate (0.2J ug/l) was found in background sample B9 and bis(2-ethylhexyl) phthalate (1J ug/l) was detected in sample B10. As shown in Figure 4-12, sample B10 was located potentially downstream of Area B. Pesticides and PCBs were not detected in surface water.

Tables 4-8 and 4-9 present the occurrence and distribution of total and dissolved inorganics in background and site-related surface water samples at Area B. Generally, low total metal concentrations were detected in all Area B surface water samples. Barium, manganese, and zinc were the only significant metals found in the background samples. Background or reference samples contained equal concentrations of barium, manganese and zinc as compared to other Area B samples. Barium (ranging from 80.9 to 94 ug/l), manganese (55 to 119 ug/l), nickel (20 ug/l), thallium (4.9 ug/l), and zinc (ranging from 9 to 27.6 ug/l) were the only metals detected in potentially site-related surface water samples. In all downstream samples, barium concentrations were equal to or higher than concentrations detected in background samples. In samples B2 and B4, zinc was detected at higher concentrations downstream than in background samples. Nickel (sample B10) and thallium (sample B2) were each detected once in downstream surface water samples; these analytes were not found in the background samples.

Low concentrations of dissolved metals were also found in all surface water samples. Antimony, barium, manganese, thallium and zinc were the only metals detected in the background samples, while barium, manganese, mercury, thallium, and zinc were the only metals detected in the downstream samples. Mercury was detected in one sample (B2) and was not detected in background samples.

Figure 4-12 details those surface water sample locations where contaminant concentrations exceeded one of the federal Ambient Water Quality Criteria (AWQC) for surface water as shown on the analytical summary tables contained in Appendix A. In summary, VOCs in Area B surface

TABLE 4-7

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE WATER AT AREA B

NAWC WARMINSTER, PENNSYLVANIA

(ug/L)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BIS(2-ETHYLHEXYL)PHTHALAT	-	1 / 2	1	NONPARAMETRIC DIST	1

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 4-8

OCCURRENCE AND DISTRIBUTION OF TOTAL INORGANICS IN SURFACE WATER AT AREA B

NAWC WARMINSTER, PENNSYLVANIA

(ug/L)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BARIUM	100	3 / 4	80.9 - 94.2	NORMAL OVER LOGNORMAL	94.2
CALCIUM	28100	3 / 3	21800 - 24300	NONPARAMETRIC DIST	24300
IRON	895	1 / 1	388	NONPARAMETRIC DIST	388
MAGNESIUM	11150	3 / 3	8270 - 9090	NONPARAMETRIC DIST	9090
MANGANESE	154	3 / 3	55 - 119	NONPARAMETRIC DIST	119
NICKEL	-	1 / 4	20	NORMAL	17.5
POTASSIUM	1545	3 / 3	910 - 1180	NONPARAMETRIC DIST	1180
SODIUM	16150	3 / 3	9760 - 13600	NONPARAMETRIC DIST	13600
THALLIUM	-	1 / 4	4.9	NORMAL	4.3
ZINC	30.60	2 / 2	9 - 27.6	NONPARAMETRIC DIST	27.6

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 4-9

OCCURRENCE AND DISTRIBUTION OF DISSOLVED INORGANICS IN SURFACE WATER AT AREA B

NAWC WARMINSTER, PENNSYLVANIA

(ug/L)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BARIUM	85.2	3 / 3	88.3 - 94.7	NONPARAMETRIC DIST	94.7
CALCIUM	26800	3 / 3	23000 - 26000	NONPARAMETRIC DIST	26000
MAGNESIUM	9845	3 / 3	8550 - 9660	NONPARAMETRIC DIST	9660
MANGANESE	132	2 / 2	49 - 123	NONPARAMETRIC DIST	123
MERCURY	-	1 / 3	0.2	NONPARAMETRIC DIST	0.2
POTASSIUM	1350	2 / 2	1150 - 1200	NONPARAMETRIC DIST	1200
SODIUM	13700	3 / 3	11200 - 13400	NONPARAMETRIC DIST	13400
THALLIUM	3.3	1 / 3	3.4	NONPARAMETRIC DIST	3.4
ZINC	12.50	2 / 2	5.8 - 18.8	NONPARAMETRIC DIST	18.80

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

water do not appear to be a concern near Area B because of the low frequency of detection and the low concentrations of three VOCs. One phthalate was detected in an Area B surface water sample at a concentration greater than background. For metals, it appears that downstream surface water concentrations were equal to or slightly greater than background surface water levels. However, none of the metal concentrations were significantly elevated. The presence of a well-developed urban neighborhood in the vicinity of Area B may be contributing to surface water quality to the extent that the impact of Area B cannot be assessed. Possible sources of surface water contamination in this area include runoff from roads, sidewalks, roofs, and the use of household lawn and garden products.

4.10 SEDIMENT RESULTS

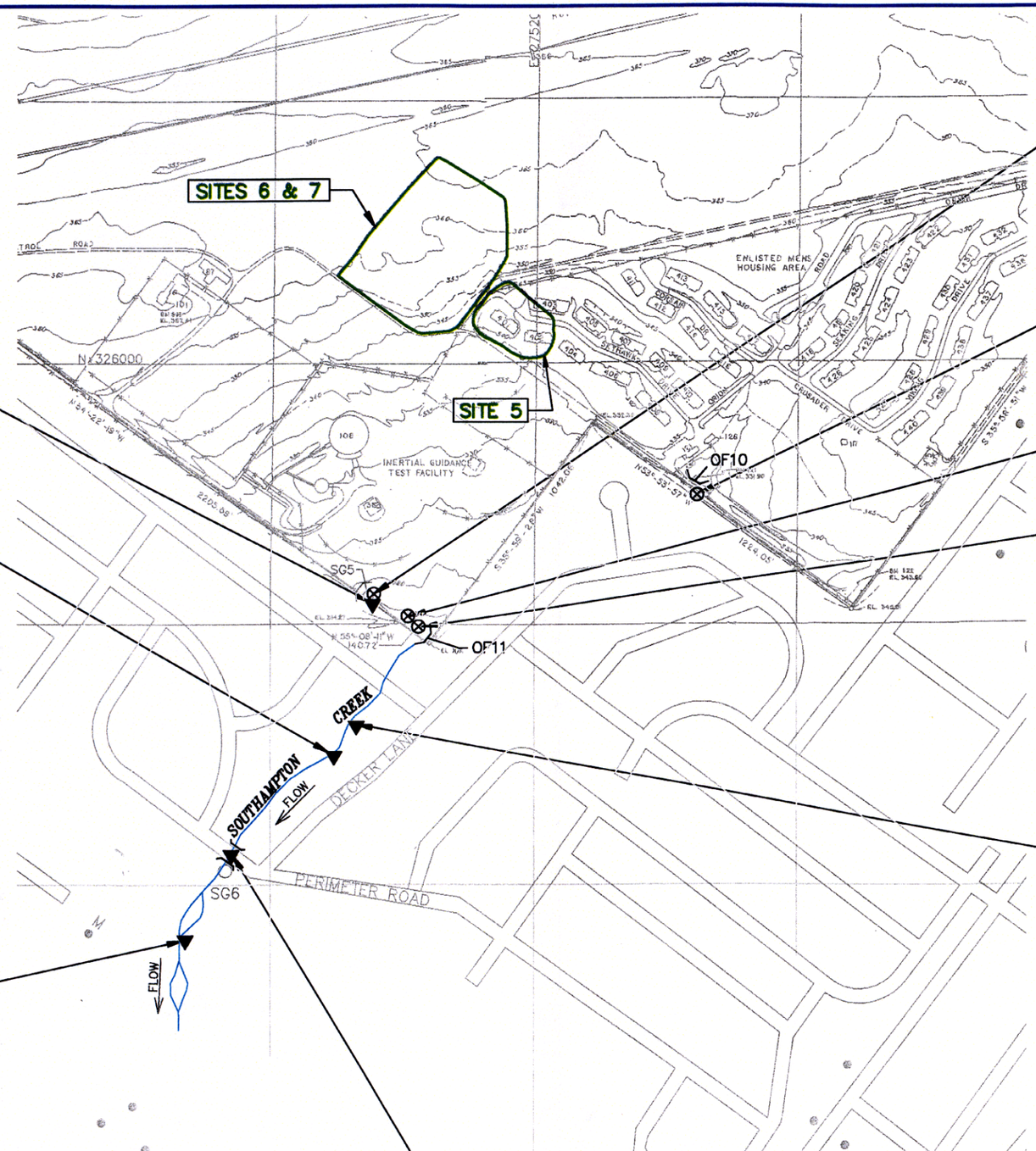
Sediment sample locations near Area B are shown on Figure 4-13. During Phase I, one sediment sample (B9) was collected; during Phase II, two sediment samples (B10, B11) were taken. Sample B11 was collected from the same location as Phase I sample B9. During Phase III, four sediment samples (B1 through B4) were taken in January 1996, while three sediment samples (B6, B7, and B8) were collected in May 1996. The designated background sediment samples (B4, B9, and B11) were collected from Southampton Creek downstream from Area B. All other Area B samples were considered to be potentially impacted by NAWC Warminster with sample B2 the farthest downstream sediment sample collected. No "true" upstream samples could be collected in the vicinity of Area B.

Table 4-10 presents the occurrence and distribution of organics in Area B sediment samples. Acetone (670J ug/kg) was the only VOC detected in any Area B sediment sample (B9). Acetone may be a common laboratory contaminant. Several semivolatile organics, primarily PAHs and phthalates, were detected in the Area B sediment samples, with generally the same compounds detected in samples B1, B9, B10, and B11. In downstream sediment samples, PAHs (ranging from 96J to 17,000J ug/kg), phthalates (ranging from 91.5J to 18,000 ug/kg), 4-methylphenol, and n-nitrosodiphenylamine were all detected. Generally, sample B10 had the highest PAH and phthalate concentrations and both methylphenol (560J ug/kg) and n-nitrosodiphenylamine (1,700J ug/kg) were detected in this sample. Sample B10 generally contained phthalate and PAH concentrations four times higher than background concentrations detected in samples B9 and B11.

Sediment sample B1 generally showed PAH and phthalate levels comparable to background levels. PAH concentrations ranging from 65J to 1,200 ug/kg were found in this sample. Three

001900 36Y

EEH 7/21/00 1412/SITE-5_OU-10/1412kt07.dwg



N

B1	
Aroclor-1260	1900 ug/kg
Anthracene	200 J ug/kg
Benzo(a)anthracene	530 ug/kg
Benzo(a)pyrene	450 ug.kg
Butylethylphthalate	120 J ug/kg
Chrysene	550 ug/kg
Fluorene	65 J ug/kg
Fluoranthene	1100 J ug/kg
Pyrene	430 J ug/kg
Cadmium	1.3 K mg/kg
Copper	59.5 K mg/kg

B2	
Copper	41.3 K mg/kg
Lead	168 mg/kg
Manganese	628 K mg/kg
Zinc	486 J mg/kg

B8	
DDE	9 J ug/kg
Aroclor-1260	580 J ug/kg

B3	
Cadmium	1.9 K mg/kg
Lead	66.1 J mg/kg

B7	
Aroclor-1260	380 J ug/kg

B6	
Aroclor-1260	270 J ug/kg

B10	
Acenaphthene	470 J ug/kg
Anthracene	1400 J ug/kg
Benzo(a)anthracene	5200 ug/kg
Benzo(a)pyrene	4400 ug.kg
Benzo(b)fluoranthene	7100 ug/kg
Benzo(g,h,i)perylene	2000 J ug/kg
Bis(2-ethylhexyl)phthalate	18000 ug/kg
DDE	24 J ug/kg
DDT	430 J ug/kg
Fluoranthene	17000 J ug/kg
Fluorene	600 J ug/kg
Indeno(1,2,3-cd)pyrene	2400 J ug/kg
Pyrene	9900 J ug/kg
Chrysene	5600 J ug/kg
Dieldrin	13 J ug/kg
Alpha-chlordane	15 J ug/kg
N-Nitrosodiphenylamine	1700 J ug/kg
Zinc	262 mg/kg

B9	
Acenaphthene	110 J ug/kg
Anthracene	330 J ug/kg
Benzo(a)anthracene	1300 J ug/kg
Benzo(a)pyrene	880 J ug/kg
Benzo(g,h,i)perylene	720 J ug/kg
Bis(2-ethylhexyl)phthalate	1900 J ug/kg
Chrysene	1500 J ug/kg
Fluoranthene	3400 J ug/kg
Fluorene	190 J ug/kg
Indeno(1,2,3-cd)pyrene	600 J ug/kg
Pyrene	2900 J ug/kg

B11/B11D	
Acenaphthene	100 J ug/kg
Anthracene	253 J ug/kg
Fluoranthene	1630 J ug/kg
Fluorene	160 J ug/kg
Benzo(a)anthracene	580 J ug/kg
Benzo(a)pyrene	490 J ug/kg
Chrysene	588 J ug/kg
Pyrene	1380 J ug/kg

B4/B4D	
Cadmium	1.4 K mg/kg

LEGEND

- ⊗ SEDIMENT SAMPLE LOCATION
- ○ STAFF GAUGE
- ▼ SURFACE WATER AND SEDIMENT SAMPLE LOCATION

0 500 1000
SCALE IN FEET

DRAWN BY LDL/EEH	DATE 7/21/00	
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE AS NOTED		

Tetra Tech NUS, Inc.

SEDIMENT EXCEEDANCES

AREA B STREAM

FORMER NAWC WARMINSTER

WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412

OWNER NO. 5010

APPROVED BY Pa DATE 29 Jul 00

DRAWING NO. FIGURE 4-13 REV.

1412kt07.dwg

TABLE 4-10

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT AREA B

NAWC WARMINSTER, PENNSYLVANIA

(ug/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
4,4'-DDE	-	2 / 5	9 - 24	NONPARAMETRIC DIST	24
4,4'-DDT	-	1 / 5	430	NORMAL OVER LOGNORMAL	270.55
ALDRIN	-	3 / 5	3.6 - 4.7	NONPARAMETRIC DIST	4.7
ALPHA-CHLORDANE	5.85	1 / 5	15	NORMAL OVER LOGNORMAL	10.03
AROCLOR-1260	-	4 / 5	270 - 1900	NONPARAMETRIC DIST	1900
DELTA-BHC	-	1 / 5	4	NONPARAMETRIC DIST	4.00
DIELDRIN	-	1 / 5	13	NORMAL	9.41
METHOXYCHLOR	-	1 / 5	79	NORMAL	55.91
4-METHYLPHENOL	-	2 / 2	450 - 560	NONPARAMETRIC DIST	560
ACENAPHTHENE	110	1 / 2	470	NONPARAMETRIC DIST	470
ANTHRACENE	330	2 / 2	200 - 1400	NONPARAMETRIC DIST	1400
BENZ(A)ANTHRACENE	1300	2 / 2	530 - 5200	NONPARAMETRIC DIST	5200
BENZO(A)PYRENE	880	2 / 2	450 - 4400	NONPARAMETRIC DIST	4400
BENZO(B)FLUORANTHENE	1300	2 / 2	690 - 7100	NONPARAMETRIC DIST	7100
BENZO(G,H,I)PERYLENE	720	2 / 2	390 - 2000	NONPARAMETRIC DIST	2000
BENZO(K)FLUORANTHENE	1000	2 / 2	250 - 2100	NONPARAMETRIC DIST	2100
BIS(2-ETHYLHEXYL)PHTHALAT	1900	2 / 2	580 - 18000	NONPARAMETRIC DIST	18000
BUTYLBENZYLPHTHALATE	-	1 / 2	120	NONPARAMETRIC DIST	120
CARBAZOLE	287.5	2 / 2	120 - 1100	NONPARAMETRIC DIST	1100
CHRYSENE	1500	2 / 2	550 - 5600	NONPARAMETRIC DIST	5600
DI-N-BUTYLPHTHALATE	-	1 / 2	5100	NONPARAMETRIC DIST	5100
DI-N-OCTYLPHTHALATE	-	1 / 2	79	NONPARAMETRIC DIST	79
DIBENZ(A,H)ANTHRACENE	96	1 / 2	55	NONPARAMETRIC DIST	55
FLUORANTHENE	3400	2 / 2	1200 - 17000	NONPARAMETRIC DIST	17000
FLUORENE	190	2 / 2	65 - 600	NONPARAMETRIC DIST	600
INDENO(1,2,3-CD)PYRENE	600	2 / 2	320 - 2400	NONPARAMETRIC DIST	2400
N-NITROSODIPHENYLAMINE	-	1 / 2	1700	NONPARAMETRIC DIST	1700
PYRENE	2900	2 / 2	1200 - 9900	NONPARAMETRIC DIST	9900

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

phthalates, di-n-octyl-, bis(2-ethylhexyl)-, and butylbenzyl-, were detected in sample B1 ranging from 79J to 580 ug/kg.

Several pesticides, including dieldrin, 4,4'-DDE, 4,4'-DDT, methoxychlor, and alpha-chlordane were detected in sample B10; concentrations ranged from 13J to 430J ug/kg. Alpha-chlordane (5.85J ug/kg) was also detected in background sample B11. Pesticides were not detected in any other Area B sediment sample.

Aroclor-1260 (1,900 ug/kg) was detected in sample B1. Based on this detection, three additional samples (B6, B7, and B8) were collected between B1 and Outfall No. 11 and tested for PCBs. The results showed a decline in Aroclor-1260 concentrations along the drainage pathway, ranging from 580J ug/kg (sample B8) to 270J ug/kg (sample B6). No other PCBs were detected in the remaining Area B sediment samples.

Table 4-11 presents the occurrence and distribution of inorganics in Area B sediment samples. Metals were present in all downstream Area B samples. In general, all the metals detected in Area B sediment appear to be in the same range regardless of whether the sample was collected background or downstream, with the exception of sample B9. Samples B1 and B3 contained concentrations of arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, vanadium, and zinc. In addition, sample B1 showed levels of cobalt and thallium. Metal concentrations in background sediment samples were generally contained the same metals as the other Area B samples but at lower concentrations.

Figure 4-13 details those sediment sample locations where contaminant concentrations exceeded one of the screening criteria (primarily the effects range low (ER-L) values for sediment as shown on the analytical summary tables contained in Appendix A. Semivolatile organic compounds, including both PAHs and phthalates, and several pesticides were detected at higher concentrations upstream than downstream in Area B. Only one pesticide (alpha-chlordane) was contained in any downstream sediment sample.

For metals, it appears that downstream sediment sample concentrations were equal to or slightly higher than upstream sediment concentrations. Regardless, the presence of a well-developed urban neighborhood in the vicinity of Area B may be contributing to the nature of sediment contamination such that the impact of Area B cannot be assessed. Possible sources of contamination in this area include runoff from roads, sidewalks, roofs, and the use of household lawn and garden products.

TABLE 4-11

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT AREA B

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
ALUMINUM	5805	4 / 4	4770 - 8090	NORMAL OVER LOGNORMAL	7560
ARSENIC	3.7	4 / 4	3.3 - 3.6	NONPARAMETRIC DIST	3.60
BARIUM	53.8	4 / 4	45.6 - 68.5	NONPARAMETRIC DIST	68.5
BERYLLIUM	0.7	4 / 4	0.63 - 0.88	NONPARAMETRIC DIST	0.88
CADMIUM	1.4	2 / 2	1.3 - 1.9	NONPARAMETRIC DIST	1.9
CALCIUM	8300	4 / 4	1270 - 3490	NONPARAMETRIC DIST	3490
CHROMIUM	16.6	4 / 4	9.3 - 18.3	NONPARAMETRIC DIST	18.3
COBALT	7.2	3 / 3	5.4 - 7.6	NONPARAMETRIC DIST	7.6
COPPER	18.4	4 / 4	20.6 - 59.5	NONPARAMETRIC DIST	59.5
IRON	15800	4 / 4	10900 - 21300	NONPARAMETRIC DIST	21300
LEAD	27.8	4 / 4	38.7 - 168	NONPARAMETRIC DIST	168
MAGNESIUM	5165	4 / 4	1750 - 2640	NONPARAMETRIC DIST	2640
MANGANESE	284	4 / 4	135 - 628	NORMAL	554.78
NICKEL	14.2	4 / 4	8.6 - 16.8	NONPARAMETRIC DIST	16.8
POTASSIUM	1325	4 / 4	397 - 767	NONPARAMETRIC DIST	767
SILVER	-	1 / 2	0.71	NONPARAMETRIC DIST	0.71
THALLIUM	-	1 / 4	0.96	NONPARAMETRIC DIST	0.96
VANADIUM	25.4	4 / 4	13.6 - 22.7	NONPARAMETRIC DIST	22.7
ZINC	129	4 / 4	111 - 486	NONPARAMETRIC DIST	486

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

4.11 SUMMARY AND CONCLUSIONS

Three inorganics (copper, vanadium, and lead) and two organics (Aroclor-1254 and benzo(a)pyrene) were identified in surface soils at concentrations above residential RBCs (Figure 4-8). The occurrence and distribution of these contaminants appears to be disperse and at relatively low-levels with the exception of Aroclor-1254, which was detected in three samples located in the central portion of trench TR5.

Similarly, subsurface samples contained few contaminants at levels above residential RBCs (Figure 4-9). Like the surface soil samples, copper, lead, and vanadium were identified in at least one sample at levels above residential RBCs. Arsenic was also identified in one sample at levels greater than the residential RBC. The presence of these contaminants does not appear to be widespread. Aroclor-1254 was identified in two subsurface samples at levels slightly above the residential RBC in two different areas of the site. PAHs, identified in only one sample, were the only other organic contaminant identified at levels above the residential RBC.

Based on soil sampling results, a comparison to groundwater protection criteria, and groundwater monitoring results, Site 5 does not appear to be a source or a potential source of groundwater contamination.

VOCs in surface water and sediments do not appear to be a concern for the Area B stream because of the low frequency of detections of three VOCs. Semivolatile organic compounds were detected in upstream and downstream Area B sediment samples and two phthalates were detected in downstream Area B surface water samples. The semivolatile organic compounds, including both PAHs and phthalates, were detected at higher concentrations downstream than upstream in Area B. While Site 5 may be contributing to this contamination in Area B, it is possible that a contribution of the PAHs and phthalates detected in Area B are originating upstream of the Area.

Several pesticides were detected in downstream Area B sediment samples. No pesticides were detected in any upstream sediment samples, therefore, pesticide contamination is probably originating in the vicinity of Area B, but not necessarily from Sites 5, 6, and 7. For metals, it appears that the downstream sample concentrations for surface water and sediment were equal to or slightly higher than upstream surface water and sediment sample concentrations. It is possible that the slightly elevated metals detected downstream in surface water are attributable to Area B sites.

The PCB Aroclor-1260 was contained in sediment samples along the drainage pathway emanating from Building 108. These levels decreased downstream of the storm drain discharge point and appear to be localized along a 250-foot stretch.

5.0 CONTAMINANT FATE AND TRANSPORT

Various aspects of contaminant fate and transport at Site 5 and Area B in general are discussed in this section. Various chemical and physical properties affecting contaminant migration are discussed in Section 5.1. Potential contaminant migration routes are identified and discussed in Section 5.2. Section 5.3 presents a brief discussion of contaminant persistence.

5.1 PHYSICAL AND CHEMICAL TRANSPORT PROPERTIES

This section provides a qualitative discussion of potential migration of the contaminants found in the vicinity of Site 5. The physical and chemical properties of these chemicals, where available, are presented in Table 5-1. These parameters may be used to evaluate the behavior of a chemical in the environment and assess exposures in the risk assessment.

Empirically determined literature values of water solubility, octanol-water partition coefficient (Kow), Koc, vapor pressure, Henry's Law constant, bioconcentration factor (BCF), and specific gravity are presented for organic chemicals, as available. Many of these parameters are not applicable to inorganic chemicals. For inorganics, specific gravity and BCFs have been presented, along with qualitative descriptions of important environmental fate properties. Calculated values, which were obtained using approximation methods, are presented when literature values are unavailable. A discussion of the environmental significance of each of these parameters follows.

5.1.1 Solubility

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is a function of its water solubility. More soluble chemicals are expected to enter water much more readily and rapidly than less soluble chemicals. The water solubilities presented in Table 5-1 indicate that the VOCs are several orders of magnitude more water soluble than semivolatile organic compounds (SVOCs) (including phthalates and PAHs) or PCBs. This conclusion is reinforced by the fact that VOCs were discovered more frequently and at greater concentrations in groundwater than less soluble chemicals. (Volatilization of VOCs from surface media is also an important factor in the observed distribution of these chemicals.)

Although PAHs and PCBs were detected in soil in this study area, such compounds have not been detected in groundwater. This is a manifestation of their limited water solubility and tendency to adsorb onto soil/sediment particles.

TABLE 5-1
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR SITE 5 CONTAMINANTS
NAWC WARMINSTER, PENNSYLVANIA

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	Bioconcentration Factor
Semivolatiles								
4-methylphenol	108.14	4400	1.92	4.00E-03	1.29E-06	1.0347	3.19	11
acenaphthene	154.21	3.42 (25C)	3.92	1.55E-03 (25C)	9.10E-05	1.0242	4.60E+03	
anthracene	178.22	0.045 (25C)	4.45	1.7E-05 (25C)	8.60E-05	1.283	1.40E+04	
benz(a)anthracene	228.28	0.0057	5.61	2.20E-08	1.00E-06	-	2.00E+05	
benzo(a)pyrene	252.30	0.0038 (25C)	5.98	5.60E-09	4.90E-07	-	5.50E+06	
benzo(b)fluoranthene	252.30	0.0014 (25C)	6.57	5.00E-07	1.22E-05	-	5.50E+05	
benzo(g,h,i)perylene	276.00	0.00026 (25C)	7.23	1.1E-10 (25C)	1.44E-07	-	1.60E+06	
benzo(k)fluoranthene	252.30	0.043 (25C)	6.84	5.00E-07	3.87E-05	-	5.50E+05	
bis(2-ethylhexyl)phthalate	390.62	0.4	5.61	6.46E-06	3.00E-07	0.99	2.00E+09	2.30E+08
butylbenzylphthalate	312	2.9	4.78	6.00E-05	8.30E-06	1.1	1.70E+05	4.70E+04
carbazole	167	-	3.29	400 (323C)	-	1.1	-	1.20E+03
chrysene	228.30	0.0018 (25C)	5.61	6.3E-09 (25C)	1.05E-06	1.274	2.00E+05	
di-n-butylphthalate	278.35	4.00E+02	5.2	1.00E-01	2.80E-07	1	5.23	
di-n-octylphthalate	391	3 (25C)	9.2	1.40E-04	1.70E-05	0.99	3.6	3.90E+08
dibenz(a,h)anthracene	278.40	0.005 (25C)	5.97	1.00E-10	7.30E-08	-	3.30E+06	
fluoranthene	202.30	0.26 (25C)	5.33	5.0E-06 (25C)	6.50E-06	1.252	3.80E+04	
fluorene	116.20	1.69 (25C)	4.18	7.10E-04	6.40E-05	1.203	7.30E+03	
indeno(1,2,3-cd)pyrene	276.30	0.00053 (25C)	7.66	1.00E-10	6.95E-08	-	1.60E+06	
N-nitrosodiphenylamine	198.23	35	2.79	1.00E-01	3.10E+00	1.152	2.81	1.40E+02
pyrene	202.30	0.13 (25C)	5.18	2.5E-06 (25C)	5.10E-06	-	3.80E+04	
Pesticides/PCBs								
4,4'-DDD	320.10	.09 (25C)	1.60E+06	1.2E-07 (25C)	2.20E-08	-	7.70E+05	53600
4,4'-DDE	318	0.04 (20C)	4.28	6.50E-06	6.80E-05	-	4.40E+06	8.00E+06
4,4'-DDT	354.50	0.0034	6.36	3.95E-07	5.40E-06	-	12.39	53600
Aroclor-1242	254	8.00E-02	-	1.00E-07	4.10E-04	-	4.79E+04	31000
Aroclor-1248	299.50	0.054	5.75	4.9E-04 (25C)	3.60E-03	-	2.50E+05	31000
Aroclor-1254	325.10	3.10E-02	6.04	7.70E-05	2.60E-03	-	5.72	31000
Aroclor-1260	375.70	0.08 (25C)	7.15	4.0E-05 (25C)	7.40E-01	-	6.70E+06	31000
aldrin	364.91	0.078	3.01	1.67E-05	1.00E-05	1.7	10.78	4670
delta-BHC	290.85	21	4.14	2.00E-02	2.50E-07	1.9	3.58	130
dieldrin	380.91	0.19	4.09	1.80E-07	5.80E-05	1.8	3.23	4700
methoxychlor	345.65	0.04	4.68	-	3.00E-05	1.4	4.9	8300
alpha-chlordane	409.80	0.056	2.78	1.00E-05	3.70E-05	1.11	5.15	1400

- = Value Not Applicable or Not Located

TABLE 5-1
SUMMARY OF PHYSICAL AND CHEMICAL DATA FOR SITE 5 CONTAMINANTS
NAWC WARMINSTER, PENNSYLVANIA

Chemical Of Concern	Molecular Weight	K_d*	Bioconcentration Factor
Inorganics			
aluminum	26.98	-	-
arsenic	74.92	25 - 31	44
barium	137.34	12 - 52	1
beryllium	9.01	26 - 100,000	19
cadmium	112.40	17 - 4,300	64
chromium, trivalent	52.00	1,900 - 4,300,000	16
chromium, hexavalent	52.00	14 - 31	16
cobalt	58.93	0.2 - 3,800	1
copper	63.54	1.4 - 333	36
iron	55.85	1.4 - 1,000	-
lead	207.19	4.5 - 7,640	1
manganese	54.94	0.2 - 10,000	1
mercury	200.59	0.06 - 200	1
nickel	58.71	18 - 1,900	47
silver	107.87	0.13 - 110	0.5
thallium	204.37	45 - 96	116
vanadium	50.94	-	1
zinc	65.37	18 - 530	47

* = K_d values are fromTable C-4 in EPA Soil Screening Guidance: User's Guide. 9355.4-23 (April 1966).
K_d values are for pH range of 5.0 to 8.0.
** = K_d values are from Table 4.2 in The Soil Chemistry of Hazardous Materials, James Dragun, Ph. D. (1988).

5.1.2 Octanol-Water Partitioning Coefficient (Kow)

The Kow is a measure of the equilibrium partitioning of a chemical between octanol and water. The Kow is also used to estimate BCFs in aquatic organisms. A linear relationship between the Kow and the uptake of chemicals by fatty tissues of animal and human receptors has been determined (Lyman et. al, 1990). PAHs, phthalates, and PCBs are several orders of magnitude more likely to partition to fatty tissues than the more water-soluble VOCs. The Kow is also useful in characterizing the sorption of compounds by organic soils when experimental values are not available.

5.1.3 Organic Carbon Partitioning Coefficient (Koc)

The Koc is related to the water solubility and the Kow. This parameter indicates the tendency of a chemical to bind to soil particles containing organic carbon. Chemicals with high Koc generally have low water solubilities and vice versa. Chemicals such as phthalates, PAHs, and PCBs are relatively immobile in the subsurface environment and are preferentially bound to the soil phase. These compounds are not subject to groundwater transport to the same extent as compounds with high water solubilities.

Koc may be used to infer the relative rates at which the more mobile chemicals are transported in the groundwater. The Koc and the fractional organic carbon content of the soil (FOC) may be used to estimate an equilibrium distribution coefficient (Kd) for the solid and aqueous matrices using the following relationship:

$$Kd = Koc \times FOC$$

where: Kd = Distribution coefficient
FOC = Soil organic carbon content
Koc = Organic carbon partition coefficient

Total organic carbon (TOC) results may be used to calculate FOC for soils. One subsurface soil taken at Area B was analyzed for TOC, and the result was 23,400 mg/kg. Thus

$$FOC = (23400 \text{ mg/kg})\ (1E\text{-}6 \text{ kg/mg})$$
$$= 0.0234 \text{ kg organic carbon/kg soil}$$

5.1.4 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 in instances where environmental interfaces such as surface soil/air and surface water/air are important, rather than in evaluation of groundwater and subsurface soils. Vapor pressures for VOCs are generally many times higher than vapor pressures for phthalate esters and PAHs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization has also been reported to be one of the environmental fate pathways of PCBs. For example, of 700,000 pounds of PCBs in uncapped landfills in the Hudson River Basin area, an estimated 3,000 pounds (about four percent) volatilize annually (Lunsford, 1982). Volatilization depends upon such factors as total exposed surface area, PCB concentrations, and amount of organic matter in the soil.

Both vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies. The Henry's Law constant is the equilibrium vapor pressure of a chemical above a solution divided by its concentration in the solution (for dilute systems). The Henry's Law constant may also be used to calculate the equilibrium contaminant concentrations in the vapor versus liquid phases for dilute solutions commonly encountered in environmental settings. The Henry's Law constant is also useful for mass transfer applications for air stripping column design.

5.1.5 Bioconcentration Factor (BCF)

BCFs represent the ratio of aquatic-organism tissue concentration to water concentration. The ratio is both contaminant and species specific, as well as tissue specific. When site-specific values are not measured, literature values may be used, or the BCF may be derived from the Kow. Phthalate esters and PAHs will bioconcentrate at orders of magnitude greater than those concentrations found in the water where the exposed species reside. Bioconcentration is a well-known property of PCBs; PCBs can be stored in fatty tissues of exposed organisms at concentrations much higher than the environmental concentration. VOCs are not as readily bioconcentrated as PCBs.

5.1.6 Specific Gravity

Specific gravity is the ratio of the mass of a given volume of pure chemical at a specified temperature to the mass of the same volume of water at a given temperature. Its primary use is to determine whether immiscible compounds or very high concentrations of a pure contaminant

will float or sink in water. As shown in Table 5-1, most of the chemicals detected in this study area were denser than water, although toluene is less dense.

As shown in Table 5-1, most of the inorganic chemicals have a strong tendency to adsorb onto sediment particles, a factor that greatly reduces their mobility. For some metals, such as cadmium, lead, and mercury, bioaccumulation also plays an important role in environmental fate. While the metals themselves are insoluble in water, soluble species of some metals, such as chromium and antimony, can increase contaminant mobility. For cyanide, environmental fate is mainly controlled by biodegradation.

5.2 POTENTIAL MIGRATION ROUTES

In general, numerous potential migration routes exist in areas contaminated with hazardous materials. Such migration routes include, but are not limited to, atmospheric migration via particulate or volatile/semivolatile emissions, overland migration of dissolved or adsorbed contaminants, surface water transport, and groundwater transport.

5.2.1 Atmospheric Migration via Vapor Emissions

The first possible route for contaminant migration through the air is the volatilization of compounds from subsurface soil or surface water (especially if exposed through excavation, erosion, etc.). Phase I did not confirm that volatilization was occurring at Site 5 in a significant manner. During the soil gas survey and the drilling of the confirmation borings, uniformly low to non-detected levels of volatile organic vapors were found, with the exception of two confirmation borings at Site 5 (VOC vapor up to 20 ppm). However, ambient air readings taken during all invasive tasks conducted at Site 5 did not exceed normal background levels. The only VOC detected in subsurface soil during the Phase II RI was toluene, and the representative concentration was low (4 ug/kg).

5.2.2 Atmospheric Migration via Particulate Emissions

Another possible scenario for contaminant migration is the generation of contaminant dusts from surface and subsurface soils during excavation or other construction activities (sediments are covered by water). This would be potentially important for metals and would depend upon the soil materials being exposed in some way. The presence of asphalt surfaces, buildings, and a vegetated soil cover in the vicinity of Site 5 has greatly reduced the potential for risks due to dust

emissions. In the event soils are disturbed in the future, this migration route may have some relevance.

5.2.3 Subsurface Contaminant Migration to Surface Water and Sediment

Chemicals found in soil, especially subsurface soil, can leach into groundwater. This is especially likely to happen with soluble compounds with low organic carbon partition coefficients (Kocs) such as the VOCs. Leaching of organic compounds was estimated using Kocs, site-specific dilution factors, and analytical data. This model is discussed in more detail in Section 5.1.3.

One possible migration route is from groundwater at Area B into Southampton Creek, which is located downstream of Site 5. Groundwater primarily moves through interconnected networks of fractures within the bedrock. Lateral groundwater and contaminant migration directions are to the south across Area B and are controlled by topography and by the presence of Southampton Creek and its tributaries south of Site 5. Groundwater flow follows the slope of the ground surface topography across Area B, flowing against the dip direction of bedrock units. In general, Area B groundwater will eventually discharge to streams within the Southampton Creek drainage basin (TtNUS, 2000a).

For VOCs, it does not appear that any potential Area B groundwater contaminants have significantly affected surface water or sediment contaminant concentrations. The Area B sediment samples contain varying levels of semivolatile organic compounds, pesticides, and PCBs. Pesticides and PCBs have historically not been detected in shallow Area B groundwater, while semivolatile organics have only been detected at trace levels.

In addition, contaminants in shallow groundwater may be potentially discharging to the storm drains associated with the Area B outfalls along the base property boundary. In some cases, these drains may act as preferential pathways if they are lined with gravel and other permeable substrate materials, when compared to the permeability of native soils. However, the available stream and water-table elevations, soil permeability data, groundwater and stream analytical results, and visual observations indicate that Area B groundwater is not significantly contributing to stream flow south of Site 5.

The second possible route of groundwater migration is from areas immediately beneath Site 5 into deeper portions of the bedrock aquifer. Once contaminants have entered the bedrock aquifer, this deeper migration may occur along geologic structures such as permeable bedding planes, subsurface fractures, and joints. The overall vertical groundwater flow gradient is

downward in this area and indicates that flow is downward from the overburden toward the shallow bedrock aquifers.

The third possible route of groundwater migration is from Site 5 to off-base areas. The nature and extent of groundwater contamination for Site 5 indicate this migration process is not significant, since elevated contaminant levels were not detected in downgradient Area B monitoring well samples (TtNUS, 2000a).

The conditions at other sites within Area B (namely Sites 6 and 7) are not conducive to groundwater discharging to Southampton Creek and its tributaries, given surface topography and the greater distance to the creek itself.

5.2.4 Surface Water and Sediment Transport

The primary migration route for stream contaminants in surface water and sediment is via downstream flow. Contaminants may, to some degree, migrate from sediment to surface water and vice versa. However, chemicals such as metals and compounds with high Koc tend to bind strongly to sediment and migrate slowly, whereas lower-Koc, more highly soluble substances would tend to stay in the surface water and migrate more rapidly (Versar, 1979).

5.2.5 Soil Transport and Migration to Groundwater and Other Media

Rainwater that falls on Site 5 may transport contaminants through runoff. Runoff can transport contaminants in surface soils in both the dissolved form and also in solid form sorbed to soil particles being eroded by the runoff. Contaminants that are transported with surface water runoff migrate quickly (on the order of hours) so that contaminants do not have the opportunity to decay significantly being reaching the receptor location.

The urban setting of Site 5 contains storm drains that transport water through a series of outfalls located along the base property boundary. A majority of the Site 5 runoff travels over asphalt roads and parking areas and other relatively impenetrable surfaces. Based on the comparison of soil concentrations to SSLs, and the comparison of groundwater concentrations to soil concentrations, it does not appear that potential contaminant soil levels are adversely impacting groundwater quality in the vicinity of Site 5.

5.3 CONTAMINANT PERSISTENCE

Several transformation processes are believed to affect the persistence of organic chemicals in the environment. The primary processes affecting contaminant fate in the environment include microbial, photolytic, and chemical degradation.

In general, photolytic degradation is not considered to be a relevant degradation mechanism for monocyclic aromatic compounds such as toluene (EPA, 1982). Furthermore, even photodegradable compounds must be present in media exposed to sunlight for such degradation to occur (such as surface soil). For PCBs, photolysis can occur, especially in the more highly chlorinated compounds, although the process is reported to be slow (Versar, 1979). Photolysis is considered to be insignificant for phthalates and of unknown significance for PAHs (Versar, 1979).

Generally, organic molecules are subject to several chemical reactions under environmental conditions. Such reaction mechanisms include acid/base reaction, addition, elimination, and hydrolysis. However, chlorinated alkanes and alkenes and monocyclic aromatics are not particularly amenable to the majority of these degradation mechanisms. Hydrolysis is considered to be negligible for PAHs and PCBs. Phthalates can be more susceptible (Versar, 1979; EPA, 1982; Lyman et. al, 1990). Hydrolysis reactions can occur under acidic, basic, or neutral conditions.

Another possible type of degradation is the dechlorination of tetrachloroethene (PCE) and TCE to 1,2-dichloroethene (1,2-DCE), 1,1-dichloroethene (1,1-DCE), and ultimately vinyl chloride (Cline and Viste, 1984). A similar type of reaction has been reported for 1,1,1-TCA in degradation to 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethane (1,1-DCA), and chloroethane.

Bacterial degradation is a potential environmental fate mechanism. This degradation is primarily biological, and anaerobic conditions are typically required for these reactions to occur. The compounds for which biodegradation is potentially considerable are toluene, and, to some extent, naphthalene and phthalates (EPA, 1982; Verschueren, 1983). It should be noted that, for cyanide, environmental fate is mainly controlled by biodegradation (volatilization is a primary pathway for hydrogen cyanide). Some metallocyanide complexes may be more persistent in the environment (Versar, 1979). Cyanides usually are not observed as widespread, high-level contaminants in the environment, since they are metabolized so readily. The frequency of cyanide detections in the vicinity of Site 5 was very low.

6.0 BASELINE RISK ASSESSMENT

This section provides a description of the risk assessment methods employed for Site 5 soils and Area B surface water and sediment, as well as a summary of the risk assessment results. The general objectives of the risk assessment were to estimate the actual or potential risks to human health and the environment resulting from the presence of contamination in surface soil, subsurface soil, surface water, and sediment. Sections 6.1 through 6.7 discuss the human health risk assessment (HHRA). Section 6.8 addresses the ecological risk assessment (ERA). The risk assessment was based on the nature and extent of contamination at Site 5 taking into consideration the results of the Phase III RI (B&R Environmental, November 1996) and the supplemental investigation conducted in December 1999.

6.1 HUMAN HEALTH RISK ASSESSMENT

The specific objectives of the HHRA were as follows:

- To estimate the actual or potential risks to human health resulting from the presence of contamination in Site 5 surface soil.
- To estimate the actual or potential risks to human health resulting from the presence of contamination in Site 5 subsurface soil.
- To estimate the actual or potential risks to human health resulting from the presence of contamination in Area B sediment.
- To estimate the actual or potential risks to human health resulting from the presence of contamination in Area B surface water.
- To provide a basis for attainment of concentrations that are protective of potential human receptors under industrial and residential exposure scenarios.
- To determine the need for remedial measures (if applicable) for these media.

Three major aspects of chemical contamination must be considered when assessing public health risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; (2) potential exposure points must exist either at the source or via migration pathways if exposure occurs at a remote location other than the source; and (3)

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 is no risk.

In order to estimate the potential for human health risk attributable to surface and subsurface soil, information regarding the toxicity of the compounds detected in the various media, the distribution of contamination, potential migration pathways, and a site-specific estimate of chemical intake via assumed exposure routes were combined. The risk assessment processes were performed in accordance with current EPA risk assessment guidance.

The current and future anticipated land use at Site 5 residential (military enlisted and family housing). Likely potential receptors include light industrial workers, recreational children (age 6-12), and residential persons. Industrial risks presented in the HHRA are purely hypothetical in nature. If the land use designation were to change in the future (e.g., recreational use), quantitative risks estimated in this section should be re-evaluated. Recreational risks are associated with nearby streams that may be frequented by local children.

The HHRA for Site 5 was divided into Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization, Uncertainty Analysis, and Conclusions. Each section is briefly discussed below.

Data Evaluation (Section 6.2) is primarily concerned with background comparison tests, identification of contaminants of potential concern (COPCs), distributional analysis of the data, and calculation of exposure point concentrations. The site-specific background and site data are analyzed and COPCs are selected that are representative of the type expected for potential human health exposure. Distributional analysis of the data is the basis for calculating an exposure point concentration, which provides the chemical input into each of the exposure pathways.

Exposure Assessment (Section 6.3) identifies potential human health exposure, including a characterization of the site setting, selection of potential receptors, selection of exposure routes by medium, a presentation of a site-conceptual model, derivation of exposure estimates for each pathway, and a special explanation of the blood-lead modeling. This section identifies potential pathways of COPC migration, selected potential receptors, and the estimated intakes of COPCs for the identified receptors.

Toxicity Assessment (Section 6.4) presents available reference doses, cancer slope factors, EPA weight of evidence, adjustment of the dose-response parameters, relative potencies for polycyclic aromatic hydrocarbons (PAHs), and toxicity criteria for chromium. Quantitative toxicity indices, where available, are presented in this section, including any applicable regulatory standards and criteria.

Risk Characterization (Section 6.5) presents the approaches for determining carcinogenic risks, noncarcinogenic risks, and lead risks. The risk characterization evaluates the potential for adverse health effects from exposure to COPC concentrations in environmental media by integrating information developed during the toxicity and exposure assessments.

Uncertainty Analysis (Section 6.6) is a discussion of the general and site-specific uncertainties associated with the HHRA.

Conclusions (Section 6.7) presents major conclusions of the HHRA.

6.2 DATA EVALUATION

This section presents the approaches for background comparison tests, identification of contaminants of potential concern (COPCs), distributional analysis of the data, and exposure point concentrations. Four environmental media were sampled at (or in the vicinity of) Site 5: on-site surface soil, on-site subsurface soil, off-site sediment, and off-site surface water. Surface water was sampled for total inorganics and organics.

6.2.1 Background Comparison Tests

To determine if results of samples from surface soil, subsurface soil, surface water, and sediment were elevated relative to background sample results, an array of statistical tests were performed. The name of each test, the statistical question answered by the test, the assumptions required to run the test, and the criterion used by each test to judge whether site data are greater than background are delineated in the headings and footnotes to background comparison tables for surface soil, subsurface soil, surface water, and sediment presented in Appendix G, Part II. These statistical procedures include three quantitative tests that look for overall differences between the entire populations of site and background data values; four quantitative tests that essentially look for hot spots; and two qualitative tests that examine only the frequency of detection (proportion of detected versus non-detected values in site versus background) but not the magnitude of values.

Each statistical test was run using a decision-making probability level (P-level) of 0.05, which means that, in situations where the test conclusion states that site-related results are greater than background, the chance of the test yielding a false conclusion caused by random variations in the data set is five percent or less. The overall conclusion (whether site results are greater than background) was assumed to be "yes" if any one of the quantitative tests concluded that site data are elevated above background. If no conclusion could be

reached for any of the quantitative tests (e.g., if the assumptions necessary to run each of the various tests were not valid), then the overall decision was based on the conclusions of the qualitative tests alone. Further information regarding each statistical test is presented below:

- The means of the two data sets were compared if both site and background matched the same type of distribution (normal or lognormal). If the site and background data exhibited equal standard deviations (based upon Bartlett's test for equal variances), then the student's t-test was applied; otherwise, Satterthwaite's t-test was performed to see if the site mean is greater than the background mean. The t-test is valid only if at least 85 percent of site data and 85 percent of background data are positive detects, there are at least three sampling points in each data set, and the pooled standard deviation is not zero.

- Nonparametric statistical tests, which do not require underlying assumptions regarding equal data distributions, were also applied in each case. The Mann-Whitney U-test was used to determine whether the site and background data are from populations with identical medians and rank distributions. 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. If more than 40 percent of nondetected results are present in either the site or the background data set or when multiple levels of detection limits are present, a different statistically valid test, Gehan's test, was substituted because recent guidance (EPA, 1992b) indicates that the Mann- Whitney test is not valid in the aforementioned situations. (Gehan's test is statistically equivalent to the Mann-Whitney Test if all results are positive.) For either of these tests to work, not all data points can be tied and there must be at least two background data points. The Mann-Whitney U test and the Gehan's test statistics were computed using appropriate score adjustments for tied values and a normal approximation when sufficient data points were available; whereas, an exact computation of probabilities was used in the situations where there were very few (for example, less than eight) data points.

- A 95 percent upper tolerance limit (UTL) test was applied to determine whether the maximum concentration detected in an area of interest was a hot spot of a magnitude exceeding 95 percent of the background population. The 95 percent UTL is defined as the calculated upper limit that, on the average, is expected to include 95 percent of the background population. If the background data were determined to match the shape of a normal or lognormal population, then the limit was calculated using the t-distribution and the appropriate normal or log-transformed mean and standard deviation from the background data set. For this test to be valid, the background data set was required to be comprised of at least 85 percent detects and at least three data points.

- A substitute procedure for the 95 percent UTL, called the 95 percent quantile test, was employed to test for hot spots if the background data were not in the shape of a lognormal or a normal population. For the quantile test to be valid, at least 19 background data points were required, no detection limit could be greater than the UTL, and at least 10 percent of the data points must be detects in the background data set.

- The upper ranks test (EPA, 1992b, 1996a) is another hot spot test. This test combines the site and background data into one set and determines whether the major portion of a subset of the largest detected results is comprised chiefly of site data rather than an equal mixture of site and background. In this procedure, the probability is calculated that k or more samples from the largest r data points in the combined data set are comprised of site data, assuming that the site and background populations are equal. In the event that there is less than a five percent chance that this could happen if the populations are indeed the same, then the test concludes that there is a hot spot comprised of k samples from the area of interest.

- In the event that none of the above quantitative, statistical tests yielded a definite "yes" or "no" decision, a test of proportions was used to determine if the percentage of positively detected results was greater in the site data versus the background data. When only a very small portion of results are detected (less than 10 percent), this test is recommended (EPA, 1996a, 1989b). The test is routinely applied using a normal distribution approximation to the probability that site is above background but is not considered valid when fewer than five samples are detected in either site or background. This limitation for the routine test of proportions precluded any comparison of site to background for nearly all volatile organic compounds (VOCs) in surface water, although most were not detected at all in background. To reach a confident decision regarding VOCs in surface water, a generalized version of the test of proportions, called the Fisher Exact Test, was required (Brownlee, 1965). This test can be applied to all situations because it calculates the exact probability for all combinations of possible outcomes and gives a probability level for the condition where the observed frequency of site detects is greater than background, given the number of samples involved.

- As recommended (EPA, 1996a, 1992a, 1989b), quantitative statistical tests were preceded by data analysis to evaluate the distributional shape for both positive and non-detected data, of which quantile plots or tables are one recommended (and efficient) approach. This data analysis is required because multiple detection limits bias or invalidate the conclusions of common statistical tests. For each chemical in each risk group, a quantile (percentile) range evaluation was required to compare the number and magnitude of site and background non-detects. In particular, some of the above tests do not tolerate any non-detects above a certain magnitude or portion of the total. In the case of the Mann-Whitney test, careful quantitative evaluation was used to determine if the site and

background populations exhibited the same distributional spread of non-detected results and whether to instead use the more robust Gehan's test.

6.2.2 Identification of COPCs

The selection of COPCs was based on various aspects of chemical concentration, occurrence, distribution, and toxicity. COPCs were selected to represent site contamination and to provide the framework for the quantitative HHRA.

Four media (surface soil, subsurface soil, off-site sediment, and off-site surface water) were assessed for Site 5 human health risks. The results of the Site 5 soil sample analysis are summarized in the occurrence and distribution tables for (1) background soil [Section 2.0 - soils that were collected from various locations at NAWC Warminster (Figure 2-6) that are considered unaffected by past site-related activities; all surface and subsurface background samples were pooled together and used as background for any site-specific surface or subsurface data set]; (2) off-site background sediment and surface water [Section 2.0 - sediment and surface water (total inorganics and organics) that were collected from off-site areas near Site 5]; (3) surface soil [Section 4.0]; (4) subsurface soil [Section 4.0]; (5) off-site sediment [Section 4.0]; and (6) off-site surface water [See Section 4.0 - for total inorganics and organics]. These tables contain statistics including frequency of detection, range of positive detection, and location of maximum detection.

Subsets of the surface soil, subsurface soil, sediment, and surface water (total inorganics and organics) databases were analyzed in this HHRA by including only those chemicals with positive detections in each media at a suspected source concern. Concentrations of inorganic and/or organic constituents detected in surface soil, subsurface soil, sediment, and surface water (total inorganics and organics), and results of background analysis (for surface soil, subsurface soil, sediment, and surface water) are presented in Section 4.0. The COPC selection protocols are defined in Table 6-1.

6.2.2.1 Surface Soil COPC Selection

Section 4.4 discusses the results of sampling surface soils at Site 5. COPCs in surface soil for all potential receptors (selected using residential soil RBC screening criteria set at cancer risk levels of 1.0×10^{-6} and HQs of 0.1) are shown on Table 6-2 and listed below:

SUMMARY OF COPC SELECTION CRITERIA, SITE 5 SURFA... ...OIL, SUBSURFACE SOIL, SEDIMENT, AND SURFACE WATER
NAWC WARMINSTER, PENNSYLVANIA

COPC Selection Protocol	Definition	Decision Result #1	Decision Result #2	Notes
Essential Nutrients	Eliminate essential nutrients (calcium, chloride, magnesium, potassium, and sodium) as COPCs.	Eliminate essential nutrients as COPCs.	Eliminate essential nutrients as COPCs.	Essential nutrients that are present at elevated concentrations will be noted in the qualitative HHRA.
Background Screening (Applicable for Surface and Subsurface Soil Only)	Compare inorganic contaminants in surface and subsurface soil to background data set.	If a surface and/or subsurface soil inorganic contaminant is within the range of background, eliminate the chemical as COPC.	If statistical tests show surface and/or subsurface inorganic contaminant levels exceed background check Frequency of Detection.	Background screening is only applicable for surface and subsurface soil inorganic contaminants. Organic contaminants are subject to a check for Frequency of Detection.
Toxicity Screen vs. RBC	Compare maximum concentrations of inorganic substances (only those that exceed background) and organic contaminants in surface and subsurface soil to Risk Based Screening Levels (RBCs).* Compare maximum concentrations of inorganic and organic substances substances in sediment and surface water to Risk Based Screening Levels (RBCs).**	If maximum concentration of contaminant is less than the applicable RBC; eliminate the contaminat as a COPC.	If the maximum concentration of a contaminant exceeds the applicable RBC, the contaminant is selected as a COPC	Chemicals that are selected as a COPC will be evaluated quantitatively in this HHRA.
Lead	Compare maximum concentrations of lead in surface and subsurface soil and sediment to a value of 400 mg/kg (EPA, 1994).*** Compare maximum concentrations of lead in surface water to a value of 15 ug/L (EPA, 1996d).****	If maximum concentration of lead in soil or sediment is less than 400 mg/kg and/or lead in surface water is less than 15 ug/L eliminate lead as a COPC.	If maximum concentration of lead in soil or sediment exceeds 400 mg/kg and/or lead in surface water exceeds 15 ug/L select lead as a COPC.	If lead is selected as a COPC, then risks are evaluated using the Integrated Exposure Uptake Biokinetic model to assess potential blood lead levels in exposed children.

* Risk-Based Concentrations (RBCs; EPA 2000b) are chemical-specific benchmark criteria, prepared by EPA Region III, which represent the concentration of a substance that is estimated to yield a lifetime cancer risk of 1E-06 or a noncarcinogenic hazard quotient (HQ) of 1. RBCs are calculated assuming default exposure assumptions for soil ingestion for a lifetime resident (child plus adult exposure). Those RBCs which are based on non-cancer toxicity are first divided by 10 before being used for screening. (This step adds a safety factor in case more than one contaminant is present that might cause an additive risk of adverse effects.)

** Risk-Based Concentrations (RBCs; EPA 2000b) are chemical-specific benchmark criteria, prepared by EPA Region III, which represent the concentration of a substance that is estimated to yield a lifetime cancer risk of 1E-06 or a noncarcinogenic hazard quotient (HQ) of 1. RBCs are calculated assuming default exposure assumptions for soil ingestion (for sediment screening) and drinking water ingestion (for surface water ingestion) for a lifetime resident (child plus adult exposure). Those RBCs which are based on non-cancer toxicity are first divided by 10 before being used for screening. (This step adds a safety factor in case more than one contaminant is present that might cause an additive risk of adverse effects.)

*** The lead screening value was developed by the EPA (1994a) Office of Solid Waste and Emergency Response (OSWER). It is not an automatic cleanup goal but rather a level above which there is sufficient concern to merit additional site-specific evaluation of risks.

**** The lead screening value was developed by the EPA (1996d). It is not an automatic cleanup goal but rather a drinking water action level above which there is sufficient concern to merit additional site-specific evaluation of risks.

TABLE 6-2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
NAWC WARMINSTER, PENNSYLVANIA - SITE 5, SURFACE SOIL

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Surface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	12500	13200	18500		mg/kg	13200	95%UCL-T	Wlg>=Wt& Wno	12500	Mean-T	CTE uses LgAV
Cadmium	mg/kg	1.88	4.05	10.5		mg/kg	4.05	95%UCL-T	Wlg>=Wt& Wno	2.02	Mean-T	CTE uses LgAV
Copper	mg/kg	133	297	875		mg/kg	297	95%UCL-T	Wt >Wlg>=Wno	140	Mean-T	CTE uses LgAV
Lead	mg/kg	85.1	130	1020		mg/kg	77.5	Mean-T	IEUBK Uses Lg	77.5	Mean-T	IEUBK Uses Lg
Manganese	mg/kg	640	785	2550	J	mg/kg	785	95%UCL-T	Wlg>=Wt& Wno	640	Mean-T	CTE uses LgAV
Mercury	mg/kg	0.688	1.63	12		mg/kg	1.63	95%UCL-T	Wlg>=Wt& Wno	0.5	Mean-T	CTE uses LgAV
Silver	mg/kg	12.2	29.2	87.2	K	mg/kg	29.2	95%UCL-T	Wlg>=Wt& Wno	14.2	Mean-T	CTE uses LgAV
Thallium	mg/kg	0.694	0.818	2	K	mg/kg	0.818	95%UCL-T	Wt >Wlg>=Wno	0.661	Mean-T	CTE uses LgAV
Vanadium	mg/kg	32.6	35.3	60.9		mg/kg	35.3	95%UCL-T	Wlg>=Wt& Wno	32.6	Mean-T	CTE uses LgAV
Zinc	mg/kg	273	371	4180	L	mg/kg	371	95%UCL-T	Wlg>=Wt& Wno	207	Mean-T	CTE uses LgAV
Aroclor-1242	ug/kg	31.8	32.9	260		ug/kg	32.9	95%UCL-T	Wt >Wlg>=Wno	26.9	Mean-T	CTE uses LgAV
Aroclor-1254	ug/kg	754	312	24000		ug/kg	312	95%UCL-T	Wt >Wlg>=Wno	141	Mean-T	CTE uses LgAV
Benz(a)anthracene	ug/kg	321	293	330	J	ug/kg	293	95%UCL-T	Wt >Wlg>=Wno	213	Mean-T	CTE uses LgAV
Benzo(a)pyrene	ug/kg	318	290	270	J	ug/kg	270	Max	Max < U95log	211	Mean-T	CTE uses LgAV
Benzo(b)fluoranthene	ug/kg	313	286	120	J	ug/kg	120	Max	Max < U95log	120	RME Conc	Log AVG > Max
Benzo(k)fluoranthene	ug/kg	314	287	90	J	ug/kg	90	Max	Max < U95log	90	RME Conc	Log AVG > Max
Chrysene	ug/kg	326	301	450		ug/kg	301	95%UCL-T	Wt >Wlg>=Wno	220	Mean-T	CTE uses LgAV
Dibenz(a,h)anthracene	ug/kg	317	295	40	J	ug/kg	40	Max	Max < U95log	40	RME Conc	Log AVG > Max
Indeno(1,2,3-cd)pyrene	ug/kg	316	296	60	J	ug/kg	60	Max	Max < U95log	60	RME Conc	Log AVG > Max

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Minimum variance unbiased estimate of arithmetic mean for lognormally distributed data (Mean-T); Mean of Normal Data (Mean-N).

NA - Not Applicable.

- Aluminum
- Cadmium
- Copper
- Lead
- Manganese
- Mercury
- Silver
- Thallium
- Vanadium
- Zinc
- Aroclor-1242
- Aroclor-1254
- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

For lead, the Integrated Exposure and Uptake Biokinetic (IEUBK) Model (Version 0.99) was used to evaluate this contaminant as a COPC. The maximum concentration of lead exceeded the RBC, while the arithmetic mean, which was used as the exposure point concentrations (EPC) in this model, was below the RBC.

The maximum detects, arithmetic means, and EPCs (discussed in Section 6.2.5) for aluminum, manganese, thallium, and benzo(a)pyrene exceeded their respective RBCs. Notable trends for each of these COPCs were as follows:

- Aluminum was detected in all 36 surface soil samples and all 36 had positive detects greater than the RBC.

- Manganese was detected in all 36 surface soil samples and 35 of the 36 samples had positive detects greater than the RBC.

- Thallium was detected in 7 out of 36 surface soil samples and 6 of the 7 samples had positive detects greater than the RBC.

- Benzo(a)pyrene was detected in 3 out of 29 surface soil samples and 2 of the 3 samples had positive detects greater than the RBC.

The maximum detect and arithmetic mean for Aroclor-1254 exceeded the RBC, however, the EPC was less than the RBC. Aroclor-1254 was detected in 19 out of 36 surface soil samples and 3 of the 19 samples had positive detects greater than the RBC.

The maximum detects and reasonable maximum exposure (RME) EPCs for mercury exceeded the RBC, however, the arithmetic mean and central tendency exposure (CTE) EPC were less than the RBC.

Mercury was detected in 20 out of 28 surface soil samples and 5 of the 20 samples had positive detects greater than the RBC.

The arithmetic mean for dibenz(a,h)anthracene exceeded the RBC, however, the maximum detect and EPCs were less than the RBC. Dibenz(a,h)anthracene was detected in 1 out of 29 surface soil samples but did not have any positive detects greater than the RBC. Dibenz(a,h)anthracene was selected as a COPC because it is a carcinogenic polycyclic aromatic hydrocarbon (PAH) and other members of this chemical family were detected at concentrations greater than their respective RBCs.

The maximum detect was less than the RBC for Aroclor-1242. This substance was selected as a COPC because it is a carcinogenic polychlorinated biphenyl (PCB) and other members of this chemical family were detected at concentrations greater than their respective RBCs.

The maximum detects for benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were less than their respective RBCs. These substances were selected as COPCs because they are carcinogenic PAHs and other members of this chemical family were detected at concentrations greater than their respective RBCs.

The maximum detects of cadmium, copper, lead, silver, vanadium, and zinc exceeded their respective RBCs, however, their arithmetic means and EPCs were less than their respective RBCs. Notable trends for these COPCs were as follows:

- Cadmium was detected in 18 out of 34 surface soil samples and 1 of the 18 samples had a positive detect greater than the RBC.

- Copper was detected in all 36 surface soil samples and 7 of the 36 samples had positive detects greater than the RBC.

- Lead was detected in all 36 surface soil samples and 1 of the 36 samples had a positive detect greater than the RBC (location: SS-05-01).

- Silver was detected in 27 out of 29 samples and 2 of the 27 samples had positive detects greater than the RBC.

- Vanadium was detected in all 36 surface soil samples and 1 of the 36 samples had a positive detect greater than the RBC (location: SS-05-09).

- Zinc was detected in all 36 surface soil samples and 1 of the 36 samples had a positive detect greater than the RBC (location: SS-05-37).

6.2.2.2 Subsurface Soil COPC Selection

Section 4.5 discusses the results of sampling subsurface soils at Site 5. COPCs in subsurface soil for all potential receptors (selected using residential soil RBC screening criteria set at cancer risk levels of 1.0 x 10^{-6} and HQs of 0.1) are shown on Table 6-3 and listed below:

- Aluminum
- Arsenic
- Barium
- Cadmium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Silver
- Thallium
- Vanadium
- Zinc
- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- Aroclor-1242
- Aroclor-1248
- Aroclor-1254
- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Chrysene

For lead, the IEUBK Model was used to evaluate this contaminant as a COPC. The maximum concentration of lead exceeded the RBC, while the arithmetic mean, which was used as the EPC in this model, was below the RBC.

The maximum detects, arithmetic means, and EPCs for aluminum, arsenic, iron, manganese, thallium, and benzo(a)pyrene exceeded their respective RBCs. Notable trends for these COPCs were as follows:

- Aluminum was detected in all 55 subsurface soil samples and 52 of the 55 samples had positive detects greater than the RBC.

- Arsenic was detected in 46 out of 53 subsurface soil samples and 45 of the 46 samples had positive detects greater than the RBC.

- Iron was detected in all 55 subsurface soil samples and all 55 had positive detects greater than the RBC.

- Manganese was detected in all 55 subsurface soil samples and 47 of the 55 samples had positive detects greater than the RBC.

TABLE 6-3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
NAWC WARMINSTER, PENNSYLVANIA - SITE 5, SUBSURFACE SOIL

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Subsurface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL of Normal Data (1)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	12600	13400	20700		mg/kg	13400	95%UCL-N	Wt >Wno> Wlg	12600	Mean-N	CTE uses AVG
Arsenic	mg/kg	2.22	3.06	12.9		mg/kg	3.06	95%UCL-T	Wt >Wlg>=Wno	2.21	Mean-T	CTE uses LgAV
Barium	mg/kg	182	217	1030		mg/kg	217	95%UCL-T	Wt >Wlg>=Wno	169	Mean-T	CTE uses LgAV
Cadmium	mg/kg	4.65	5.5	137		mg/kg	5.5	95%UCL-T	Wt >Wlg>=Wno	2.47	Mean-T	CTE uses LgAV
Copper	mg/kg	636	802	19300	J	mg/kg	802	95%UCL-T	Wt >Wlg>=Wno	237	Mean-T	CTE uses LgAV
Iron	mg/kg	28600	33700	92600		mg/kg	33700	95%UCL-T	Wt >Wlg>=Wno	28500	Mean-T	CTE uses LgAV
Lead	mg/kg	138	142	2400	K	mg/kg	72.7	Mean-T	IEUBK Uses Lg	72.7	Mean-T	IEUBK Uses Lg
Manganese	mg/kg	740	937	9240	J	mg/kg	937	95%UCL-T	Wt >Wlg>=Wno	693	Mean-T	CTE uses LgAV
Mercury	mg/kg	0.248	0.347	2.6		mg/kg	0.347	95%UCL-T	Wt >Wlg>=Wno	0.17	Mean-T	CTE uses LgAV
Nickel	mg/kg	39	39.3	625		mg/kg	39.3	95%UCL-T	Wt >Wlg>=Wno	30	Mean-T	CTE uses LgAV
Silver	mg/kg	13.6	38.3	111		mg/kg	38.3	95%UCL-T	Wt >Wlg>=Wno	15.3	Mean-T	CTE uses LgAV
Thallium	mg/kg	0.622	0.703	1.1	K	mg/kg	0.703	95%UCL-T	Wt >Wlg>=Wno	0.57	Mean-T	CTE uses LgAV
Vanadium	mg/kg	160	61.6	6510		mg/kg	61.6	95%UCL-T	Wt >Wlg>=Wno	45.7	Mean-T	CTE uses LgAV
Zinc	mg/kg	265	286	4760	L	mg/kg	286	95%UCL-T	Wt >Wlg>=Wno	170	Mean-T	CTE uses LgAV
4,4'-DDD	ug/kg	297	19.4	12000		ug/kg	19.4	95%UCL-T	Wt >Wlg>=Wno	9.03	Mean-T	CTE uses LgAV
4,4'-DDE	ug/kg	68.3	11.1	2600	K	ug/kg	11.1	95%UCL-T	Wt >Wlg>=Wno	6.23	Mean-T	CTE uses LgAV
4,4'-DDT	ug/kg	157	13.3	6300		ug/kg	13.3	95%UCL-T	Wt >Wlg>=Wno	6.95	Mean-T	CTE uses LgAV
Aroclor-1242	ug/kg	33.8	32.7	100	J	ug/kg	32.7	95%UCL-T	Wt >Wlg>=Wno	27	Mean-T	CTE uses LgAV
Aroclor-1248	ug/kg	37	34	315		ug/kg	34	95%UCL-T	Wt >Wlg>=Wno	27.4	Mean-T	CTE uses LgAV
Aroclor-1254	ug/kg	59	63	395		ug/kg	63	95%UCL-T	Wt >Wlg>=Wno	44.1	Mean-T	CTE uses LgAV
Benz(a)anthracene	ug/kg	316	384	1100	J	ug/kg	384	95%UCL-T	Wt >Wlg>=Wno	265	Mean-T	CTE uses LgAV
Benzo(a)pyrene	ug/kg	310	375	920	J	ug/kg	375	95%UCL-T	Wt >Wlg>=Wno	262	Mean-T	CTE uses LgAV
Benzo(b)fluoranthene	ug/kg	302	371	1000	J	ug/kg	371	95%UCL-T	Wt >Wlg>=Wno	252	Mean-T	CTE uses LgAV
Chrysene	ug/kg	336	403	2000	J	ug/kg	403	95%UCL-T	Wt >Wlg>=Wno	270	Mean-T	CTE uses LgAV

(1) Represents the 95% UCL of normal data for normal distributions; Represents the log-transformed 95% UCL for lognormal distributions.
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Minimum variance unbiased estimate of arithmetic mean for lognormally distribute
Mean of Normal Data (Mean-N).
NA - Not Applicable.

- Thallium was detected in 7 out of 52 subsurface soil samples and 4 of the 7 samples had positive detects greater than the RBC.

- Benzo(a)pyrene was detected in 1 out of 32 subsurface soil samples and 1 sample had a positive detect greater than the RBC (location: SB-05-54).

The maximum detects, arithmetic means, and RME EPCs for copper and vanadium exceeded their RBCs, However, their CTE EPCs were less than their respective RBCs. Notable trends for these COPCs were as follows:

- Copper was detected in all 42 subsurface samples and 9 of the 42 samples had positive detects greater than the RBC.

- Vanadium was detected in all 54 subsurface samples and 3 of the 54 samples had positive detects greater than the RBC.

The maximum detects for barium, cadmium, lead, mercury, nickel, silver, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aroclor-1254, benz(a)anthracene, and benzo(b)fluoranthene exceeded their respective RBCs. However, their arithmetic means and EPCs were less than their respective RBCs. Notable trends for these COPCs were as follows:

- Barium was detected in all 54 subsurface soil samples and 4 of the 54 samples had positive detects greater than the RBC.

- Cadmium was detected in 13 out of 54 subsurface soil samples and 6 of the 13 samples had positive detects greater than the RBC.

- Lead was detected in all 54 subsurface soil samples and 5 of the 54 samples had positive detects greater than the RBC.

- Mercury was detected in 22 out of 50 subsurface soil samples and 6 of the 22 samples had positive detects greater than the RBC.

- Nickel was detected in all 55 subsurface soil samples and 3 of the 53 samples had positive detects greater than the RBC.

- Silver was detected in 33 out of 52 subsurface soil samples and 7 of the 33 samples had positive detects greater than the RBC.

- Zinc was detected in all 52 subsurface soil samples and 1 of the 52 samples had a positive detect greater than the RBC (location: SB-05-29).

- 4,4'-DDD was detected in 5 out of 41 subsurface soil samples and 1 of the 54 samples had a positive detect greater than the RBC (location: SB-05-54).

- 4,4'-DDE was detected in 5 out of 40 subsurface soil samples and 1 of the 54 samples had a positive detect greater than the RBC (location: SB-05-54).

- 4,4'-DDT was detected in 4 out of 41 subsurface soil samples and 1 of the 54 samples had a positive detect greater than the RBC (location: SB-05-54).

- Aroclor-1254 was detected in 9 out of 41 subsurface soil samples and 2 of the 9 samples had positive detects greater than the RBC.

- Benz(a)anthracene was detected in 1 out of 32 subsurface soil samples and 1 sample had a positive detect greater than the RBC (location: SB-05-54).

- Benzo(b)fluoranthene was detected in 3 out of 32 subsurface soil samples and 1 of the 3 samples had a positive detect greater than the RBC (location: SB-05-54).

The maximum detects for Aroclor-1242 and Aroclor-1248 were less than their respective RBCs. These substances were selected as COPCs because they are carcinogenic PCBs and other members of this chemical family were detected at concentrations greater than their respective RBCs.

The maximum detect for chrysene was less than the RBC. Chrysene was selected as a COPC because it is a carcinogenic PAH and other members of this chemical family were detected at concentrations greater than their respective RBCs.

6.2.2.3 Sediment COPC Selection

Section 4.7 discusses the results of sampling sediment downgradient of Site 5 and Area B in general. For metals, COPCs in sediment were selected based on comparing concentrations to background. For organics, all positively detected chemicals were retained as COPCs. Sediment COPCs are listed below:

- Aluminum
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Nickel
- Thallium
- Zinc
- 4,4'-DDD
- 4,4'-DDT
- 4-Methylphenol
- Acenaphthene
- Aldrin
- Alpha-Chlordane
- Anthracene
- Aroclor-1260
- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Butylbenzylphthalate
- Carbazole
- Chrysene
- Delta-BHC
- Di-n-butylphthalate
- Di-n-octylphthalate
- Dibenz(a,h)anthracene
- Dieldrin
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Methoxychlor
- N-nitrosodiphenylamine
- Pyrene

6.2.2.4 Surface Water COPC Selection

Section 4.6 discusses the results of sampling surface water at off-base areas near Site 5. Seven samples, including three background samples, were collected. For metals, the COPCs in surface water (total inorganics and organics) were selected if their representative concentrations were greater than the representative concentration of the background. For organics, all positively, detected chemicals were retained as COPCs. These COPCs are listed below:

- Nickel
- Thallium
- Bis(2-ethylhexyl)phthalate

Notable trends for these COPCs are as follows:

- Nickel was detected in 1 surface water sample at a concentration of 20 ug/L, which exceeded the background representative concentration.

- Thallium was detected in 1 surface water sample at a concentration of 4.9 ug/L, which exceeded the background representative concentration.

- Bis(2-ethylhexyl)phthalate was detected in 1 surface water sample at a concentration of 1 ug/L, which exceeded the background representative concentration.

6.2.3 Distributional Analysis of the Data

This section presents the approaches taken for distributional analysis of the Site 5 analytical data. Distributional analysis of the sampling data is important in determining the exposure point concentration (EPC) used to quantitatively estimate risks at the site. Statistical analyses discussed in this section adhere to the guidance referenced in several EPA and related publications (EPA, 1989a, 1989b, 1992a, 1992b, and 1996a). Before EPCs were estimated for each COPC, the underlying statistical distribution of data was determined for each COPC. The Shapiro-Wilk W test or the Shapiro-Francia Test (EPA, 1992a) were performed to determine if the data set of chemical concentrations matched the shape of a normal or lognormal distribution. [The latter test is required if there are greater than 50 samples (EPA, 1992a, 1996a).] Normally distributed data exhibit a characteristic "bell-shape" curve that is symmetrical, whereas lognormal data have a skewed shape (a longer tail at the high-concentration tail). For each COPC, the W test was performed once using the original data and once after data were converted to their logarithms. A 5% level of significance was used to determine if the data deviated 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 confidence limit on the mean, 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 than a normal distribution, a lognormal transformation of data was performed before the upper 95th percentile confidence limit on the mean concentrations was computed. If neither distribution matched the data set of interest, the assumption of the better fitting of the two types of distributions was followed (EPA, 1989a).

The distributional analysis results for COPCs in surface soil, subsurface soil, sediment, surface water are shown in Tables 6-4 through 6-7, respectively. As shown on Table 6-4, the COPCs in surface soil generally matched a lognormal or nonparametric (assumed lognormal) distribution better than a normal distribution, especially aluminum, barium, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, mercury, nickel, potassium, silver, sodium, vanadium, and zinc. Only arsenic and cyanide fit a normal distribution better than a lognormal distribution. As shown on Table 6-5, the COPCs in subsurface soil generally matched a nonparametric (assumed lognormal) distribution better than a normal distribution. Cyanide matched a lognormal distribution, however, because of the low number of sampling locations, there is less confidence in the shape of the distribution. Only aluminum, magnesium, 2-hexanone, and 4-methyl-2-pentanone fit a normal distribution better than a lognormal distribution. As shown on Tables 6-6 and 6-7 the COPCs in sediment and surface water were matched with a particular distribution (normal, lognormal,

Table 6-4
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF CONTAMINANTS - SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $H_{0.95}$ (Lognorm.) or $T_{0.95}$ (Normal)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration	Representative Concentration
				W-norm.	W-lognorm.	W-Table						
Aluminum	36	35	lognormal	0.9534	0.9724	0.935	1.7296	0.19	12500	13200	18500	13200
Antimony	31	30	nonparametric (assumed lognorm.)	0.8873	0.9203	0.929	2.3986	0.979	2.89	4.9	8.8	4.9
Arsenic	36	35	normal	0.9658	0.7876	0.935	1.6896	1.87	4.23	4.76	7.9	4.76
Barium	36	35	lognormal	0.8852	0.9731	0.935	1.8591	0.428	103	118	311	118
Beryllium	36	35	lognormal	0.9323	0.9706	0.935	1.7488	0.232	0.925	0.991	1.6	0.991
Cadmium	34	33	lognormal	0.7123	0.9441	0.933	2.8076	1.33	1.88	4.05	10.5	4.05
Calcium	36	35	nonparametric (assumed lognorm.)	0.3144	0.864	0.935	2.1185	0.746	2780	3000	35400	3000
Chromium	36	35	lognormal	0.951	0.9887	0.935	1.7714	0.278	23.4	25.4	49.2	25.4
Cobalt	36	35	lognormal	0.9045	0.9871	0.935	1.7791	0.293	9.78	10.7	21.3	10.7
Copper	36	35	nonparametric (assumed lognorm.)	0.7054	0.9307	0.935	2.9085	1.43	133	297	875	297
Cyanide	16	15	nonparametric (assumed normal)	0.8396	0.7997	0.887	1.7531	0.137	0.459	0.519	0.56	0.519
Iron	36	35	lognormal	0.8545	0.9411	0.935	1.8013	0.333	23100	25500	48300	25500
Lead	36	35	lognormal	0.5861	0.9361	0.935	2.5387	1.13	85.1	130	1020	77.5
Magnesium	36	35	nonparametric (assumed lognorm.)	0.4591	0.8153	0.935	1.8835	0.463	2770	3070	16000	3070
Manganese	36	35	lognormal	0.7702	0.97	0.935	1.9834	0.594	640	785	2550	785
Mercury	28	27	lognormal	0.2928	0.948	0.924	3.3692	1.66	0.688	1.63	12	1.63
Nickel	36	35	lognormal	0.6758	0.9518	0.935	1.9262	0.522	18.7	21.7	83.2	21.7
Potassium	36	35	lognormal	0.7639	0.9765	0.935	2.0033	0.618	1130	1380	4660	1380
Selenium	13	12	nonparametric (assumed lognorm.)	0.6249	0.7956	0.866	2.4667	0.765	0.663	1.09	2.6	1.09
Silver	29	28	lognormal	0.6654	0.9319	0.926	2.7969	1.27	12.2	29.2	87.2	29.2
Sodium	15	14	lognormal	0.5845	0.8835	0.881	2.2991	0.695	184	269	831	269
Thallium	36	35	nonparametric (assumed lognorm.)	0.597	0.837	0.935	1.9973	0.611	0.694	0.818	2	0.818
Vanadium	36	35	lognormal	0.928	0.9529	0.935	1.766	0.267	32.6	35.3	60.9	35.3
Zinc	36	35	lognormal	0.3588	0.9365	0.935	2.6482	1.22	273	371	4180	371
4,4'-DDD	30	29	nonparametric (assumed lognorm.)	0.4957	0.6449	0.927	2.16	0.752	4.23	5.07	27	5.07
4,4'-DDE	35	34	nonparametric (assumed lognorm.)	0.4924	0.6236	0.934	1.9916	0.6	3.3	3.77	9.5	3.77
4,4'-DDT	35	34	nonparametric (assumed lognorm.)	0.4386	0.5914	0.934	1.9759	0.581	3.22	3.6	14	3.6
Alpha-Chlordane	32	31	nonparametric (assumed lognorm.)	0.3411	0.5428	0.93	1.9123	0.485	1.46	1.59	2.9	1.59
Aroclor-1242	36	35	nonparametric (assumed lognorm.)	0.3022	0.4209	0.935	1.9729	0.582	31.8	32.9	260	32.9
Aroclor-1254	36	35	nonparametric (assumed lognorm.)	0.19	0.7227	0.935	2.9657	1.47	754	312	24000	312
Beta-BHC	36	35	nonparametric (assumed lognorm.)	0.2927	0.3941	0.935	1.8928	0.476	1.4	1.48	5.6	1.48
Dieldrin	33	32	nonparametric (assumed lognorm.)	0.2995	0.3851	0.931	1.9941	0.593	3.21	3.36	25	3.36
Endosulfan Sulfate	35	34	nonparametric (assumed lognorm.)	0.32	0.4482	0.934	1.905	0.489	2.77	2.97	10	2.97
Endrin	36	35	nonparametric (assumed lognorm.)	0.1738	0.3249	0.935	2.4191	1.03	24.7	6.57	810	6.57
Endrin Aldehyde	33	32	nonparametric (assumed lognorm.)	0.3248	0.4852	0.931	1.9079	0.484	2.77	3	6.7	3
Gamma-Chlordane	31	30	nonparametric (assumed lognorm.)	0.4251	0.5233	0.929	1.8953	0.456	1.36	1.53	6.1	1.53
2-Methylnaphthalene	29	28	nonparametric (assumed lognorm.)	0.2268	0.5455	0.926	2.1513	0.737	317	285	160	160
Benz(a)anthracene	29	28	nonparametric (assumed lognorm.)	0.2325	0.6005	0.926	2.1628	0.748	321	293	330	293
Benzo(a)pyrene	29	28	nonparametric (assumed lognorm.)	0.2305	0.5954	0.926	2.1673	0.753	318	290	270	270
Benzo(b)fluoranthene	29	28	nonparametric (assumed lognorm.)	0.2321	0.6271	0.926	2.1888	0.773	313	286	120	120
Benzo(g,h,i)perylene	29	28	nonparametric (assumed lognorm.)	0.2315	0.6127	0.926	2.1807	0.766	313	285	100	100
Benzo(k)fluoranthene	29	28	nonparametric (assumed lognorm.)	0.2319	0.6244	0.926	2.1888	0.773	314	287	90	90
Bis(2-ethylhexyl)phthalate	17	16	nonparametric (assumed lognorm.)	0.3015	0.6925	0.892	2.7335	1.04	408	478	270	270
Chrysene	29	28	nonparametric (assumed lognorm.)	0.2358	0.5905	0.926	2.1576	0.743	326	301	450	301

Table 6-4
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF CONTAMINANTS - SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $H_{0.95}$ (Lognorm.) or $T_{0.95}$ (Normal)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration	Representative Concentration
				W-norm.	W-lognorm.	W-Table						
Di-n-butylphthalate	24	23	nonparametric (assumed lognorm.)	0.2486	0.6115	0.916	2.2865	0.817	359	352	48	48
Dibenz(a,h)anthracene	29	28	nonparametric (assumed lognorm.)	0.2319	0.6301	0.926	2.1926	0.777	317	295	40	40
Fluoranthene	29	28	nonparametric (assumed lognorm.)	0.2344	0.6799	0.926	2.2347	0.817	306	283	170	170
Indeno(1,2,3-cd)pyrene	29	28	nonparametric (assumed lognorm.)	0.234	0.6581	0.926	2.2082	0.792	316	296	60	60
Naphthalene	29	28	nonparametric (assumed lognorm.)	0.231	0.6166	0.926	2.1869	0.772	314	286	47	47
Phenanthrene	29	28	nonparametric (assumed lognorm.)	0.2373	0.6991	0.926	2.2503	0.831	310	294	120	120
Pyrene	29	28	nonparametric (assumed lognorm.)	0.2345	0.6672	0.926	2.2094	0.793	313	290	310	290
2-Butanone	18	17	nonparametric (assumed lognorm.)	0.4169	0.4861	0.897	2.1597	0.632	9.19	11.6	42	11.6
2-Hexanone	29	28	nonparametric (assumed lognorm.)	0.3315	0.4437	0.926	1.956	0.524	7.93	8.72	51	8.72
4-Methyl-2-pentanone	31	30	nonparametric (assumed lognorm.)	0.823	0.8692	0.929	1.7085	0.12	5.63	5.84	6	5.84
Acetone	18	17	nonparametric (assumed normal)	0.7975	0.7074	0.897	1.7396	62.3	70	95.5	170	95.5
Benzene	31	30	nonparametric (assumed lognorm.)	0.8563	0.8773	0.929	1.9182	0.487	3.6	4.32	2	2
Carbon Disulfide	31	30	nonparametric (assumed lognorm.)	0.8076	0.8321	0.929	1.8794	0.434	3.77	4.41	1	1
Chloroethane	31	30	nonparametric (assumed lognorm.)	0.7792	0.8098	0.929	1.8435	0.381	3.82	4.35	2	2
Chloromethane	31	30	nonparametric (assumed lognorm.)	0.8339	0.8457	0.929	1.879	0.433	3.87	4.53	5	4.53
Ethylbenzene	31	30	nonparametric (assumed lognorm.)	0.7485	0.7668	0.929	1.8355	0.369	3.84	4.35	3	3
Methylene Chloride	5	4	nonparametric (assumed lognorm.)	0.5643	0.7525	0.762	9.83	2.1	67.2	2310000	320	320
Toluene	31	30	nonparametric (assumed lognorm.)	0.4675	0.91	0.929	2.2227	0.82	4.97	6.5	40	6.5
Trichloroethene	31	30	nonparametric (assumed lognorm.)	0.5034	0.7556	0.929	2.0342	0.627	5.29	6.19	33	6.19
Xylene (Total)	31	30	nonparametric (assumed normal)	0.8247	0.7874	0.929	1.6973	2.97	7.31	8.21	19	8.21

Notes:

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shapiro test.
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data.
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.

Table 6-5
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF CONTAMINANTS - SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution of Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $H_{0.95}$ (Lognorm.) or $T_{0.95}$ (Normal)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration	Representative Concentration
				W-norm.	W-lognorm.	W-Table						
Aluminum	55	54	nonparametric (assumed normal)	0.9674	0.8942	0.98	1.6736	3320	12600	13400	20700	13400
Antimony	36	35	nonparametric (assumed lognorm.)	0.4484	0.9312	0.935	2.992	1.49	3.95	7.94	50.4	7.94
Arsenic	53	52	nonparametric (assumed lognorm.)	0.7329	0.9684	0.979	2.2776	0.979	2.22	3.06	12.9	3.06
Barium	54	53	nonparametric (assumed lognorm.)	0.5939	0.9221	0.98	2.1291	0.828	182	217	1030	217
Beryllium	53	52	nonparametric (assumed lognorm.)	0.9052	0.9727	0.979	1.8437	0.455	1.32	1.5	3.7	1.5
Cadmium	54	53	nonparametric (assumed lognorm.)	0.2011	0.8604	0.98	3.1316	1.71	4.65	5.5	137	5.5
Calcium	53	52	nonparametric (assumed lognorm.)	0.5154	0.9425	0.979	2.1095	0.803	2800	3300	22000	3300
Chromium	55	54	nonparametric (assumed lognorm.)	0.3134	0.8253	0.98	1.9791	0.654	28.8	32.2	305	32.2
Cobalt	54	53	nonparametric (assumed lognorm.)	0.9449	0.9661	0.98	1.8252	0.427	13.4	15	30.1	15
Copper	42	41	nonparametric (assumed lognorm.)	0.2235	0.8793	0.942	3.5795	1.97	636	802	19300	802
Cyanide	3	2	*lognormal	0.9826	0.9972	0.767	3.9631	0.284	1.15	2.59	1.5	1.5
Iron	55	54	nonparametric (assumed lognorm.)	0.7907	0.9191	0.98	1.9454	0.609	28600	33700	92600	33700
Lead	54	53	nonparametric (assumed lognorm.)	0.3463	0.8083	0.98	2.9217	1.55	138	142	2400	72.7
Magnesium	53	52	nonparametric (assumed normal)	0.9658	0.9535	0.979	1.6747	2020	3950	4420	8660	4420
Manganese	55	54	nonparametric (assumed lognorm.)	0.3619	0.9604	0.98	2.242	0.95	740	937	9240	937
Mercury	50	49	nonparametric (assumed lognorm.)	0.4804	0.8463	0.947	2.9691	1.57	0.248	0.347	2.6	0.347
Nickel	55	54	nonparametric (assumed lognorm.)	0.2882	0.8201	0.98	2.1708	0.876	39	39.3	625	39.3
Potassium	54	53	nonparametric (assumed lognorm.)	0.9186	0.9719	0.98	2.1347	0.834	2110	2840	6950	2840
Selenium	30	29	nonparametric (assumed lognorm.)	0.5456	0.6907	0.927	1.8929	0.448	0.375	0.426	1.3	0.426
Silver	52	51	nonparametric (assumed lognorm.)	0.5421	0.9068	0.979	3.288	1.82	13.6	38.3	111	38.3
Sodium	38	37	nonparametric (assumed lognorm.)	0.6886	0.9146	0.938	1.98	0.599	190	226	677	226
Thallium	52	51	nonparametric (assumed lognorm.)	0.5255	0.8687	0.979	2.0333	0.713	0.622	0.703	1.1	0.703
Vanadium	54	53	nonparametric (assumed lognorm.)	0.1182	0.4791	0.98	2.2335	0.938	160	61.6	6510	61.6
Zinc	52	51	nonparametric (assumed lognorm.)	0.3291	0.8147	0.979	2.6551	1.32	265	286	4760	286
4,4'-DDD	41	40	nonparametric (assumed lognorm.)	0.1607	0.3956	0.941	2.9702	1.51	297	19.4	12000	19.4
4,4'-DDE	40	39	nonparametric (assumed lognorm.)	0.1656	0.4124	0.94	2.6722	1.27	68.3	11.1	2600	11.1
4,4'-DDT	41	40	nonparametric (assumed lognorm.)	0.1609	0.3624	0.941	2.7899	1.37	157	13.3	6300	13.3
Alpha-Chlordane	40	39	nonparametric (assumed lognorm.)	0.2835	0.4428	0.94	2.0143	0.649	1.85	1.85	5.7	1.85
Aroclor-1242	41	40	nonparametric (assumed lognorm.)	0.2469	0.3871	0.941	1.9696	0.598	33.8	32.7	100	32.7
Aroclor-1248	41	40	nonparametric (assumed lognorm.)	0.2529	0.3193	0.941	2.0124	0.65	37	34	315	34
Aroclor-1254	41	40	nonparametric (assumed lognorm.)	0.4408	0.5234	0.941	2.2901	0.942	59	63	395	63
Beta-BHC	41	40	nonparametric (assumed lognorm.)	0.2173	0.3623	0.941	1.9362	0.555	1.65	1.57	1.9	1.57
Dieldrin	41	40	nonparametric (assumed lognorm.)	0.2423	0.3871	0.941	1.9635	0.591	3.35	3.24	8.8	3.24
Endosulfan Sulfate	41	40	nonparametric (assumed lognorm.)	0.3028	0.4312	0.941	2.0401	0.683	3.82	3.72	25	3.72
Gamma-Chlordane	41	40	nonparametric (assumed lognorm.)	0.2893	0.4377	0.941	2.0151	0.654	1.86	1.85	6.8	1.85
Methoxychlor	41	40	nonparametric (assumed lognorm.)	0.2597	0.3861	0.941	1.9863	0.619	17.8	17.2	70	17.2
1,4-Dichlorobenzene	32	31	nonparametric (assumed lognorm.)	0.4468	0.6791	0.93	2.3449	0.939	332	394	220	220
Benz(a)anthracene	32	31	nonparametric (assumed lognorm.)	0.483	0.7657	0.93	2.2652	0.866	316	384	1100	384
Benzo(a)pyrene	32	31	nonparametric (assumed lognorm.)	0.4767	0.7698	0.93	2.253	0.855	310	375	920	375
Benzo(b)fluoranthene	32	31	nonparametric (assumed lognorm.)	0.4756	0.8083	0.93	2.2998	0.898	302	371	1000	371
Benzo(g,h,i)perylene	32	31	nonparametric (assumed lognorm.)	0.4785	0.769	0.93	2.2558	0.858	311	377	960	377
Bis(2-ethylhexyl)phthalate	26	25	nonparametric (assumed lognorm.)	0.3819	0.817	0.92	2.1899	0.75	239	287	180	180
Chrysene	32	31	nonparametric (assumed lognorm.)	0.4565	0.7301	0.93	2.322	0.918	336	403	2000	403
Di-n-butylphthalate	25	24	nonparametric (assumed lognorm.)	0.5106	0.8185	0.918	2.5923	1.08	390	578	57	57

Table 6-5
REPRESENTATIVE CONCENTRATION AND STATISTICAL DISTRIBUTION OF CONTAMINANTS - SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Substance	Number of Sample Results	Degrees of Freedom	Statistical Distribution or Site Data	Results of Shapiro-Wilk or Shapiro-Francia Distribution Tests			Table Value for $H_{0.95}$ (Lognorm.) or $T_{0.95}$ (Normal)	Standard Deviation or Log Standard Deviation	Arithmetic Mean of All Site Results	Upper 95 % Confidence Limit (UCL) on Mean	Maximum Positive Site Concentration	Representative Concentration
				W-norm.	W-lognorm.	W-Table						
Fluoranthene	33	32	nonparametric (assumed lognorm.)	0.4738	0.8091	0.931	2.3517	0.953	305	378	1500	378
Naphthalene	32	31	nonparametric (assumed lognorm.)	0.463	0.7364	0.93	2.3245	0.921	347	420	120	120
Phenanthrene	32	31	nonparametric (assumed lognorm.)	0.4592	0.7108	0.93	2.3122	0.91	326	389	1800	389
Pyrene	32	31	nonparametric (assumed lognorm.)	0.4571	0.7618	0.93	2.3842	0.974	344	417	2500	417
1,1-Dichloroethene	53	52	nonparametric (assumed lognorm.)	0.7261	0.8293	0.979	1.8482	0.462	4.11	4.6	2	2
2-Butanone	41	40	nonparametric (assumed lognorm.)	0.3227	0.6594	0.941	1.9693	0.598	8.83	9.27	91	9.27
2-Hexanone	51	50	nonparametric (assumed normal)	0.6808	0.6527	0.978	1.6759	1.65	5.49	5.87	2	2
4-Methyl-2-pentanone	52	51	nonparametric (assumed normal)	0.724	0.6422	0.979	1.6753	1.84	5.26	5.69	4	4
Acetone	20	19	nonparametric (assumed lognorm.)	0.5153	0.5533	0.905	3.1338	1.37	39.4	76.7	300	76.7
Benzene	53	52	nonparametric (assumed lognorm.)	0.6596	0.8021	0.979	1.8746	0.503	4.31	4.84	16	4.84
Carbon Disulfide	53	52	nonparametric (assumed lognorm.)	0.7177	0.8234	0.979	1.8601	0.481	4.37	4.91	13	4.91
Ethylbenzene	53	52	nonparametric (assumed lognorm.)	0.7077	0.804	0.979	1.8467	0.46	4.08	4.56	3	3
Tetrachloroethene	52	51	nonparametric (assumed lognorm.)	0.7247	0.8114	0.979	1.8509	0.464	4.15	4.65	14	4.65
Toluene	53	52	nonparametric (assumed lognorm.)	0.7728	0.8838	0.979	1.9012	0.542	4.23	4.89	15	4.89
Vinyl Chloride	53	52	nonparametric (assumed lognorm.)	0.7189	0.7999	0.979	1.8475	0.461	4.18	4.69	7	4.69
Xylene (Total)	53	52	nonparametric (assumed lognorm.)	0.4033	0.6276	0.979	1.8126	0.404	7.39	8.17	34	8.17

Notes:

Units are mg/kg for inorganics, ug/kg for organics.
Number of sample results excludes rejected data or blank-qualified data. Duplicates are consolidated into one result. Non-detected results are treated as present at one-half the detection limit in all calculations.
Statistical distribution of data is determined using Shapiro-Wilk test for n <= 50, Shapiro-Francia test for n > 50. Statistical significance level is 0.05.
A normal distribution is assumed if the test statistic W-norm. is >= than the reference value (W-table), and W-norm. > W-lognorm.
A lognormal distribution is assumed if the test statistic W-lognorm. is >= the reference value (W-table), and W-lognorm. >= W-norm. A lognormal distribution is also the default assumption if neither distribution passes Shapiro test.
H-values and standard deviations of log-transformed data are used to calculate the UCL if data are assumed to be lognormally distributed. Student's T-values and standard deviations are used for normally distributed data.
Arithmetic mean includes positive detections and non-detected results (detection limits are divided by two).
The representative concentration is selected as the lower of the 95 % UCL on the mean and the maximum positive site concentration.
*Distributional shape based on n<5. Evaluation may not be accurate.

E 6-6

OCCURRENCE AND DISTRIBUTION OF CONTAMINANTS IN SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
ALUMINUM	5805	4 / 4	4770 - 8090	NORMAL OVER LOGNORMAL	7560
ARSENIC	3.7	4 / 4	3.3 - 3.6	NONPARAMETRIC DIST	3.60
BARIUM	53.8	4 / 4	45.6 - 68.5	NONPARAMETRIC DIST	68.5
BERYLLIUM	0.7	4 / 4	0.63 - 0.88	NONPARAMETRIC DIST	0.88
CADMIUM	1.4	2 / 2	1.3 - 1.9	NONPARAMETRIC DIST	1.9
CALCIUM	8300	4 / 4	1270 - 3490	NONPARAMETRIC DIST	3490
CHROMIUM	16.6	4 / 4	9.3 - 18.3	NONPARAMETRIC DIST	18.3
COBALT	7.2	3 / 3	5.4 - 7.6	NONPARAMETRIC DIST	7.6
COPPER	18.4	4 / 4	20.6 - 59.5	NONPARAMETRIC DIST	59.5
IRON	15800	4 / 4	10900 - 21300	NONPARAMETRIC DIST	21300
LEAD	27.8	4 / 4	38.7 - 168	NONPARAMETRIC DIST	168
MAGNESIUM	5165	4 / 4	1750 - 2640	NONPARAMETRIC DIST	2640
MANGANESE	284	4 / 4	135 - 628	NORMAL	554.78
NICKEL	14.2	4 / 4	8.6 - 16.8	NONPARAMETRIC DIST	16.8
POTASSIUM	1325	4 / 4	397 - 767	NONPARAMETRIC DIST	767
SILVER	-	1 / 2	0.71	NONPARAMETRIC DIST	0.71
THALLIUM	-	1 / 4	0.96	NONPARAMETRIC DIST	0.96
VANADIUM	25.4	4 / 4	13.6 - 22.7	NONPARAMETRIC DIST	22.7
ZINC	129	4 / 4	111 - 486	NONPARAMETRIC DIST	486

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

TABLE 6-6 (continued)

OCCURRENCE AND DISTRIBUTION OF CONTAMINANTS IN SEDIMENT

NAWC WARMINSTER, PENNSYLVANIA

(ug/kg)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
4,4'-DDE	-	2 / 5	9 - 24	NONPARAMETRIC DIST	24
4,4'-DDT	-	1 / 5	430	NORMAL OVER LOGNORMAL	270.55
ALDRIN	-	3 / 5	3.6 - 4.7	NONPARAMETRIC DIST	4.7
ALPHA-CHLORDANE	5.85	1 / 5	15	NORMAL OVER LOGNORMAL	10.03
AROCLOR-1260	-	4 / 5	270 - 1900	NONPARAMETRIC DIST	1900
DELTA-BHC	-	1 / 5	4	NONPARAMETRIC DIST	4.00
DIELDRIN	-	1 / 5	13	NORMAL	9.41
METHOXYCHLOR	-	1 / 5	79	NORMAL	55.91
4-METHYLPHENOL	-	2 / 2	450 - 560	NONPARAMETRIC DIST	560
ACENAPHTHENE	110	1 / 2	470	NONPARAMETRIC DIST	470
ANTHRACENE	330	2 / 2	200 - 1400	NONPARAMETRIC DIST	1400
BENZ(A)ANTHRACENE	1300	2 / 2	530 - 5200	NONPARAMETRIC DIST	5200
BENZO(A)PYRENE	880	2 / 2	450 - 4400	NONPARAMETRIC DIST	4400
BENZO(B)FLUORANTHENE	1300	2 / 2	690 - 7100	NONPARAMETRIC DIST	7100
BENZO(G,H,I)PERYLENE	720	2 / 2	390 - 2000	NONPARAMETRIC DIST	2000
BENZO(K)FLUORANTHENE	1000	2 / 2	250 - 2100	NONPARAMETRIC DIST	2100
BIS(2-ETHYLHEXYL)PHTHALAT	1900	2 / 2	580 - 18000	NONPARAMETRIC DIST	18000
BUTYLBENZYLPHTHALATE	-	1 / 2	120	NONPARAMETRIC DIST	120
CARBAZOLE	287.5	2 / 2	120 - 1100	NONPARAMETRIC DIST	1100
CHRYSENE	1500	2 / 2	550 - 5600	NONPARAMETRIC DIST	5600
DI-N-BUTYLPHTHALATE	-	1 / 2	5100	NONPARAMETRIC DIST	5100
DI-N-OCTYLPHTHALATE	-	1 / 2	79	NONPARAMETRIC DIST	79
DIBENZ(A,H)ANTHRACENE	96	1 / 2	55	NONPARAMETRIC DIST	55
FLUORANTHENE	3400	2 / 2	1200 - 17000	NONPARAMETRIC DIST	17000
FLUORENE	190	2 / 2	65 - 600	NONPARAMETRIC DIST	600
INDENO(1,2,3-CD)PYRENE	600	2 / 2	320 - 2400	NONPARAMETRIC DIST	2400
N-NITROSODIPHENYLAMINE	-	1 / 2	1700	NONPARAMETRIC DIST	1700
PYRENE	2900	2 / 2	1200 - 9900	NONPARAMETRIC DIST	9900

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

6-7

OCCURRENCE AND DISTRIBUTION OF CONTAMINANTS IN SURFACE WATER

NAWC WARMINSTER, PENNSYLVANIA

(ug/L)

SUBSTANCE	BACKGROUND	SITE-RELATED			
	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BARIUM	100	3 / 4	80.9 - 94.2	NORMAL OVER LOGNORMAL	94.2
CALCIUM	28100	3 / 3	21800 - 24300	NONPARAMETRIC DIST	24300
IRON	895	1 / 1	388	NONPARAMETRIC DIST	388
MAGNESIUM	11150	3 / 3	8270 - 9090	NONPARAMETRIC DIST	9090
MANGANESE	154	3 / 3	55 - 119	NONPARAMETRIC DIST	119
NICKEL	-	1 / 4	20	NORMAL	17.5
POTASSIUM	1545	3 / 3	910 - 1180	NONPARAMETRIC DIST	1180
SODIUM	16150	3 / 3	9760 - 13600	NONPARAMETRIC DIST	13600
THALLIUM	-	1 / 4	4.9	NORMAL	4.3
ZINC	30.60	2 / 2	9 - 27.6	NONPARAMETRIC DIST	27.6

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

Warm_Site_5_SW_SD_Occ.xls 7/13/00 12:47 PM

TABLE 6-7 (continued)
OCCURRENCE AND DISTRIBUTION OF CONTAMINANTS IN SURFACE WATER
NAWC WARMINSTER, PENNSYLVANIA
(ug/L)

	BACKGROUND	SITE-RELATED			
SUBSTANCE	REPRESENTATIVE CONCENTRATION*	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION**	STATISTICAL DISTRIBUTION	REPRESENTATIVE CONCENTRATION
BIS(2-ETHYLHEXYL)PHTHALAT	-	1 / 2	1	NONPARAMETRIC DIST	1

* = REPRESENTATIVE CONCENTRATION FOR BACKGROUND IS PRESENTED IN TABLE X-X

** = QUALIFIERS FOR DATA ARE PRESENTED IN DATA PRESENTATION TABLES

nonparametric [assumed lognormal], however, because 5 or less samples were collected in sediment and 4 or less samples were collected in surface water, there is low confidence in the shapes of these distributions.

6.2.4 Exposure Point Concentrations

An EPC was calculated for each COPC identified in the surface and subsurface soil data sets. Post-remedial concentrations of detected chemicals at each medium were evaluated. Usability of results is discussed below. The EPC was calculated using the latest risk assessment guidance from EPA (1985, 1989a, 1991a, 1998a) and Gilbert (1987).

6.2.4.1 Calculation of Exposure Point Concentrations

Where available, validated data were used to calculate EPCs. The validated data for Site 5 were generated between 1989 and 1999 as part of RI fieldwork. For purposes of calculating the EPC, a value of one-half the sample quantitation limit was assumed for non-detect (U, UJ, and UL qualified) results. Estimated values (J qualified), biased values (L and K qualified), other qualified values (N and P qualified) were used as the reported value. Rejected (R and UR qualified) and blank-contamination (B and BJ qualified) values were eliminated from further consideration.

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 arises whenever half the detection limit exceeded the positive result. In these situations, the positive result was used to represent the non-detect.

The calculation of an EPC involves two steps. First, the distribution of the data was determined as discussed in the preceding section. Then, based on the distribution of the data, an EPC was either calculated or selected.

Several important assumptions were used to evaluate the distribution of the data (Section 6.2.4):

- The distribution of a data set was determined using a Shapiro-Wilk test.
- The distributions were classified as lognormal, normal, or unknown.
- If the data were not determined to match either a lognormal or normal distribution, they were classified as the better fitting of the two types of distributions.

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

$$S = \sqrt{\sum\left(\frac{(x_i - \mu)^2}{n-1}\right)}$$

where:

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

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

$$UCL_{LOG} = e^{\left[\mu + 0.5S^2 + \left(\frac{SH}{\sqrt{n-1}}\right)\right]}$$

where:

e	=	constant (base of the natural log, equal to 2.718)
μ	=	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 EPC was then selected as the lesser value of the one-sided 95 percent UCL and the maximum positive value in the data set.

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

First, the standard deviation of the sample set was determined:

$$S = \sqrt{\Sigma\left(\frac{(x_i - \mu)^2}{n-1}\right)}$$

where:

S	=	Standard deviation of the data
X_i	=	Individual sample value
μ	=	Arithmetic mean of the n samples
n	=	Number of samples

The one-sided upper 95 percent confidence limit (UCL_{NOR}) was calculated as follows:

$$UCL_{NOR} = \mu + \frac{(t * S)}{\sqrt{n}}$$

where:

S	=	Standard deviation of the data
t	=	One-sided t distribution factor
μ	=	Arithmetic mean of the n samples
n	=	Number of samples

The EPC was then selected as the lesser value of the one-sided 95 percent UCL and the maximum positive value in the data set.

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

6.2.4.2 Reasonable Maximum Exposure EPCs

Reasonable maximum exposure (RME) EPCs were considered for use in this HHRA. RME is the exposure that is expected to represent an upper-bound exposure in a given medium of interest. RME EPCs are selected from the maximum value, 95% upper confidence limit on the mean of normally distributed data (95% UCL-N), or the upper 95% upper confidence limit on log transformed data (95% UCL-T). As explained in Section 6.2.4.1, the RME EPC is the lower of the maximum value and the 95% UCL-N or 95% UCL-T (selected based on distribution of the data).

6.2.4.3 EPCs for Current/Future and Future Surface Soil Exposure Pathways

Surface soil EPCs for the current/future industrial adult, future residential child, and future residential adult are shown on Table 6-2. The RME EPC in surface soil for lead was based on an estimate of the mean (in this case the minimum variance unbiased estimate of the arithmetic mean of lognormally distributed data) as required by the IEUBK Model. The maximum detected concentration was less than the calculated UCL-statistic for benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene; therefore, the RME EPC in surface soil for these COPCs were based on the maximum detected concentration. The calculated UCL-statistic was less than the reported maximum for each of the remaining surface soil COPCs [aluminum, cadmium, copper, manganese, mercury, silver, thallium, vanadium, zinc, Aroclor-1242, Aroclor-1254, benz(a)anthracene, and chrysene], therefore, RME EPCs for each of these contaminants were based on the 95% UCL-T statistic. The rationale for each 95% UCL-statistic was based on determination of the data distributional shape (normal, lognormal, nonparametric [assumed lognormal], or nonparametric [assumed normal]) and statistical scores that were presented on Table 6-4.

6.2.4.4 EPCs for Current/Future and Future Subsurface Soil Exposure Pathways

Subsurface soil EPCs for the current/future industrial adult, future residential child, and future residential adult are shown on Table 6-3. The RME EPC in subsurface soil for lead was based on an estimate of the mean as required by the IEUBK Model. The calculated UCL-statistic was less than the reported maximum for aluminum, therefore, the RME EPC was based on the 95% UCL-N statistic. The calculated UCL-T statistic was less than the reported maximum for arsenic, barium, cadmium, copper, iron, manganese, mercury, nickel, silver, thallium, vanadium, zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aroclor-1242, Aroclor-1248, Aroclor-1254, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene, therefore, the RME EPC was based on the 95% UCL-T statistic. The rationale for each 95% UCL-statistic was based on determination of the data distributional shape (normal, lognormal, nonparametric [assumed lognormal], or nonparametric [assumed normal]) and statistical scores that were presented on Table 6-5.

6.2.4.5 EPCs for Future Sediment Exposure Pathways

Sediment EPCs for the future recreational child (age 6 - 12) are shown on Table 6-6. The UCL-statistic could not be calculated for most organic and some inorganic compounds because of the low number of data points. Therefore, the majority of RME EPCs in sediment for these COPCs were based on the maximum detected concentration.

6.2.4.6 EPCs for Future Surface Water Exposure Pathways

Surface water EPCs for the future recreational child (age 6 - 12) are shown on Table 6-7. The calculated UCL-statistics were less than the reported maximums for nickel and thallium, therefore, the RME EPC was based on the 95% UCL-N statistic. The reported maximum was less than the calculated UCL statistcs for bis(2-ethylhexyl)phathalate; therefore, the RME EPC was based on the maximum concentration.

6.3 EXPOSURE ASSESSMENT

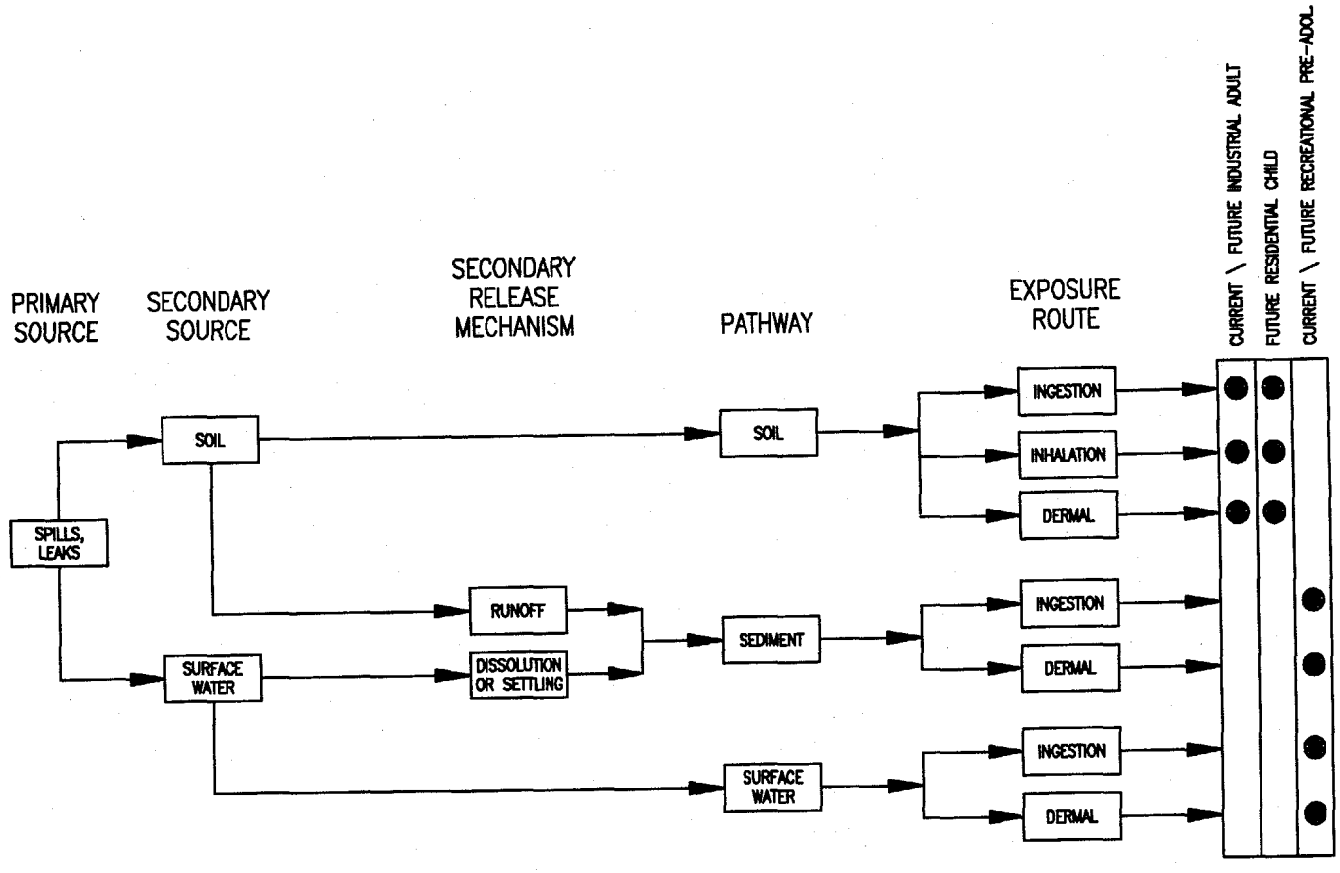
The exposure assessment evaluates the potential for human exposure to the chemicals detected in the environmental media at Site 5 investigated during the RI. This section presents a characterization of the exposure setting, characterizes the exposed populations, identifies actual or potential exposure routes, and summarizes the methods used to generate exposure estimates. The nature and extent of contamination for each media of interest for which exposures were based are presented in Section 4.0.

6.3.1 Characterization of the Exposure Setting

A characterization of the site setting (e.g. land use, hydrology, and soil characteristics) is presented in Section 3.0. The Site 5 area is comprised of media of interest at or surrounding the site including surface soil, subsurface soil, sediment, and surface water. Any media contamination occurring within the study area that were attributable to Site 5 would generally be present as the result of migration of contaminants away from the site via spills, infiltration, overland runoff, or fugitive dust emissions. Contaminant migration and accompanying receptor exposures within the study area would have to be associated with primary, secondary and tertiary release mechanisms and transport processes. Section 5.0 provides a more thorough discussion of these mechanisms and processes.

6.3.2 Potential Receptors

The potential receptors chosen for Site 5 are discussed in detail in this section. Figure 6-1 displays the conceptual model for human health risks related to site 5. The on/off-base receptors were selected based on several criteria (i.e., current and anticipated future land use, accessibility to the site, and media of interest sampled) and are listed as follows:



No.	DATE	REVISIONS	BY	CHKD.	APPD.
1	4/25/0	DRAWN, UPDATED & NEW BORDER	LDL		

DRAWN BY LDL DATE 4/29/99
CHECKED BY DATE
REVISED BY DATE
SCALE NONE

Tetra Tech NUS, Inc.

AREA B, SITE 5
CONCEPTUAL MODEL
HUMAN HEALTH RISK ASSESSMENT
FORMER NAWC WARMINSTER
WARMINSTER, PENNSYLVANIA

CONTRACT NO. 1412
OWNER NO. 4010
APPROVED BY DATE 10 Jul 00
DRAWING NO. FIGURE 1
REV. 1

6.3.2.1 Surface Soil Exposure

The surface soil exposure scenarios are presented below (a more detailed explanation of each exposure parameter selected for each potential receptor is provided in Section 6.3.3):

- Current/Future Industrial Adult - This receptor is an adult who uses Site 5 for work-related industrial purposes 250 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in surface soil.
- Future Residential Child - This receptor is a child (age 1 - 6) who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in surface soil.
- Future Residential Adult - This receptor is an adult who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in surface soil.
- Future Lifetime Resident - This receptor is a residential child (age 1 - 6) and a residential adult who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in surface soil. [This additive residential exposure scenario is included to estimate the lifetime cancer risk under a residential land use scenario].

6.3.2.2 Subsurface Soil Exposure

The subsurface soil exposure scenarios are presented below. A more detailed explanation of each exposure parameter selected for each potential receptor is provided in Section 6.3.3. The exposure scenarios for subsurface soils included:

- Current/Future Industrial Adult - This receptor is an adult who uses Site 5 for work-related industrial purposes 250 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in subsurface soil.
- Future Residential Child - This receptor is a child (age 1 - 6) who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in subsurface soil.
- Future Residential Adult - This receptor is an adult who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in subsurface soil.

- Future Lifetime Resident - This receptor is a residential child (age 1 - 6) and a residential adult who resides at or near Site 5 for 350 days/year. This receptor is potentially exposed via ingestion of, dermal absorption with, and inhalation of COPCs in subsurface soil. (This additive residential exposure scenario is included to estimate the lifetime cancer risk under a residential land use scenario.)

6.3.2.3 Sediment Exposure

The sediment exposure scenario is presented below. A more detailed explanation of each exposure parameter selected for the potential receptor is provided in Section 6.3.3. The exposure scenario for sediment included:

- Future Recreational Child (age 6 to 12 years) – The future recreational child will live in a future residence at or near Site 5. This receptor contacts sediment present in streams through wading activities. This receptor is potentially exposed via ingestion of and dermal absorption with COPCs in sediment. Noncarcinogenic and carcinogenic risks were estimated for the recreational child receptor.

6.3.2.4 Surface Water (Total Inorganics and Organics) Exposure

The surface water (total inorganics and organics) exposure scenario is presented below. A more detailed explanation of each exposure parameter selected for the potential receptor is provided in Section 6.3.3. The exposure scenario for surface water (total inorganics) included:

- Future Recreational Child (age 6 to 12 years) – The future recreational child will live in a future residence at or near Site 5. This receptor wades in surface water present in streams near Site 5. This receptor is potentially exposed via ingestion of and dermal absorption with COPCs in surface water (total inorganics and organics). Noncarcinogenic and carcinogenic risks were estimated for the recreational child receptor.

6.3.3 Exposure Estimates

The estimation routes, methods, and models presented in this section are consistent with current EPA risk assessment guidance (EPA, 1989a, 1991b, and 1998b). Exposure estimates associated with each exposure route are presented below. All exposure scenarios incorporate RME EPCs in the estimation of intakes. There are four environmental media for Site 5 through which potential receptors can be either directly or indirectly exposed to site-related COPCs: surface soil, subsurface soil, sediment, and surface water.

Noncarcinogenic risks were 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 along 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) were generally greater for children than for adults because of differences in body weight and intake. Carcinogenic risks, on the other hand, were calculated as an incremental lifetime risk and, therefore, incorporate terms to represent the exposure duration (years) over the course of a lifetime (70 years).

6.3.3.1 Surface and Subsurface Soil Exposure Estimates

Three potential exposure routes were associated with direct exposure to surface and subsurface soil at Site 5, including:

- Ingestion
- Dermal absorption
- Inhalation of fugitive dust

For surface soil, all three exposure routes were evaluated using the current/future industrial adult receptor, future residential child receptor, future residential adult receptor, and future lifetime residential receptor [cancer risks only]. These receptors were chosen because they are expected to be representative of typical industrial or residential exposures at Site 5.

For subsurface soil, all three exposure routes were evaluated using the current/future industrial adult receptor, future residential child receptor, future residential adult receptor, and future lifetime residential receptor [cancer risks only]. These receptors were chosen because they are expected to be representative of typical industrial or residential exposures at Site 5.

Ingestion of and dermal contact with soil are expected to contribute to the majority of the risk under the soil exposure scenarios, whereas risks based on exposure to fugitive dust are expected to be low. For fugitive dust emissions under industrial and residential exposure, the fraction of vegetative surface cover was assumed to be 50% of the surface area. Derivation of the particle emission factor is presented in EPA's Soil Screening Guidance (EPA, 1996b). Concentrations of VOCs in surface soil and subsurface soil do not exceed inhalation of volatile soil screening levels (SSLs; EPA, 1996b), therefore, these exposure pathways were not quantitatively evaluated in this HHRA.

Table 6-8 through Table 6-11 present the RME input parameters selected for the surface and subsurface exposure pathways for the future residential child. Table 6-12 through Table 6-15 present the RME input parameters selected for surface and subsurface exposure pathways for the future residential adult. Table 6-16 through Table 6-19 present the RME input parameters selected for the surface and subsurface exposure pathways for the current/future industrial adult.

The only input values not shown on the exposure input tables (Tables 6-10 through 6-21) are the chemical-specific absorption factors for the dermal pathway. These values were provided by EPA Region III. For surface soil and subsurface soil COPCs, absorption factors were as follows (EPA, 1995): aluminum (1%), arsenic (3%), barium (1%), cadmium (1%), copper (1%), iron (1%), lead (1%), manganese (1%), mercury (1%), nickel (1%), silver (1%), thallium (1%), vanadium (1%), zinc (1%), 4,4'-DDD (10%), 4,4'-DDE (10%), 4,4'-DDT (10%), Aroclor-1242 (6%), Aroclor-1248 (6%), Aroclor-1254 (6%), benz(a)anthracene (10%), benzo(a)pyrene (10%), benzo(b)fluoranthene (10%), benzo(k)fluoranthene (10%), chrysene (10%), dibenz(a,h)anthracene (10%), and indeno(1,2,3-cd)pyrene (10%). Derivation of the surface areas (used in all dermal exposure equations in this risk assessment) for each of the potential receptors was based on the sum of the surface areas for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix J. This table also shows the input values used to derive the average body weights for the age-range categories for the residential child (age 1 – 6). Sample calculations for ingestion, dermal absorption, and inhalation of fugitive dust of COPCs in surface and subsurface soil are provided in Appendix G, Part 3.

6.3.3.2 Sediment Soil Exposure Estimates

Two potential exposure routes were associated with direct exposure to sediment at off-site areas near Site 5, including ingestion and dermal absorption.

For sediment, both exposure routes were evaluated using the future recreational child (age 6 - 12) receptor. This receptor was chosen because it is expected to be representative of typical recreational exposures at off-site areas near Site 5.

Tables 6-20 and 6-21 present the RME input parameters (and rationale) selected for the sediment exposure pathways for the future recreational child. The only input values not shown on the exposure input tables are the chemical-specific absorption factors for the dermal pathway. These values were provided by EPA Region III. For sediment COPCs, absorption factors were as follows (EPA, 1995): 1% for inorganics, 10% for semivolatile organic compounds and pesticides, 6% for polychlorinated biphenyls, 0.05% for any volatile organic compound with a vapor pressure greater than that of benzene, and 3% for any volatile organic compound with a vapor pressure less than that of benzene. Derivation of the surface

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME CHILD RESIDENT CONTACT WITH SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	95	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, forearms, lower legs, and feet of Residential Child of age 1 through 6 years> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-9

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.2	EPA, 1997	--	--	
	ET	Exposure Time	hours/day	24	(b)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	

Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 24 Hours per day of exposure based on entire day spent at residence.

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

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

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME CHILD RESIDENT CONTACT WITH SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	95	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, forearms, lower legs, and feet of Residential Child of age 1 through 6 years> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-11

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.2	EPA, 1997	--	--	
	ET	Exposure Time	hours/day	24	(b)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	6	EPA, 1997	--	--	
	BW	Body Weight	kg	16.6	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	2190	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 24 Hours per day of exposure based on entire day spent at residence.

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

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

T. 2

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT RESIDENT CONTACT WITH SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	297	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, forearms, lower legs, and feet of Residential Adult> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-13

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997	--	--	
	ET	Exposure Time	hours/day	24	(b)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 24 Hours per day of exposure based on entire day spent at residence.

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

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

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT RESIDENT CONTACT WITH SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	297	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	

Notes/Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, forearms, lower legs, and feet of Residential Adult> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-15

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997	--	--	
	ET	*Exposure Time*	*hours/day*	24	(b)	--	--	
	EF	Exposure Frequency	days/year	350	EPA, 1997	--	--	
	ED	Exposure Duration	years	24	EPA, 1997	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8760	EPA, 1989	--	--	

Sources:

Lifetime exposures for future residents (child/adult) will be quantified indirectly, by adding child and adult cancer risks in the Risk Characterization section of this risk assessment.

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 24 Hours per day of exposure based on entire day spent at residence.

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

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

T. 6

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT INDUSTRIAL WORKER CONTACT WITH SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	50	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	599	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	

Notes/Sources:

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, and forearms of Industrial Worker> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-17

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997	--	--	
	ET	Exposure Time	hours/day	8	(b)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	

Notes/Sources:

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 8 Hours per day of exposure based on an average workday.

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

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

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT INDUSTRIAL WORKER CONTACT WITH SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	50	EPA, 1997	--	--	CS x IR-S x FI x EF x ED x CF3 x 1/(BW x AT)
	FI	Fraction Ingested From Contaminated Source	--	1	(a)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	
Dermal	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Dermal Absorbed Dose (mg/kg-day) =
	SMAFB	Summation [Adherence Factor per Body Part Exposed]	mg/event	599	(b)	--	--	CS x SA x SSAF x DABS x EV x EF x ED x CF3 x 1/(BW x AT)
	DABS	Dermal Absorption Factor (Solid)	--	Chemical-Specific	EPA, 1995	--	--	
	EV	Event Frequency	events/day	1	(c)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	CF3	Conversion Factor 3	kg/mg	1E-06	--	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	

Sources:

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Summation of [body part specific adherence factor (mg/cm2-event) * applicably exposed body part surface area <represented by face, hands, and forearms of Industrial Worker> for soil (cm2)]. See Appendix J.

(c). Professional Judgment. 1 Event per day.

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

EPA, 1995. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance Manual, EPA/903-K-95-003. December

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

TABLE 6-19

VALUES USED FOR DAILY INTAKE CALCULATIONS - RME ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL

NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical Concentration in Soil	mg/kg	See Table 3	See Table 3	--	--	Intake (mg/kg-day) =
	PEF	Particulate Emission Factor from Soil	m3/kg	1.32E+09	(a)	--	--	(CS/PEF) x IR-A x ET x EF x ED x 1/(BW x AT)
	IR-A	Inhalation Rate	m3/hr	1.6	EPA, 1997	--	--	
	ET	Exposure Time	hours/day	8	(b)	--	--	
	EF	Exposure Frequency	days/year	250	EPA, 1997	--	--	
	ED	Exposure Duration	years	25	EPA, 1997	--	--	
	BW	Body Weight	kg	70	EPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25550	EPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	9125	EPA, 1989	--	--	

Notes/Sources:

(a). Site Specific PEF. See Appendix G for derivation.

(b). Professional Judgment. 8 Hours per day of exposure based on an average workday.

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

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

TABLE 6-20
EXPOSURE INPUT PARAMETERS - SEDIMENT INGESTION
NAWC WARMINSTER, PENNSYLVANIA

Incidental Ingestion of Sediment			
Input Parameter	Description	Value	Rationale
C	Exposure concentration	Representative concentration (mg/kg)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a)
IR	Ingestion rate	200 mg/day (recreational child)	(EPA, 1991a)
FI	Fraction ingested from contaminated source	1.0	Professional judgement based on current and projected future land use and observed activity patterns
EF	Exposure frequency	7 days/year (recreational child)	(EPA, 1991a)
ED	Exposure duration	6 years (recreational child)	(EPA, 1991a)
BW	Body weight	25 kg (recreational child)	Wading is expected to occur for older children (age 6 and older; weight 25 kg (EPA, 1991a)
AT	Averaging time	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	Carcinogens (EPA, 1989a)

TABLE 6-21
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

Dermal Contact with Sediment			
Input Parameter	Description	Value	Rationale
C	Exposure concentration	Representative concentration (mg/kg)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a
SA	Skin surface area available for contact	792 sq. cm/day	Feet only; child; sediment (EPA, 1991g)
AF	Soil-to-skin adherence facto	0.2 mg/sq. cm	(EPA, 1992f)
ABS	Absorption factor	Inorganics = 0.01 (except arsenic) SVOCs/Pest = 0.1 PCBs = 0.06 VOCs = if VP>benzene, 0.0005 if VP<benzene, 0.03 Arsenic = 0.03	Feldman and Maibach (1970) Webster and Maibach (1985) EPA (1984a) EPA (1995)
EF	Exposure frequency	7 days/year (recreational child)	(EPA, 1991a)
ED	Exposure duration	6 years (recreational child)	(EPA, 1991a)
BW	Body weight	25 kg (recreational child)	Wading is expected to occur for older children (age 6 and older; weight 25 kg) (EPA, 1991a)
AT	Averaging time	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	Carcinogens (EPA, 1989a)

areas (used in all dermal exposure equations in this risk assessment) for each of the potential receptors was based upon the sum of the surface areas for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix G, Part 3. This table also shows the input values used to derive the average body weight for the recreational child (age 6 - 12). Sample calculations for ingestion and dermal absorption of COPCs in sediment are provided in Appendix G, Part 4.

6.3.3.3 Surface Water Exposure Estimates

Two potential exposure routes were associated with direct exposure to surface water at off-site areas near Site 5, including ingestion and dermal absorption. For surface water, both exposure routes were evaluated using the future recreational child (age 6 - 12) receptor. This receptor was chosen because it is expected to be representative of typical recreational exposures at off-site areas near Site 5.

Tables 6-22 and 6-23 presents the RME input parameters (and rationale) selected for the surface water exposure pathways for the future recreational child. The only input values not shown on the exposure input tables are the chemical-specific permeability constants for the dermal pathway. For the surface water COPCs, nickel, thallium and bis(2-ethylhexyl)phthalate, the permeability constants were obtained from EPA (1992e). Derivation of the surface areas (used in all dermal exposure equations in this risk assessment) for each of the potential receptors was based upon the sum of the surface areas for contributing body parts. These were derived from several sources (EPA, 1997b and EPA, 1985) and are shown in detail in a table in Appendix J. This table also shows the input values used to derive the average body weight for the recreational child (age 6 - 12). Sample calculations for ingestion and dermal absorption of COPCs in surface water are provided in Appendix G, Part 3.

6.3.4 Blood-Lead Modeling

As outlined in OSWER Directive 9355.4-12, EPA (1994a) has developed an approach to evaluating lead risks that recognizes the multimedia nature of lead exposures, incorporating absorption and pharmacokinetic information. Research has been conducted concerning lead intake and resultant blood-lead levels. Determinations of lead uptake from soil and drinking water were considered. Potential blood-lead level increases are estimated and are discussed, along with the potential implications of blood-lead results for residential children. The following discussion presents information that is useful in estimating lead exposure.

No threshold has been defined for effects related to blood-lead increases. Effects below blood-lead levels of 10 ug/dL are difficult to define. Inhibition of certain enzymes involved in red blood cell metabolism has

TABLE 6-22
EXPOSURE INPUT PARAMETERS - SURFACE WATER INGESTION
NAWC WARMINSTER, PENNSYLVANIA

Incidental Ingestion of Surface Water (Recreational Children)			
Input Parameter	Description	Value	Rationale
C	Exposure concentration	Representative concentratio (mg/L)	Upper 95% confidence limit on arithmetic average (based upon normal or log-transformed data distribution) (EPA, 1989a)
IR	Ingestion rate	0.2 L/day	(EPA, 1989a)
EF	Exposure frequency	7 days/year	(EPA, 1989a)
ED	Exposure duration	6 years	(EPA, 1991a)
BW	Body weight	25 kg (recreational child)	Wading is expected to occur for older children (age 6 and older; weight 25 kg) (EPA, 1991a)
AT	Averaging time	ED x 365 days/year	Noncarcinogens (EPA, 1989a)
		70 years x 365 days/year	Carcinogens (EPA, 1989a)

TABLE 6-23
EXPOSURE INPUT PARAMETERS - DERMAL CONTACT WITH SURFACE WATER
NAWC WARMINSTER, PENNSYLVANIA

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

been reported to occur at 10 to 15 ug/dL and possibly lower. Small increases in blood pressure have been observed in adults with blood-lead levels down to 7 ug/dL (EPA, 1994b). The most sensitive subpopulation to effects below 7 ug/dL, would be infants, whose early neurological development can be affected by blood-lead concentrations reportedly down to 5 ug/dL (EPA, 1994b). 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, 1994b). 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, 1994b). For adults, the ratio is approximately 0.06 ug/dL blood lead per ug/L in water (EPA, 1994b).

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).

Blood-lead levels in residential children (age 0 - 6) were estimated using the Integrated Exposure and Uptake Biokinetic (IEUBK) Model (version 0.99) developed by EPA (EPA, 1994b). The model is applied using the average surface soil at Site 5. As discussed in Section 6.2.2, lead was selected as a COPC in surface soil and subsurface soil [the maximum detection of lead (1,020 mg/kg in surface soil and 2,400 mg/kg in subsurface soil) exceeds the 400 mg/kg OWSER Directive benchmark criterion].

For the assessment of ingestion of lead in surface soil and subsurface soil by residential children, default values in the model are used to represent background lead concentrations in air, house dust, water, and the level of material contribution. Additionally, the model's default values are used to represent respiratory rate, soil and water ingestion rates, and the percent of lead absorption by the various exposure routes. The only site-specific factor put into the IEUBK Model is the average lead concentration of 77.5 mg/kg in surface soil and 72.7 mg/kg in subsurface soil.

The output 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 threshold significance 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, 1994a). This histogram, along with input information particular to each run of the IEUBK model, is presented in Appendix G, Part 1. The estimated percentage of residential

children (age 0 through 6 years) with a blood-lead level above 10 ug/dL is also presented in Section 6.5.6. Uncertainties associated with the IEUBK model are discussed in Section 6.6.4.

6.4 DOSE-RESPONSE ASSESSMENT

The dose-response assessment identifies 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. Toxicity information for the COPCs in surface soil, subsurface soil, sediment, and surface water at Site 5 are presented in Tables 6-24 through 6-27 and Appendix H in the form of toxicological profiles.

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.

Dose-response values [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.

6.4.1 Reference Doses

The RfD is developed by EPA for chronic and/or subchronic human exposure to hazardous chemicals and is based solely on the noncarcinogenic effects of chemical substances. Subchronic RfDs are specifically developed to be protective for a portion of a lifetime exposure to a compound (as a Superfund program guideline, 2 weeks to 7 years). 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). It 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. The uncertainty factor is based on the availability of toxicity data.

TABLE 6-24

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Aluminum	Chronic	1.00E+00	mg/kg-day	2.70E-01	2.70E-01	mg/kg-day	CNS		EPA-NCEA	04/01/00
Arsenic	Chronic	3.00E-04	mg/kg-day	9.50E-01	2.85E-04	mg/kg-day	Skin	3	IRIS	06/09/00
Barium	Chronic	7.00E-02	mg/kg-day	1.00E+00	7.00E-02	mg/kg-day	Cardiovascular/ Kidney	3	IRIS	06/09/00
Cadmium	Chronic	1.00E-03	mg/kg-day	5.00E-02	5.00E-05	mg/kg-day	Kidney	10	IRIS	06/09/00
Copper		4.00E-02	mg/kg-day	6.00E-01	2.40E-02	mg/kg-day	GI Tract		HEAST	1997
Iron		3.00E-01	mg/kg-day	1.00E+00	3.00E-01	mg/kg-day	Liver/Pancreas		EPA-NCEA	04/01/00
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	Chronic	2.40E-02	mg/kg-day	1.00E+00	2.40E-02	mg/kg-day	CNS	1	IRIS	06/09/00
Mercury	Chronic	1.00E-04	mg/kg-day	1.50E-01	1.50E-05	mg/kg-day	CNS	10	IRIS	06/09/00
Nickel	Chronic	2.00E-02	mg/kg-day	1.00E-01	2.00E-03	mg/kg-day	Decr. Org. Wt.	300	IRIS	06/09/00
Silver	Chronic	5.00E-03	mg/kg-day	1.00E+00	5.00E-03	mg/kg-day		3	IRIS	06/09/00
Thallium	Chronic	7.00E-05	mg/kg-day	1.00E+00	7.00E-05	mg/kg-day	Blood	3000	IRIS	06/09/00
Vanadium	Chronic	7.00E-03	mg/kg-day	2.00E-02	1.40E-04	mg/kg-day	NOAEL	100	HEAST	1997
Zinc	Chronic	3.00E-01	mg/kg-day	2.50E-01	7.50E-02	mg/kg-day	Blood	3	IRIS	06/09/00
4,4'-DDD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDT	Chronic	5.00E-04	mg/kg-day	1.00E+00	5.00E-04	mg/kg-day	Liver	100	IRIS	06/09/00
Aroclor-1242	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1248	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1254	Chronic	2.00E-05	mg/kg-day	1.00E+00	2.00E-05	mg/kg-day	Skin/Eye	300	IRIS	06/09/00
Benz(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chrysene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

(1) Refer to RAGS, Part A

(2) Adjusted Dermal Value = Oral RfD Value * Oral to Dermal Adjustment Factor

(3) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

TABLE [illegible]

NON-CANCER TOXICIT[illegible] -- INHALATION

NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Aluminum	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Barium	Chronic	—	—	1.43E-04	mg/kg-day	Fetotoxicity		HEAST Alternative	1997
Cadmium	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Copper	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	Chronic	—	—	1.43E-05	mg/kg-day	CNS	1000	IRIS	06/09/00
Mercury	Chronic	—	—	8.60E-05	mg/kg-day	CNS	30	IRIS	06/09/00
Nickel	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Silver	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDD	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDE	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDT	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1242	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1248	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Aroclor-1254	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Benz(a)anthracene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Chrysene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	—	—	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

(1) Provide equation used for derivation in text.

(2) For IRIS values, provide the date IRIS was searched.

For HEAST values, provide the date of HEAST.

For NCEA values, provide the date of the article provided by NCEA.

TABLE 6-26
CANCER TOXICITY DATA -- ORAL/DERMAL
NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	Weight of Evidence/ Cancer Guideline Description	Source Target Organ	Date (2) (MM/DD/YY)
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	1.50E+00	9.50E-01	1.58E+00	1/(mg/kg-day)	A	IRIS	06/09/00
Barium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manganese	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mercury	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Silver	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4,4'-DDD	2.40E-01	1.00E+00	2.40E-01	1/(mg/kg-day)	B2	IRIS	06/09/00
4,4'-DDE	3.40E-01	1.00E+00	3.40E-01	1/(mg/kg-day)	B2	IRIS	06/09/00
4,4'-DDT	3.40E-01	1.00E+00	3.40E-01	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1242	2.00E+00	1.00E+00	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1248	2.00E+00	1.00E+00	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1254	2.00E+00	1.00E+00	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Benz(a)anthracene	7.30E-01	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Benzo(a)pyrene	7.30E+00	1.00E+00	N/A**	1/(mg/kg-day)	B2	IRIS	06/09/00
Benzo(b)fluoranthene	7.30E-01	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Benzo(k)fluoranthene	7.30E-02	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Chrysene	7.30E-03	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Dibenz(a,h)anthracene	7.30E+00	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Indeno(1,2,3-cd)pyrene	7.30E-01	1.00E+00	N/A**	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00

IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables

** = Dermal slope factor not applicable for carcinogenic PAHs

(1) Oral Cancer Slope Factor/Oral to Dermal Adjustment Factor.
(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of article provided by NCEA.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Weight of Evidence:
Known/Likely
Cannot be Determined
Not Likely

TABLE [illegible]
CANCER TOXICITY [illegible] - INHALATION
NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Unit Risk	Units	Adjustment	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (1) (MM/DD/YY)
Aluminum	---	---	---	N/A	N/A	N/A	N/A	N/A
Arsenic	---	---	---	1.51E+01	1/(mg/kg-day)	A	IRIS	06/09/00
Barium	---	---	---	N/A	N/A	N/A	N/A	N/A
Cadmium	---	---	---	6.30E+00	1/(mg/kg-day)	B1	IRIS	06/09/00
Copper	---	---	---	N/A	N/A	N/A	N/A	N/A
Iron	---	---	---	N/A	N/A	N/A	N/A	N/A
Lead	---	---	---	N/A	N/A	N/A	N/A	N/A
Manganese	---	---	---	N/A	N/A	N/A	N/A	N/A
Mercury	---	---	---	N/A	N/A	N/A	N/A	N/A
Nickel	---	---	---	N/A	N/A	N/A	N/A	N/A
Silver	---	---	---	N/A	N/A	N/A	N/A	N/A
Thallium	---	---	---	N/A	N/A	N/A	N/A	N/A
Vanadium	---	---	---	N/A	N/A	N/A	N/A	N/A
Zinc	---	---	---	N/A	N/A	N/A	N/A	N/A
4,4'-DDD	---	---	---	N/A	N/A	N/A	N/A	N/A
4,4'-DDE	---	---	---	N/A	N/A	N/A	N/A	N/A
4,4'-DDT	---	---	---	3.40E-01	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1242	---	---	---	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1248	---	---	---	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Aroclor-1254	---	---	---	2.00E+00	1/(mg/kg-day)	B2	IRIS	06/09/00
Benz(a)anthracene	---	---	---	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	---	---	---	3.10E+00	1/(mg/kg-day)	B2	EPA-NCEA	04/01/00
Benzo(b)fluoranthene	---	---	---	N/A	N/A	N/A	N/A	N/A
Benzo(k)fluoranthene	---	---	---	N/A	N/A	N/A	N/A	N/A
Chrysene	---	---	---	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	---	---	---	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	---	---	---	N/A	N/A	N/A	N/A	N/A

IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables

Weight of Evidence:
Known/Likely
Cannot be Determined
Not Likely

(1) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity.

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. Oral and dermal RfDs, primary target organs, uncertainty/modifying factors, and sources for selected COPCs in surface soil, subsurface soil, sediment, and surface water are provided in Table 6-24. Inhalation RfDs, primary target organs, uncertainty/modifying factors, and sources for selected COPCs in surface soil and subsurface soil are provided in Table 6-25.

Target organ data have been extracted from the Integrated Risk Information System (IRIS; EPA, 2000a), Health Effect Assessment Summary Tables (HEAST; EPA, 1997a), or other applicable sources. Only the target organs that are affected in the applicable study in which the RfD was derived have been included in Tables 6-24 and 6-25. When multiple target organs are cited in the applicable RfD-derivation study, only the primary target organ will be selected and used in this HHRA.

Noncarcinogenic risks for lead were not quantified and compared to RfDs, because EPA has implemented an approach to evaluating lead risks that does not provide a single-point estimate output. Instead, potential lead exposures are evaluated using a biokinetic model to estimate expected blood-lead increases. The blood-lead model is discussed in Section 6.3.4. A discussion of the results of the blood-lead model estimates is presented in Section 6.5.6.

6.4.2 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.

Oral and dermal SFs, weight of evidence, and sources for selected COPCs in surface soil, subsurface soil, sediment, and surface water are provided in Table 6-26. Inhalation SFs, weight of evidence, and sources for selected COPCs in surface soil and subsurface soil are provided in Table 6-27.

Carcinogenic risks for lead were not quantified, because EPA has not published a SF for inorganic lead. Instead, potential lead exposures were evaluated using a biokinetic model to estimate expected blood-lead increases. A discussion of these results is presented in Section 6.5.6.

6.4.3 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 as follows (EPA, 1992c):

WEIGHT OF EVIDENCE CATEGORY	DEFINTION
A	Known human carcinogen
B1	Probably human carcinogen, limited human data are available
B2	Probable human carcinogen, sufficient animal data are available but inadequate human data are available
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity in humans

6.4.4 Adjustment of Dose-Response Parameters for Dermal Exposure

Risks associated with dermal exposures were evaluated using toxicity values that are specific to absorbed dermal doses. Most oral toxicity values are based on administered doses rather than absorbed doses (TCE being an important exception). Therefore, in accordance with EPA Region III (1995) and EPA (1989a, Appendix A) guidance, the toxicity values based on administered doses were adjusted before they were used for evaluating absorbed doses.

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

$$RfD_{Adjusted} = RfD_{Oral} * GI_{Oral}$$

$$SF_{Adjusted} = {SF_{Oral}}/{GI_{Oral}}$$

where:

GI_{Oral}	=	Gastrointestinal (GI) Absorption Efficiency (EPA, 1995)
RfD_{Oral}	=	Oral Reference Dose (EPA, 2000a; EPA, 1997a; or EPA-NCEA)
SF_{Oral}	=	Oral Slope Factor (EPA, 2000a; EPA, 1997a; or EPA-NCEA)

Dermally adjusted RfDs and SFs for COPCs are presented in Tables 6-24 and 6-26, respectively.

6.4.5 Carcinogenicity of PAHs

Carcinogenic PAHs are related by chemical structure. Only benzo(a)pyrene has an EPA published SF (EPA, 2000a). All other carcinogenic PAHs, except carbazole, have SFs based on their potency relative to benzo(a)pyrene. The relative potency factors (RPF) for carcinogenic PAH COPCs at Site 5 were as follows: (EPA, 2000b):

- Benzo(a)pyrene (RPF = 1.0)
- Benz(a)anthracene (RPF = 0.1)
- Benzo(b)fluoranthene (RPF = 0.1)
- Benzo(k)fluoranthene (RPF = 0.01)
- Chrysene (RPF = 0.001)
- Dibenz(a,h)anthracene (RPF = 1.0)
- Indeno(1,2,3-cd)pyrene (RPF = 0.1)

6.4.6 Toxicity Criteria for Chromium

The toxicity criteria for trivalent chromium (III) were used in this HHRA evaluation because hexavalent chromium was not detected in any of the samples collected in Site 5 media. Chromium speciation data were available for surface soil data and subsurface soil data for a representative number of samples.

6.5 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 were generated based on risk assessment methods outlined in current EPA guidance (EPA, 1989a).

Noncarcinogenic risk estimates were presented in the form of HQs and HIs that are determined through comparison of estimated intakes with published RfDs. Incremental cancer risk estimates were 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 noncarcinogenic and carcinogenic risks were summarized for each exposure route on a series of tables in this section.

6.5.1 Noncarcinogenic Risks

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

$$HQ = \frac{Intake}{RfD}$$

HIs were 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 target organ(s) affected by each chemical because these are generally the organ(s) associated with RfD-derived effects, and results (HIs) for different organs are not truly additive. The HI is not defined as 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.

6.5.2 Carcinogenic Risks

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

$$Risk = Intake * SF$$

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

$$Risk = 1 - e^{-(Intake*SF)}$$

The risk determined using these equations is defined as 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 1.0×10^{-6} indicates that the exposed receptor has a one in a million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons. The calculated cancer risks should be recognized as upper-limit estimates. SFs are defined as 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.

EPA has generally defined risks in the range of 1.0×10^{-4} to 1.0×10^{-6} as being acceptable for most hazardous waste facilities addressed under CERCLA. For CERCLA activities, residual risks on the order of 1.0×10^{-6} are the primary goal but are often modified by such regulatory requirements as MCLs or chemical-specific clean-up goals.

6.5.3 Comparison of Quantitative Risk Estimates to Benchmark Criteria

In order to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical benchmarks.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects from individual COPCs contributing to the risk are considered. Only those chemicals that impact the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Thus, COPCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be COCs.

EPA has defined the range of 1.0×10^{-4} to 1.0×10^{-6} as the incremental cancer risk (ICR) "target range" for most hazardous waste facilities evaluated. Cumulative ICRs greater than 1.0×10^{-4} generally will indicate that some degree of remediation is required, and ICRs below 1.0×10^{-6} normally will not result in remedial efforts. Whenever ICRs fall between 1.0×10^{-4} to 1.0×10^{-6}, decisions for remediation will be made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be chemicals of concern (COCs)

Potential RME hazard indices and RME cancer risks were estimated for current and future potential receptors using the methodologies presented in Sections 6.2 through 6.4. The following sections present a summary of the results of the estimation of risk at Site 5.

Receptor risks are presented for each area of interest 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 that are reported as "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed.

6.5.4 Site-Specific Noncarcinogenic Risks

Noncarcinogenic risks estimated for potential receptors are discussed below and presented on Tables 6-28 through 6-41.

6.5.4.1 Surface Soil

The total of the HQs for a residential child exposed to surface soil at Site 5 was 1.41 (Table 6-28, contribution from ingestion/dermal absorption and Table 6-29 inhalation of fugitive dust), indicating that individual HQs and target organ His should be evaluated. Ingestion exposure contributed the major portion of the noncarcinogenic risk. The principal COPC contributing to the HI was manganese [0.38 – target organ central nervous system (CNS)]. Additional COPCs with minor contributions, between 0.1 and 0.2 HQ, include aluminum, mercury, thallium, and Aroclor-1254.

For the residential child, in order to evaluate the possibility of additive noncarcinogenic effects to the same target organ, noncarcinogenic risks were grouped according to target organ. In combination, none of the above HIs would yield an HI greater than 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur.

The total of the HQs for a residential adult exposed to surface soil at Site 5 was 0.21 (Table 6-30, contribution from ingestion/dermal absorption and Table 6-31 inhalation of fugitive dust), which was below the acceptable level of 1.0.

The estimated RME hazard index for an industrial adult exposed to surface soil at Site 5 was 0.10 (Table 6-32, contribution from ingestion/dermal absorption and Table 6-33, inhalation of fugitive dust), which was below the acceptable level of 1.0.

TABLE 6-28
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.53E-01	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	1.53E-01
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	4.68E-05	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	4.68E-02
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	3.43E-03	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	8.58E-02
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	8.95E-04	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	9.07E-03	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	3.78E-01
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	1.88E-05	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	1.88E-01
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	3.37E-04	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	6.75E-02
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	9.45E-06	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	1.35E-01
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.08E-04	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	5.83E-02
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	4.29E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.43E-02
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	3.80E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	3.60E-06	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	1.80E-01
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	3.39E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.12E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.39E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.04E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	3.48E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	4.62E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	6.93E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.31E+00

TABLE 6-28 (continued)
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	7.24E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	2.68E-03
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	2.22E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	4.45E-03
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.63E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	6.79E-04
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	4.25E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	4.31E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.79E-03
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	8.94E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	5.96E-03
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.60E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	3.20E-04
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	4.49E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	6.41E-04
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.94E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	1.38E-02
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	2.04E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	2.71E-04
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.81E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.71E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	8.56E-03
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.61E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.48E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	6.59E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	4.94E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.65E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	2.20E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	3.29E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.92E-02
												Total of Routes	1.35E+00

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-29
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.66E-05	mg/kg-day	--	--	--	mg/kg-day	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	5.10E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	3.74E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	9.77E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	9.89E-07	mg/kg-day	--	--	1.43E-05	mg/kg-day	6.92E-02
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.05E-09	mg/kg-day	--	--	8.60E-05	mg/kg-day	2.39E-05
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	3.68E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.03E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.45E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	4.68E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	4.15E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	3.93E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	3.69E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.40E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.51E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.13E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	3.79E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.04E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	7.56E-11	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												6.92E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-30
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.81E-02	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	1.81E-02
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	5.55E-06	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	5.55E-03
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	4.07E-04	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	1.02E-02
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.06E-04	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.08E-03	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	4.48E-02
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.23E-06	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	2.23E-02
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	4.00E-05	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	8.00E-03
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.12E-06	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	1.60E-02
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.84E-05	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	6.91E-03
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	5.08E-04	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.69E-03
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	4.51E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	4.27E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	2.14E-02
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.01E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.70E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.64E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.23E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.12E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.48E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.22E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.55E-01

TABLE 6-30 (continued)
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	5.37E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	1.99E-03
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.65E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	3.30E-03
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.21E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	5.03E-04
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.15E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.19E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.33E-03
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	6.63E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	4.42E-03
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.19E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	2.38E-04
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	3.33E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	4.75E-04
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.44E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	1.03E-02
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.51E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	2.01E-04
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.34E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.27E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	6.35E-03
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.19E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.10E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.88E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	3.66E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.22E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.63E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.44E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.91E-02
												Total of Routes	1.84E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-31
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	5.26E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.61E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.18E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.09E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.13E-07	mg/kg-day	--	--	1.43E-05	mg/kg-day	2.19E-02
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	6.50E-10	mg/kg-day	--	--	8.60E-05	mg/kg-day	7.55E-06
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.16E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	3.26E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.41E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.48E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.31E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.24E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.17E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.08E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.78E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	3.59E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.20E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.59E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.39E-11	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												2.19E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-32
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	6.46E-03	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	6.46E-03
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.98E-06	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	1.98E-03
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.45E-04	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	3.63E-03
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.79E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.84E-04	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.60E-02
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	7.97E-07	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	7.97E-03
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.43E-05	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	2.86E-03
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	4.00E-07	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	5.72E-03
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.73E-05	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	2.47E-03
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.82E-04	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	6.05E-04
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.61E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.53E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	7.63E-03
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.43E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.32E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.87E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	4.40E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.47E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.96E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.94E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												5.53E-02

TABLE 6-32 (continued)
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	7.74E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	2.87E-03
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	2.37E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	4.75E-03
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.74E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	7.25E-04
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	4.54E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	4.60E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.92E-03
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	9.55E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	6.37E-03
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.71E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	3.42E-04
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	4.79E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	6.85E-04
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	2.07E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	1.48E-02
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	2.17E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	2.90E-04
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.93E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.83E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	9.14E-03
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.72E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.58E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	7.03E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	5.27E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.76E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	2.34E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	3.52E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												4.19E-02
												Total of Routes	9.72E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-33
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.25E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	3.84E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	2.82E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	7.35E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	7.45E-08	mg/kg-day	--	--	1.43E-05	mg/kg-day	5.21E-03
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	1.55E-10	mg/kg-day	--	--	8.60E-05	mg/kg-day	1.80E-06
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	2.77E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	7.76E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	3.35E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	3.52E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	3.12E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	2.96E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	2.78E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	2.56E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.14E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	8.54E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	2.86E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	3.80E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	5.69E-12	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												5.21E-03

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

6.5.4.2 Subsurface Soil

The total of the HQs for a residential child exposed to subsurface soil at Site 5 was 2.9 (Table 6-34, contribution from ingestion/dermal absorption and Table 6-35, inhalation of fugitive dust), inddicating that individual HQs and target organ His should be evaluated. Ingestion exposure contributed the major portion of the noncarcinogenic risk. The principal COPCs and their HQ contributions to the HI are copper [0.23 – target organ gastro intestinal tract], iron [1.3 – target liver/pancreas] and manganese (0.45 – target organ CNS). Additional COPCs with minor contributions, between 0.1 and 0.2 HQ, include aluminum, arsenic, thallium, and vanadium.

For the residential child, in order to evaluate the possibility of additive noncarcinogenic effects to the same target organ, noncarcinogenic risks were grouped according to target organ. In this case the HI from exposure to iron for the target organs liver and pancreas both are 1.3, which marginally exceeds unity (1.0). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0 for a particular target organ, however, it should be noted that iron is an essential mineral that is ubiquitous in the soil.

The total of the HQs for a residential adult exposed to subsurface soil at Site 5 was 0.39 (Table 6-36, contribution from ingestion/dermal absorption and Table 6-37, inhalation of fugitive dust), which was below the acceptable level of 1.0.

The total of the HQs for an industrial adult exposed to subsurface soil at Site 5 was 0.18 (Table 6-38, contribution from ingestion/dermal absorption and Table 6-39, inhalation of fugitive dust), which was below the acceptable level of 1.0.

6.5.4.3 Sediment

The total of the HQs for a recreational child (age 6 - 12) exposed to sediment at off-site areas near Site 5 was 0.03 (Table 6-40, contribution from ingestion/dermal absorption), which was below the acceptable level of 1.0.

6.5.4.4 Surface Water (Total Inorganics and Organics)

The total of the HQs for a recreational child (age 6 - 12) exposed to surface water (total inorganics and organics) at off-site areas near Site 5 was 0.01E-3 (Table 6-41, contribution from ingestion/dermal absorption), which was below the acceptable level of 1.0.

TABLE 6-34
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.55E-01	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	1.55E-01
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	3.54E-05	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	1.18E-01
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.51E-03	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	3.58E-02
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	6.35E-05	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	6.35E-02
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	9.27E-03	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	2.32E-01
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	3.89E-01	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.30E+00
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	8.40E-04	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.08E-02	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	4.51E-01
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.01E-06	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	4.01E-02
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	4.54E-04	mg/kg-day	2.00E-02	mg/kg-day	N/A	N/A	2.27E-02
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	4.42E-04	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	8.85E-02
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	8.12E-06	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	1.16E-01
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	7.12E-04	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	1.02E-01
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.30E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.10E-02
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.24E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.28E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.54E-07	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	3.07E-04
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	3.78E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	3.93E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	7.28E-07	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	3.64E-02
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	4.44E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	4.33E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	4.29E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	4.66E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												2.77E+00

TABLE 6-34 (continued)
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	7.35E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	2.72E-03
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	5.37E-07	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	1.89E-03
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.19E-05	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	1.70E-04
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	3.02E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	6.04E-03
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	4.40E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.83E-03
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.85E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	6.16E-03
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	3.99E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	5.14E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	2.14E-03
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.90E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	1.27E-03
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	2.16E-06	mg/kg-day	2.00E-03	mg/kg-day	N/A	N/A	1.08E-03
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	2.10E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	4.20E-04
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	3.86E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	5.51E-04
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	3.38E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	2.41E-02
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.57E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	2.09E-04
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	1.06E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	6.09E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	7.30E-09	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	1.46E-05
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.79E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.87E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	3.46E-08	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	1.73E-03
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	2.11E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	2.06E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	2.04E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	2.21E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												5.04E-02
												Total of Routes	2.82E+00

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-35
CALCULATION OF NON-CANCER HAZARDS - CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.69E-05	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	3.86E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.73E-07	mg/kg-day	--	--	1.43E-04	mg/kg-day	1.91E-03
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	6.93E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.01E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.25E-05	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	9.16E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.18E-06	mg/kg-day	--	--	1.43E-05	mg/kg-day	8.26E-02
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.37E-10	mg/kg-day	--	--	8.60E-05	mg/kg-day	5.09E-06
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	4.95E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	4.83E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	8.86E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	7.76E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.60E-07	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.45E-11	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.40E-11	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.68E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	4.12E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	4.29E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	7.94E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	4.84E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	4.73E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	4.68E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.08E-10	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												8.45E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-36
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.84E-02	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	1.84E-02
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	4.19E-06	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	1.40E-02
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.97E-04	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	4.25E-03
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	7.53E-06	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	7.53E-03
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.10E-03	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	2.75E-02
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.62E-02	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.54E-01
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	9.96E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.28E-03	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	5.35E-02
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.75E-07	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	4.75E-03
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	5.38E-05	mg/kg-day	2.00E-02	mg/kg-day	N/A	N/A	2.69E-03
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	5.25E-05	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	1.05E-02
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	9.63E-07	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	1.38E-02
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	8.44E-05	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	1.21E-02
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.92E-04	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	1.31E-03
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.66E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.52E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.82E-08	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	3.64E-05
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	4.48E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	4.66E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	8.63E-08	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	4.32E-03
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.26E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	5.14E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.08E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.52E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.28E-01

TABLE 6-36 (continued)
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	5.45E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	2.02E-03
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	3.98E-07	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	1.40E-03
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	8.83E-06	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	1.26E-04
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.24E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	4.48E-03
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.26E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.36E-03
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.37E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	4.57E-03
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	2.96E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	3.81E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.59E-03
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.41E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	9.41E-04
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.60E-06	mg/kg-day	2.00E-03	mg/kg-day	N/A	N/A	7.99E-04
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.56E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	3.12E-04
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	2.86E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	4.09E-04
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.51E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	1.79E-02
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.16E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	1.55E-04
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	7.89E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	4.52E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	5.41E-09	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	1.08E-05
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.33E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.38E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	2.56E-08	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	1.28E-03
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.56E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.53E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.51E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.64E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												3.73E-02
												Total of Routes	3.66E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-37
CALCULATION OF NON-CANCER HAZARDS - ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	5.34E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.22E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	8.65E-08	mg/kg-day	--	--	1.43E-04	mg/kg-day	6.05E-04
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.19E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.20E-07	mg/kg-day	--	--	--	mg/kg-day	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.34E-05	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	2.90E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	3.73E-07	mg/kg-day	--	--	1.43E-05	mg/kg-day	2.61E-02
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.38E-10	mg/kg-day	--	--	8.60E-05	mg/kg-day	1.61E-06
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.57E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.53E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	2.80E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.45E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.14E-07	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	7.73E-12	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	4.42E-12	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	5.30E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.30E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.35E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	2.51E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.53E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.49E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.48E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.61E-10	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												2.67E-02

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-38
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	6.56E-03	mg/kg-day	1.00E+00	mg/kg-day	N/A	N/A	6.56E-03
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.50E-06	mg/kg-day	3.00E-04	mg/kg-day	N/A	N/A	4.99E-03
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.06E-04	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	1.52E-03
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.69E-06	mg/kg-day	1.00E-03	mg/kg-day	N/A	N/A	2.69E-03
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.92E-04	mg/kg-day	4.00E-02	mg/kg-day	N/A	N/A	9.81E-03
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.65E-02	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	5.50E-02
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	3.56E-05	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	4.58E-04	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.91E-02
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.70E-07	mg/kg-day	1.00E-04	mg/kg-day	N/A	N/A	1.70E-03
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.92E-05	mg/kg-day	2.00E-02	mg/kg-day	N/A	N/A	9.61E-04
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.87E-05	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	3.75E-03
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	3.44E-07	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	4.91E-03
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	3.01E-05	mg/kg-day	7.00E-03	mg/kg-day	N/A	N/A	4.31E-03
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.40E-04	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	4.66E-04
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	9.49E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	5.43E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	6.51E-09	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	1.30E-05
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.60E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.66E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	3.08E-08	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	1.54E-03
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.88E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.83E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.82E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.97E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												1.17E-01

TABLE 6-38 (continued)
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	7.85E-04	mg/kg-day	2.70E-01	mg/kg-day	N/A	N/A	2.91E-03
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	5.74E-07	mg/kg-day	2.85E-04	mg/kg-day	N/A	N/A	2.01E-03
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.27E-05	mg/kg-day	7.00E-02	mg/kg-day	N/A	N/A	1.82E-04
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	3.22E-07	mg/kg-day	5.00E-05	mg/kg-day	N/A	N/A	6.45E-03
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	4.70E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	1.96E-03
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.98E-03	mg/kg-day	3.00E-01	mg/kg-day	N/A	N/A	6.58E-03
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	4.26E-06	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	5.49E-05	mg/kg-day	2.40E-02	mg/kg-day	N/A	N/A	2.29E-03
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	2.03E-08	mg/kg-day	1.50E-05	mg/kg-day	N/A	N/A	1.36E-03
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	2.30E-06	mg/kg-day	2.00E-03	mg/kg-day	N/A	N/A	1.15E-03
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	2.24E-06	mg/kg-day	5.00E-03	mg/kg-day	N/A	N/A	4.49E-04
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	4.12E-08	mg/kg-day	7.00E-05	mg/kg-day	N/A	N/A	5.89E-04
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	3.61E-06	mg/kg-day	1.40E-04	mg/kg-day	N/A	N/A	2.58E-02
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.68E-05	mg/kg-day	7.50E-02	mg/kg-day	N/A	N/A	2.24E-04
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	1.14E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	6.51E-09	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	7.80E-09	mg/kg-day	5.00E-04	mg/kg-day	N/A	N/A	1.56E-05
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.92E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.99E-08	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	3.69E-08	mg/kg-day	2.00E-05	mg/kg-day	N/A	N/A	1.85E-03
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	2.25E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	2.20E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	2.17E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	2.36E-07	mg/kg-day	--	mg/kg-day	N/A	N/A	--
	(Total)												5.38E-02
												Total of Routes	1.71E-01

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-39
CALCULATION OF NON-CANCER HAZARDS - ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.27E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	2.90E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.06E-08	mg/kg-day	--	--	1.43E-04	mg/kg-day	1.44E-04
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	5.22E-10	mg/kg-day	--	--	--	mg/kg-day	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	7.61E-08	mg/kg-day	--	--	--	mg/kg-day	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	3.20E-06	mg/kg-day	--	--	--	mg/kg-day	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	6.90E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	8.89E-08	mg/kg-day	--	--	1.43E-05	mg/kg-day	6.22E-03
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	3.29E-11	mg/kg-day	--	--	8.60E-05	mg/kg-day	3.83E-07
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	3.73E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	3.63E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	6.67E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	5.84E-09	mg/kg-day	--	--	--	mg/kg-day	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	2.71E-08	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	1.84E-12	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.05E-12	mg/kg-day	--	--	--	mg/kg-day	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.26E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	3.10E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	3.23E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	5.98E-12	mg/kg-day	--	--	--	mg/kg-day	--
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	3.64E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	3.56E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	3.52E-11	mg/kg-day	--	--	--	mg/kg-day	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	3.82E-11	mg/kg-day	--	--	--	mg/kg-day	--
	(Total)												6.36E-03

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

TABLE 6-40
NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - AREA B
SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDE	NA	NA
4,4'-DDT	8.3E-05	4.1E-05
4-METHYLPHENOL	1.7E-05	1.1E-05
ACENAPHTHENE	1.2E-06	9.5E-07
ALDRIN	2.4E-05	1.9E-05
ALPHA-CHLORDANE	2.6E-05	1.3E-05
ANTHRACENE	7.2E-07	4.4E-07
AROCLOR-1260	NA	NA
BENZ(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)PHTHALA	1.4E-04	1.1E-04
BUTYL BENZYL PHTHALATE	9.2E-08	7.3E-08
CARBAZOLE	NA	NA
CHRYSENE	NA	NA
DELTA-BHC	NA	NA
DI-N-BUTYL PHTHALATE	7.8E-06	3.4E-06
DI-N-OCTYL PHTHALATE	6.1E-07	2.7E-07
DIBENZ(A,H)ANTHRACENE	NA	NA
DIELDRIN	2.9E-05	2.3E-05
FLUORANTHENE	6.5E-05	5.2E-05
FLUORENE	2.3E-06	1.8E-06
INDENO(1,2,3-CD)PYRENE	NA	NA
METHOXYCHLOR	1.7E-06	7.5E-07
N-NITROSODIPHENYLAMINE	NA	NA
PYRENE	5.1E-05	3.1E-05
ALUMINUM	1.2E-03	4.6E-05
ARSENIC	1.8E-03	7.7E-05
BARIUM	1.5E-04	1.5E-04
BERYLLIUM	2.7E-05	1.1E-04
CADMIUM	5.8E-04	4.6E-04
CHROMIUM	2.8E-06	5.6E-06
COBALT	1.9E-05	7.7E-07
COPPER	2.3E-04	1.5E-05
IRON	1.1E-02	4.3E-04
LEAD	NA	NA
MANGANESE	3.7E-03	4.9E-03
NICKEL	1.3E-04	3.4E-05
SILVER	2.2E-05	4.3E-06
THALLIUM	1.8E-03	7.3E-05
ZINC	2.5E-04	3.9E-05
TOTAL RISK	2.13E-02	6.64E-03

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMI
ICAL

TABLE 6-41
NONCARCINOGENIC HQS, WADING, FUTURE RECREATIONAL RECEPTORS - AREA B
SURFACE WATER
NAWC WARMINSTER, PA

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
BIS(2-ETHYLHEXYL)PHTHALAT	7.7E-06	9.6E-04
NICKEL	1.3E-04	4.1E-05
THALLIUM	8.2E-03	3.8E-04
TOTAL RISK	• 8.34E-03	1.76E-03

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

6.5.5 Site-Specific Carcinogenic Risks

Carcinogenic risks estimated for potential receptors are discussed below and presented on Tables 6-42 through 6-59.

6.5.5.1 Surface Soil

RME cancer risk for a residential child exposed to surface soil at Site 5 was estiimated at 3.3×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-42, contribution from ingestion/dermal absorption and Table 6-43, inhalation of fugitive dust). Benzo(a)pyrene (via ingestion) was the primary contributor to the cancer risk with an individual cancer risk of 2.0×10^{-6}.

RME cancer risk for a residential adult exposed to surface soil at Site 5 was estimated at 1.6×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-44, contribution from ingestion/dermal absorption and Table 6-45, inhalation of fugitive dust). Benzo(a)pyrene (via ingestion) was the primary contributor to the cancer risk with an individual cancer risk of 9.3×10^{-7}.

RME cancer risk for a lifetime residential receptor [child and adult combined exposure] exposed to surface soil at Site 5 was estimated at 4.96×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-46, contribution from ingestion/dermal absorption and Table 6-47, inhalation of fugitive dust). The primary contributors to the cancer risk were benzo(a)pyrene (via ingestion) with an individual cancer risk of 2.9×10^{-6} and Aroclor-1254 (via ingestion and dermal contact) with an individual cancer risk of 1.0×10^{-6}.

RME cancer risk for an industrial adult exposed to surface soil at Site 5 was estimated at 7.2×10^{-7}, which was below EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-48, contribution from ingestion/dermal absorption and Table 6-49, inhalation of fugitive dust).

6.5.5.2 Subsurface Soil

RME cancer risk for a residential child exposed to subsurface soil at Site 5 was estimated at 8.2×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-50, contribution from ingestion/dermal absorption and Table 6-51 inhalation of fugitive dust). The primary contributors to the cancer risk were arsenic (via ingestion) with an individual cancer risk of 4.6×10^{-6} and benzo(a)pyrene (via ingestion) with an individual cancer risk of 2.7×10^{-6}.

TABLE 6-42
CALCULATION OF CANCER RISKS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.31E-02	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	4.01E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	2.94E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	7.67E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	7.77E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	1.61E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	2.89E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	8.10E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	3.50E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	3.67E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	3.26E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	6.52E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	3.09E-07	mg/kg-day	2.00E+00	1/(mg/kg-day)	6.18E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	2.90E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.12E-07
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	2.67E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.95E-06
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.19E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	8.67E-08
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	8.91E-08	mg/kg-day	7.30E-02	1/(mg/kg-day)	6.51E-09
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	2.98E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	2.18E-09
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	3.96E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.89E-07
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	5.94E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.34E-08
	(Total)										3.27E-06

TABLE 6-42 (continued)
CALCULATION OF CANCER RISKS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	6.21E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.91E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.40E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.65E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.69E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	7.67E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.37E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	3.85E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.66E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.75E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.55E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.10E-09
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.47E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.94E-08
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.38E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.27E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.64E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	4.23E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.42E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.88E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.82E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.24E-08
										Total of Routes	3.31E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-43
CALCULATION OF CANCER RISKS - CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.43E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	4.38E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	2.76E-09
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	3.21E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	8.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	8.48E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	1.76E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	3.15E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	8.84E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	3.81E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	4.01E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	3.55E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	7.11E-12
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	3.37E-11	mg/kg-day	2.00E+00	1/(mg/kg-day)	6.74E-11
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	3.17E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	2.92E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	9.04E-11
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.30E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	9.72E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	3.25E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	4.32E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	6.48E-12	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.92E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-44
CALCULATION OF CANCER RISKS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	6.20E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.90E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.39E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.64E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.69E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	7.66E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.37E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	3.84E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.66E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.74E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.55E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.09E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.47E-07	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.93E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	1.38E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.00E-07
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	1.27E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	9.26E-07
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	5.64E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.11E-08
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	4.23E-08	mg/kg-day	7.30E-02	1/(mg/kg-day)	3.09E-09
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.41E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	1.03E-09
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.88E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.37E-07
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.82E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.06E-08
	(Total)										1.55E-06

TABLE 6-44 (continued)
CALCULATION OF CANCER RISKS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.84E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	5.65E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	4.14E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.08E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.10E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.27E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	4.07E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.14E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.92E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	5.18E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	4.59E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.18E-09
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	4.35E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	8.70E-08
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.09E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.77E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.67E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.26E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.20E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.58E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										9.62E-08
										Total of Routes	1.65E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-45
CALCULATION OF CANCER RISKS - ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.80E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	5.53E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	3.49E-09
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	4.06E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.06E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.07E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.23E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	3.99E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.12E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.82E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	5.07E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	4.50E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	8.99E-12
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	4.26E-11	mg/kg-day	2.00E+00	1/(mg/kg-day)	8.53E-11
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.00E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.69E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.14E-10
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.64E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.23E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.11E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.47E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.20E-12	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.69E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-46
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	6.20E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.90E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.39E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	3.64E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	3.69E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	7.66E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	1.37E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	3.84E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.66E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.74E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	4.80E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.61E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	4.55E-07	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.11E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.28E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	3.12E-07
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.94E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.88E-06
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.75E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.28E-07
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.31E-07	mg/kg-day	7.30E-02	1/(mg/kg-day)	9.59E-09
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.39E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	3.21E-09
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.84E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.26E-07
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.76E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	6.39E-08
	(Total)										4.83E-06

TABLE 6-46 (continued)
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.84E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	5.65E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	4.14E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.08E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.10E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.27E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	4.07E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.14E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.92E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	5.18E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	6.14E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.23E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	5.82E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.16E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.09E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	3.77E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.67E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.26E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.20E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.58E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.29E-07
										Total of Routes	4.96E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-47
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	1.80E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	9.91E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	6.24E-09
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	4.06E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.06E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.07E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.23E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	3.99E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.12E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	4.82E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	5.07E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	8.05E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.61E-11
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	7.63E-11	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.53E-10
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	4.00E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	6.61E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.05E-10
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	1.64E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.23E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	4.11E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	5.47E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	8.20E-12	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										6.62E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-48
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	2.31E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	7.08E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	5.19E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.35E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.37E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	2.85E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	5.10E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.43E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	6.17E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	6.48E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	5.75E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.15E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	5.45E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.09E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	5.12E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	3.74E-08
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	4.72E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	3.44E-07
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.10E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.53E-08
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.57E-08	mg/kg-day	7.30E-02	1/(mg/kg-day)	1.15E-09
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	5.26E-08	mg/kg-day	7.30E-03	1/(mg/kg-day)	3.84E-10
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	6.99E-09	mg/kg-day	7.30E+00	1/(mg/kg-day)	5.10E-08
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	1.05E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	7.65E-09
	(Total)										5.78E-07

TABLE 6-48 (continued)
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	2.76E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	8.48E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	6.22E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	1.62E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	1.64E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	3.41E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	6.11E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	1.71E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	7.39E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	7.77E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	6.89E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.38E-08
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	6.53E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.31E-07
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	6.13E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	5.65E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	2.51E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	1.88E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	6.30E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	8.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	1.26E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.44E-07
										Total of Routes	7.22E-07

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-49
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Surface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.32E+04	mg/kg	1.32E+04	mg/kg	M	4.47E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	4.05E+00	mg/kg	4.05E+00	mg/kg	M	1.37E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	8.65E-10
	Copper	2.97E+02	mg/kg	2.97E+02	mg/kg	M	1.01E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.75E+01	mg/kg	7.75E+01	mg/kg	M	2.63E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	7.85E+02	mg/kg	7.85E+02	mg/kg	M	2.66E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	1.63E+00	mg/kg	1.63E+00	mg/kg	M	5.52E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	2.92E+01	mg/kg	2.92E+01	mg/kg	M	9.89E-10	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	8.18E-01	mg/kg	8.18E-01	mg/kg	M	2.77E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	3.53E+01	mg/kg	3.53E+01	mg/kg	M	1.20E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	3.71E+02	mg/kg	3.71E+02	mg/kg	M	1.26E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Aroclor-1242	3.29E+01	ug/kg	3.29E+01	ug/kg	M	1.11E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.23E-12
	Aroclor-1254	3.12E+02	ug/kg	3.12E+02	ug/kg	M	1.06E-11	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.11E-11
	Benz(a)anthracene	2.93E+02	ug/kg	2.93E+02	ug/kg	M	9.93E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	2.70E+02	ug/kg	2.70E+02	ug/kg	M	9.15E-12	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.84E-11
	Benzo(b)fluoranthene	1.20E+02	ug/kg	1.20E+02	ug/kg	M	4.07E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(k)fluoranthene	9.00E+01	ug/kg	9.00E+01	ug/kg	M	3.05E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	3.01E+02	ug/kg	3.01E+02	ug/kg	M	1.02E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Dibenz(a,h)anthracene	4.00E+01	ug/kg	4.00E+01	ug/kg	M	1.36E-12	mg/kg-day	--	1/(mg/kg-day)	--
	Indeno(1,2,3-cd)pyrene	6.00E+01	ug/kg	6.00E+01	ug/kg	M	2.03E-12	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										9.16E-10

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-50
CALCULATION OF CANCER RISKS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.33E-02	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	3.03E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	4.55E-06
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.15E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	5.45E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	7.94E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	3.34E-02	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	7.20E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	9.28E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	3.44E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	3.89E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	3.79E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	6.96E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	6.10E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	2.83E-04	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	1.92E-08	mg/kg-day	2.40E-01	1/(mg/kg-day)	4.61E-09
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.10E-08	mg/kg-day	3.40E-01	1/(mg/kg-day)	3.74E-09
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.32E-08	mg/kg-day	3.40E-01	1/(mg/kg-day)	4.48E-09
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	3.24E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	6.48E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	3.37E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	6.73E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	6.24E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.25E-07
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	3.80E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.78E-07
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	3.71E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	2.71E-06
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	3.67E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	2.68E-07
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	3.99E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	2.91E-09
	(Total)										8.07E-06

TABLE 6-50 (continued)
CALCULATION OF CANCER RISKS - CHILD RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	6.30E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	4.61E-08	mg/kg-day	1.58E+00	1/(mg/kg-day)	7.27E-08
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.02E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.59E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.77E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.59E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	3.42E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	4.41E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.63E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.85E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.80E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	3.31E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.90E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.35E-06	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	9.13E-10	mg/kg-day	2.40E-01	1/(mg/kg-day)	2.19E-10
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	5.22E-10	mg/kg-day	3.40E-01	1/(mg/kg-day)	1.78E-10
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	6.26E-10	mg/kg-day	3.40E-01	1/(mg/kg-day)	2.13E-10
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.54E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.08E-09
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.60E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.20E-09
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	2.96E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	5.93E-09
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.81E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.76E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.75E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.90E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										8.55E-08
										Total of Routes	8.16E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-51
CALCULATION OF CANCER RISKS - CHILD RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.45E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	3.31E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	4.99E-09
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.34E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	5.94E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	3.74E-09
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	8.66E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	3.64E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	7.85E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.01E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	3.75E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	4.25E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	4.14E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	7.59E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	6.65E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.09E-08	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.10E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.20E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.44E-12	mg/kg-day	3.40E-01	1/(mg/kg-day)	4.89E-13
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	3.53E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	7.07E-12
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	3.67E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	7.35E-12
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	6.81E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.36E-11
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	4.15E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	4.05E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.26E-10
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	4.01E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	4.35E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										8.89E-09

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

RME cancer risk for a residential adult exposed to subsurface soil at Site 5 was estimated at 4.1×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-52, contribution from ingestion/dermal absorption and Table 6-53, inhalation of fugitive dust). The primary contributors to the cancer risk were arsenic (via ingestion and dermal contact) with an individual cancer risk of 2.4×10^{-6} and benzo(a)pyrene (via ingestion) with an individual cancer risk of 1.3E-06.

RME cancer risk for lifetime residential receptors exposed to subsurface soil at Site 5 was estimated at 1.2×10^{-5}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-54, contribution from ingestion/dermal absorption and Table 6-55, inhalation of fugitive dust). The primary contributors to the cancer risk were arsenic (via ingestion and dermal contact) with an individual cancer risk of 7.0×10^{-6} and benzo(a)pyrene (via ingestion) with an individual cancer risk of 4.0×10^{-6}.

RME cancer risk for an industrial adult exposed to subsurface soil at Site 5 was estimated at 1.8×10^{-6}, which was within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-56, contribution from ingestion/dermal absorption and Table 6-57, inhalation of fugitive dust). Arsenic (via ingestion and dermal contact) was the primary contributor to the cancer risk with an individual cancer risk of 1.1×10^{-6}.

6.5.5.3 Sediment

RME cancer risk for a recreational child (age 6 - 12) exposed to sediment at off-site areas near Site 5 was 9.4×10^{-7} which was below EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-58, contribution from ingestion/dermal absorption).

6.5.5.4 Surface Water

RME cancer risks for a recreational child (age 6 - 12) exposed to surface water (total inorganics and organics) at off-site areas near Site 5 was 2.3×10^{-8} which was below EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6} (Table 6-59, contribution from ingestion/dermal absorption).

6.5.6 Lead Risks

Lead was identified as a COPC in surface soil and subsurface soil at Site 5. The "N/A" footnote was applied to all risk tables that had lead selected as a COPC. This was necessary because EPA's approach to evaluating lead risks goes beyond providing a single point estimate output and incorporates absorption and pharmacokinetic properties. Section 6.3.4 discusses background information related to

TABLE 6-52
CALCULATION OF CANCER RISKS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	6.29E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.44E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.16E-06
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.02E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.58E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.77E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.58E-02	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	3.41E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	4.40E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.63E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.85E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.80E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	3.30E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.89E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.34E-04	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	9.11E-09	mg/kg-day	2.40E-01	1/(mg/kg-day)	2.19E-09
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	5.21E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	1.77E-09
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	6.25E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	2.12E-09
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.54E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.07E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.60E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.19E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	2.96E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	5.92E-08
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.80E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.32E-07
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.76E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	1.29E-06
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.74E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	1.27E-07
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.89E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	1.38E-09
	(Total)										3.83E-06

TABLE 6-52 (continued)
CALCULATION OF CANCER RISKS - ADULT RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.87E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.37E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	2.16E-07
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	3.03E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	7.67E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.12E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.70E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	1.01E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.31E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.84E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	5.48E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	5.34E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	9.81E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	8.59E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.99E-06	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.71E-09	mg/kg-day	2.40E-01	1/(mg/kg-day)	6.49E-10
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.55E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	5.26E-10
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.86E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	6.31E-10
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	4.56E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.12E-09
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	4.74E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.49E-09
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	8.79E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.76E-08
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.36E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	5.23E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.18E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.62E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.54E-07
										Total of Routes	4.08E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-53
CALCULATION OF CANCER RISKS - ADULT RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.83E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	4.18E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	6.31E-09
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.96E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	7.51E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	4.73E-09
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.10E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.60E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	9.93E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.28E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.74E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	5.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	5.23E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	9.61E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	8.42E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.91E-08	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.65E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.52E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.82E-12	mg/kg-day	3.40E-01	1/(mg/kg-day)	6.18E-13
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	4.47E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	8.94E-12
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	4.65E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.29E-12
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	8.61E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.72E-11
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.25E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	5.12E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	1.59E-10
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.07E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.51E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										1.12E-08

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-54
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	6.29E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	4.47E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	6.70E-06
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	1.02E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	2.58E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	3.77E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.58E-02	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	3.41E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	4.40E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.63E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.85E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.80E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	3.30E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.89E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	1.34E-04	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.83E-08	mg/kg-day	2.40E-01	1/(mg/kg-day)	6.80E-09
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.62E-08	mg/kg-day	3.40E-01	1/(mg/kg-day)	5.51E-09
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	1.94E-08	mg/kg-day	3.40E-01	1/(mg/kg-day)	6.60E-09
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	4.77E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.55E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	4.96E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	9.93E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	9.20E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.84E-07
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.61E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.09E-07
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	5.47E-07	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.00E-06
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.42E-07	mg/kg-day	7.30E-01	1/(mg/kg-day)	3.95E-07
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.88E-07	mg/kg-day	7.30E-03	1/(mg/kg-day)	4.29E-09
	(Total)										1.19E-05

TABLE 6-54 (continued)
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.87E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.83E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	2.88E-07
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	3.03E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	7.67E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.12E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.70E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	1.01E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.31E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.84E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	5.48E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	5.34E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	9.81E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	8.59E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.99E-06	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	3.62E-09	mg/kg-day	2.40E-01	1/(mg/kg-day)	8.68E-10
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	2.07E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	7.04E-10
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	2.48E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	8.43E-10
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	6.10E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.22E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	6.34E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.27E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	1.18E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.35E-08
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.36E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	5.23E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.18E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.62E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.39E-07
										Total of Routes	1.22E-05

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-55
CALCULATION OF CANCER RISKS - LIFETIME RESIDENT PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Resident
Receptor Age: Child/Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	1.83E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	7.49E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	1.13E-08
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	2.96E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	1.35E-09	mg/kg-day	6.30E+00	1/(mg/kg-day)	8.48E-09
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.10E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	4.60E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	9.93E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.28E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	4.74E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	5.37E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	5.23E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	9.61E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	8.42E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	3.91E-08	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	2.65E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.52E-12	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	3.25E-12	mg/kg-day	3.40E-01	1/(mg/kg-day)	1.11E-12
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	8.00E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.60E-11
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	8.32E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.66E-11
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	1.54E-11	mg/kg-day	2.00E+00	1/(mg/kg-day)	3.08E-11
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	5.25E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	9.17E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	2.84E-10
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	5.07E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	5.51E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.01E-08

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-56
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	2.34E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	5.35E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	8.02E-07
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	3.79E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	9.61E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.40E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	5.89E-03	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	1.27E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.64E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	6.06E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	6.87E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	6.69E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	1.23E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	1.08E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	5.00E-05	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	3.39E-09	mg/kg-day	2.40E-01	1/(mg/kg-day)	8.14E-10
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	1.94E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	6.59E-10
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	2.32E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	7.90E-10
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	5.71E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.14E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	5.94E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.19E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	1.10E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.20E-08
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	6.71E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.90E-08
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	6.55E-08	mg/kg-day	7.30E+00	1/(mg/kg-day)	4.78E-07
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	6.48E-08	mg/kg-day	7.30E-01	1/(mg/kg-day)	4.73E-08
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	7.04E-08	mg/kg-day	7.30E-03	1/(mg/kg-day)	5.14E-10
	(Total)										1.42E-06

TABLE 6-56 (continued)
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER CONTACT (ING. & DER.) WITH SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Contact (Ing. & Der.) with Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal Absorption	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	2.80E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	2.05E-07	mg/kg-day	1.58E+00	1/(mg/kg-day)	3.24E-07
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	4.54E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	1.15E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	1.68E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	7.05E-04	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	1.52E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	1.96E-05	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	7.26E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	8.23E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	8.02E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	1.47E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	1.29E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	5.99E-06	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	4.06E-09	mg/kg-day	2.40E-01	1/(mg/kg-day)	9.75E-10
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	2.32E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	7.90E-10
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	2.78E-09	mg/kg-day	3.40E-01	1/(mg/kg-day)	9.47E-10
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	6.84E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.37E-08
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	7.12E-09	mg/kg-day	2.00E+00	1/(mg/kg-day)	1.42E-08
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	1.32E-08	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.64E-08
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	8.04E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	7.85E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	7.77E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	8.44E-08	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										3.81E-07
										Total of Routes	1.81E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 6-57
CALCULATION OF CANCER RISKS - ADULT INDUSTRIAL WORKER PARTICULATE DUST INHALATION FROM SITE 5 SUBSURFACE SOIL
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Particulates
Exposure Point: Inhalation of Particulates from Site 5 Subsurface Soil
Receptor Population: Industrial Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Aluminum	1.34E+04	mg/kg	1.34E+04	mg/kg	M	4.54E-07	mg/kg-day	--	1/(mg/kg-day)	--
	Arsenic	3.06E+00	mg/kg	3.06E+00	mg/kg	M	1.04E-10	mg/kg-day	1.51E+01	1/(mg/kg-day)	1.57E-09
	Barium	2.17E+02	mg/kg	2.17E+02	mg/kg	M	7.35E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Cadmium	5.50E+00	mg/kg	5.50E+00	mg/kg	M	1.86E-10	mg/kg-day	6.30E+00	1/(mg/kg-day)	1.17E-09
	Copper	8.02E+02	mg/kg	8.02E+02	mg/kg	M	2.72E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Iron	3.37E+04	mg/kg	3.37E+04	mg/kg	M	1.14E-06	mg/kg-day	--	1/(mg/kg-day)	--
	Lead	7.27E+01	mg/kg	7.27E+01	mg/kg	M	2.46E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Manganese	9.37E+02	mg/kg	9.37E+02	mg/kg	M	3.18E-08	mg/kg-day	--	1/(mg/kg-day)	--
	Mercury	3.47E-01	mg/kg	3.47E-01	mg/kg	M	1.18E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Nickel	3.93E+01	mg/kg	3.93E+01	mg/kg	M	1.33E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Silver	3.83E+01	mg/kg	3.83E+01	mg/kg	M	1.30E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Thallium	7.03E-01	mg/kg	7.03E-01	mg/kg	M	2.38E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Vanadium	6.16E+01	mg/kg	6.16E+01	mg/kg	M	2.09E-09	mg/kg-day	--	1/(mg/kg-day)	--
	Zinc	2.86E+02	mg/kg	2.86E+02	mg/kg	M	9.69E-09	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDD	1.94E+01	ug/kg	1.94E+01	ug/kg	M	6.57E-13	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDE	1.11E+01	ug/kg	1.11E+01	ug/kg	M	3.76E-13	mg/kg-day	--	1/(mg/kg-day)	--
	4,4'-DDT	1.33E+01	ug/kg	1.33E+01	ug/kg	M	4.51E-13	mg/kg-day	3.40E-01	1/(mg/kg-day)	1.53E-13
	Aroclor-1242	3.27E+01	ug/kg	3.27E+01	ug/kg	M	1.11E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.22E-12
	Aroclor-1248	3.40E+01	ug/kg	3.40E+01	ug/kg	M	1.15E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	2.30E-12
	Aroclor-1254	6.30E+01	ug/kg	6.30E+01	ug/kg	M	2.13E-12	mg/kg-day	2.00E+00	1/(mg/kg-day)	4.27E-12
	Benz(a)anthracene	3.84E+02	ug/kg	3.84E+02	ug/kg	M	1.30E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Benzo(a)pyrene	3.75E+02	ug/kg	3.75E+02	ug/kg	M	1.27E-11	mg/kg-day	3.10E+00	1/(mg/kg-day)	3.94E-11
	Benzo(b)fluoranthene	3.71E+02	ug/kg	3.71E+02	ug/kg	M	1.26E-11	mg/kg-day	--	1/(mg/kg-day)	--
	Chrysene	4.03E+02	ug/kg	4.03E+02	ug/kg	M	1.37E-11	mg/kg-day	--	1/(mg/kg-day)	--
	(Total)										2.79E-09

(1) *Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.*

TABLE 6-58
CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - AREA B
SEDIMENT
NAWC WARMINSTER, PA

SUBSTANCE	SEDIMENT INGESTION	SEDIMENT DERMAL CONTACT
4,4'-DDE	1.1E-10	5.3E-11
4,4'-DDT	1.2E-09	6.0E-10
4-METHYLPHENOL	N/A	N/A
ACENAPHTHENE	N/A	N/A
ALDRIN	1.1E-09	8.3E-10
ALPHA-CHLORDANE	1.7E-10	8.5E-11
ANTHRACENE	N/A	N/A
AROCLOR-1260	1.9E-07	9.0E-08
BENZ(A)ANTHRACENE	5.0E-08	*
BENZO(A)PYRENE	4.2E-07	*
BENZO(B)FLUORANTHENE	6.8E-08	*
BENZO(G,H,I)PERYLENE	N/A	N/A
BENZO(K)FLUORANTHENE	2.0E-09	*
BIS(2-ETHYLHEXYL)PHTHALA	3.3E-09	2.6E-09
BUTYL BENZYL PHTHALATE	N/A	N/A
CARBAZOLE	2.9E-10	*
CHRYSENE	5.4E-10	*
DELTA-BHC	N/A	N/A
DI-N-BUTYL PHTHALATE	N/A	N/A
DI-N-OCTYL PHTHALATE	N/A	N/A
DIBENZ(A,H)ANTHRACENE	5.3E-09	*
DIELDRIN	2.0E-09	1.6E-09
FLUORANTHENE	N/A	N/A
FLUORENE	N/A	N/A
INDENO(1,2,3-CD)PYRENE	2.3E-08	*
METHOXYCHLOR	N/A	N/A
N-NITROSODIPHENYLAMINE	1.1E-10	8.7E-11
PYRENE	N/A	N/A
ALUMINUM	N/A	N/A
ARSENIC	7.1E-08	3.0E-09
BARIUM	N/A	N/A
BERYLLIUM	5.0E-08	2.0E-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
NICKEL	N/A	N/A
SILVER	N/A	N/A
THALLIUM	N/A	N/A
ZINC	N/A	N/A
TOTAL RISK	8.9E-07	3.0E-07

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMI
* CANCER RISK FOR PAHS NOT ESTIMATED FOR DERMAL EXPOSURE

TABLE 6-59
CARCINOGENIC RISK, WADING, FUTURE RECREATIONAL RECEPTORS - AREA B
SURFACE WATER
NAWC WARMINSTER, PA

SUBSTANCE	SURFACE WATER INGESTION	SURFACE WATER DERMAL CONTACT
BIS(2-ETHYLHEXYL)PHTHALAT	1.8E-10	2.3E-08
NICKEL	N/A	N/A
THALLIUM	N/A	N/A
TOTAL RISK	1.8E-10	2.3E-08

N/A = NOT APPLICABLE, NO TOXICITY VALUE HAS BEEN ESTABLISHED FOR THIS CHEMICAL

blood-lead estimation methods. Exposure to lead in surface soil was evaluated using the EPA IEUBK Lead Model, and those results are described below.

The average concentrations of lead in surface soil (77.5 mg/kg) and subsurface soil (72.7 mg/kg) were used as input into the IEUBK Model. All other media inputs into the IEUBK Model were default parameters. The estimated percentage of residential children with a blood lead level above 10 ug/dL is 0.10% in surface soil and 0.09% in subsurface soil. This is below EPA's protective level cutoff of 5%. Adverse effects to residential children (age 0 - 6) are not expected from lead concentrations in surface soil and subsurface soil at Site 5. The IEUBK Model histograms and model specific input parameters are shown in Appendix G, Part 1.

A summary of all Site 5 carcinogenic and noncarcinogenic risks for each exposure scenario is presented on Table 6-60.

6.6 UNCERTAINTY ANALYSIS FOR THE HHRA

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the HHRA. Uncertainties are related to each of the main components of the assessment (i.e., data evaluation, dose-response assessment, exposure assessment, and risk characterization). The effect of a particular uncertainty on the outcome of the assessment (i.e., risk estimates) is also indicated, where possible.

As discussed in EPA (1989a), the measures used in 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 HHRA uncertainties are noted below.

6.6.1 Uncertainties Associated with Data Evaluation

Major uncertainties associated with data evaluation are highlighted below.

- The areal extent of the samples (including the number collected and location of the sampling points) in a particular medium impacts the calculation of EPCs. Several areas at Site 5 were sampled underneath pavement or other impermeable surfaces. Therefore, current risks may be overestimated. Future risks may also be biased similarly high, unless construction activities expose subsurface soils from these inaccessible areas.

TABLE 6-60
SUMMARY OF NONCARCINOGENIC AND CARCINOGENIC RISKS, SITE 5 - ALL EXPOSURE PATHWAYS
REASONABLE MAXIMUM EXPOSURE
NAWC WARMINSTER, PENNSYLVANIA

Scenario / Receptor	Industrial Adult	Residential Child Age 1-6	Residential Adult	Resident Lifetime*	Recreational Child Age 6-12
HAZARD INDEX					
Surface Soil - Exposure Routes					
Incidental Ingestion	5.53E-02	1.31E+00	1.55E-01	NA	NA
Dermal Contact	4.19E-02	3.92E-02	2.91E-02	NA	NA
Fugitive Dust Inhalation	5.21E-03	6.92E-02	2.19E-02	NA	NA
Subtotal of Surface Soil	**0.1**	**1.4**	**0.21**	**NA**	**NA**
Subsurface Soil - Exposure Routes					
Incidental Ingestion	1.17E-01	2.77E+00	3.28E-01	NA	NA
Dermal Contact	5.38E-02	5.04E-02	3.73E-02	NA	NA
Fugitive Dust Inhalation	6.36E-03	8.45E-02	2.67E-02	NA	NA
Subtotal of Subsurface Soil	**0.177**	**2.90**	**0.392**	**NA**	**NA**
Sediment - Exposure Routes					
Incidental Ingestion	NA	NA	NA	NA	2.13E-02
Dermal Contact	NA	NA	NA	NA	6.54E-03
Subtotal of Sediment	**NA**	**NA**	**NA**	**NA**	**0.03**
Surface Water (Total Inorganics and Organics) - Exposure Routes					
Incidental Ingestion	NA	NA	NA	NA	8.34E-03
Dermal Contact	NA	NA	NA	NA	1.38E-03
Subtotal of Surface Water	**NA**	**NA**	**NA**	**NA**	**0.010**
INCREMENTAL CANCER RISK					
Surface Soil - Exposure Routes					
Incidental Ingestion	5.78E-07	3.27E-06	1.55E-06	4.83E-06	NA
Dermal Contact	1.44E-07	3.24E-08	9.62E-08	1.29E-07	NA
Fugitive Dust Inhalation	9.16E-10	2.92E-09	3.69E-09	6.62E-09	NA
Subtotal of Surface Soil	**7.23E-07**	**3.31E-06**	**1.65E-06**	**4.96E-06**	**NA**
Subsurface Soil - Exposure Routes					
Incidental Ingestion	1.42E-06	8.07E-06	3.83E-06	1.19E-05	NA
Dermal Contact	3.81E-07	8.55E-08	2.54E-07	3.39E-07	NA
Fugitive Dust Inhalation	2.79E-09	8.89E-09	1.12E-08	2.01E-08	NA
Subtotal of Subsurface Soil	**1.80E-06**	**8.16E-06**	**4.10E-06**	**1.23E-05**	**NA**
Sediment - Exposure Routes					
Incidental Ingestion	NA	NA	NA	NA	8.40E-07
Dermal Contact	NA	NA	NA	NA	1.00E-07
Subtotal of Sediment	**NA**	**NA**	**NA**	**NA**	**9.40E-07**
Surface Water (Total Inorganics and Organics) - Exposure Routes					
Incidental Ingestion	NA	NA	NA	NA	1.80E-10
Dermal Contact	NA	NA	NA	NA	2.30E-08
Subtotal of Surface Water	**NA**	**NA**	**NA**	**NA**	**2.32E-08**

* = Lifetime Residential Risks are the summed Cancer Risks for Residential Child (6 year exposure) and Residential Adult (24 year exposure).
NA = Exposure route not applicable in that medium for that receptor.

Hazard Indices (i.e., summation of the hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects.

- 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.

- Uncertainties exist regarding selection of a concentration for input into the quantitative risk assessment. The use of the exposure point 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 use of the EPC as the input value into the quantitative risk assessment as a representation of site concentrations of COPCs generally lowers the chances of under estimation of the actual risk present in a exposure pathway to a potential receptor. However, the use of the exposure point concentration may overestimate the actual risk present in an exposure pathway at a particular area of interest. To help avoid this problem, the maximum value was used in place of the upper 95 percent limit when the latter was larger.

- 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 UCL on the mean, which in turn would create some additional uncertainty as to whether the estimated risk is a reasonable approximation of high end exposure. To help limit the potential for overestimation , the maximum value was used in place of the upper 95 percent UCL on the mean when the latter was larger.

- The chemical analytical database has some limitations regarding the representativeness of the laboratory results, the inclusion of nondetected data, data gaps, number of samples collected, and heterogeneity of sample data. The effects of these limitations on the results of the risk assessment are varied. However, every effort was made to collect and use samples that reflect actual site conditions. Nondetected results were treated using one-half the detection limit in all statistical functions. These actions should minimize uncertainty in the database.

- The use of screening concentrations that are based on a single route of exposure (i.e. ingestion) may lead to the underestimation of risks since they do not account for the additive effects across various exposure pathways. The resultant effects of the risks are not considered significant because

conservative values, derived from a target Hazard Index of 0.1 for noncarcinogens and a target risk of 1.0×10^{-6} for carcinogens, were employed.

- The use of residential surface soil screening concentrations for COPC selection under an industrial exposure scenario represents a conservative approach since exposure under an industrial scenario is expected to be lower than exposure under a residential scenario which are the basis of the RBC values. Consequently, COPCs may be selected that are not truly reflective of significant risk exposures under an industrial scenario which is evident from the noncarcinogenic and carcinogenic industrial risks estimated in this HHRA.

- The use of background comparisons involving representative concentrations of inorganic substances in sediment and surface water as part of COPC selection under a recreational exposure scenario presents an uncertainty regarding the values used to represent the background. This uncertainty exists because very few samples for background analysis were obtained and it is possible that the representative concentration may not be an accurate reflection of the upper range of concentration levels for the entire background. Consequently, inorganic COPCs may be selected that are not truly reflective of significant risk exposures under a recreational user scenario, which is evident from the noncarcinogenic and carcinogenic recreational risks estimated in this HHRA.

6.6.2 Uncertainties Associated with Exposure Assessment

Major uncertainties associated with the exposure assessment are listed below.

- The likelihood of the occurrence of the defined exposure scenarios is not always known. Identified land use and activity patterns at a site are limited to the observations made during the field investigation, known land uses in the surrounding area, and information provided by the Navy on anticipated future land use.

- Several receptor characteristics, for the recreational receptor such as age groups, exposure frequency, and exposure duration are generally based on professional judgment.

- There are limitations to using various models and/or equations to estimate exposure doses or contaminant concentrations. For example, modeled concentrations (i.e., generated fugitive dust concentrations) may not be indicative of actual site conditions during exposure.

- In general, the underestimation of risks was prevented using conservative exposure assumptions and exposure concentrations. Maximum detected concentrations are sometimes used as EPCs in

exposure pathways at the site. Although maximum concentrations are not a reasonable estimate of the concentration expected to be experienced by a receptor over time, the use of these values does provide a highly conservative estimate of risk to potential receptors.

- Exposure to fugitive dust emissions (surface and subsurface soil exposure only) conservatively assumes that receptors 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. Additionally, expected exposure to fugitive dust is based on a default PEF as provided in EPA's Soil Screening Guidance (EPA, 1996b). The effect of this uncertainty is expected to be low based on the fact that carcinogenic and noncarcinogenic risks were several orders of magnitude less than exposure via ingestion and dermal adsorption pathways.

- The model for dermal exposure to soil and sediment assumes that only a very thin, constant thickness layer of solid media is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil or sediment 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.

- 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 variability's 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.

- Exposure assumptions can add uncertainty into the risk assessment process based on input values selected for each exposure route. The rationale for each assumption was provided in each table of input parameters. Receptor characteristics, such as age and skin surface areas, are based on published values. Conservative values (based on reasonable maximum exposure or professional

judgment) are used in most exposure equations, except where average values are expected to better correspond to actual site conditions.

6.6.3 Uncertainties Associated with Dose-Response Assessment

The major uncertainties associated with the dose-response assessment are listed below.

- 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 RfD values is generally considered to be conservative because the reference 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.

- The uncertainty associated with the dermal exposure risk estimates is high because of the derivation of the dermal slope factor and reference dose. The dermal toxicity factors are based on default oral absorption factors. This can result in an over- or underestimation of the toxicity factors. It can cause the dermal exposure to be a primary contributor to the cumulative cancer risk and/or hazard index. The uncertainty associated with the dermal exposure route may overestimate the risk posed by Site 5.

- Nonthreshold (carcinogenic) effects are extrapolated from the high doses administered to laboratory animals to the low doses received under more common human exposure scenarios.

- Results of laboratory animal studies are extrapolated to human or environmental receptors.

- There is considerable interspecies variation in toxicological endpoints used in characterizing potential health effects resulting from exposure to a chemical.

- There is considerable variability in sensitivity among individuals of any particular species.

- Short-time toxicological studies are used to predict long-term effects.

As discussed in Section 6.4, established RfDs have an inherent amount of uncertainty. Uncertainty factors for RfDs used in this HHRA are presented in Table 6-24 and 6-25. Some chemical specific uncertainties should be noted as follows:

- Although the more restrictive basis for evaluating risk associated with exposure to arsenic is to assume it is a carcinogen, carcinogenic effects are not the primary health effects expected to be manifested upon exposure to arsenic. The preponderance of scientific information indicates that humans are capable of metabolizing arsenic to expedite its elimination from the body (ATSDR, 1988). Its elimination from the body obviously mitigates the possibility for arsenic to manifest carcinogenic effects. Therefore, evaluating arsenic as a noncarcinogen would be more appropriate. [Specifically, the body methylates the arsenic to form monomethyl arsenic and dimethyl arsenic. There is a limited capacity for the body to metabolize methylate arsenic, but this limit is generally reached when the body's intake of arsenic approximately exceeds 500 µg/day. Concentrations of arsenic in surface soil for potential receptors evaluated in this HHRA result in intakes that are well within the body's ability to metabolize arsenic. Although some humans may be more sensitive to arsenic, in that they are "poor methylators," the average exposure concentration for the site is more than three orders of magnitude below the normal limit of metabolic saturation and is most likely below levels that would trigger responses in sensitive individuals.]

- In nature, chromium (III) predominates over chromium (VI) (Langård and Norseth 1986). Little chromium (VI) exists in biological materials, except shortly after exposure, because reduction to chromium (III) occurs rapidly. Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, the latter which is considered to be more toxic. At Site 5 it was assumed that chromium is present in the trivalent form because representative samples were collected and analyzed for hexavalent chromium in surface and subsurface soil. Because analytical data were obtained to support this conclusion, there is negligible risk of underestimating the noncarcinogenic risks from chromium at the site.

- Incidental ingestion of iron exceeded EPA's threshold of 1.0 under the exposure pathway for a residential child exposed to subsurface soil. Currently no toxicity values for iron are published in IRIS or in HEAST. The oral reference dose used to evaluate exposures to iron was obtained from the current EPA Region III RBC tables. This value is based on an allowable daily intake and not on an adverse effect level. In addition iron is considered an essential nutrient. Consequently, iron's presence in soil may not warrant serious health concerns.

Two contaminants (benzo(g,h,i)perylene and phenanthrene (surface soil and subsurface soil) did not have listed toxicity values for use in the quantitative risk assessment; therefore, COPC selection and risks were not estimated for exposure to these chemicals. The uncertainty associated with not estimating quantitative risks for these chemicals is discussed qualitatively below:

- Benzo(g,h,i)perylene was detected in 3 out of 29 surface soil samples at a maximum concentration of 100 J ug/kg, and 1 out of 32 subsurface soil samples at a maximum concentration of 960 J ug/kg. The exclusion of benzo(g,h,i)perylene could potentially underestimate the carcinogenic and/or noncarcinogenic risk at Site 5. Benzo(g,h,i)perylene was detected at concentrations similar to the major PAHs detected in surface soil and subsurface soil. Due to the low levels of risk associated with PAHs at the site, the relative levels of benzo(g,h,i)perylene as compared to other PAHs, and the infrequency of detection in surface soil, the exclusion of benzo(g,h,i)perylene is not expected to have a significant impact on the surface soil or subsurface soil risks; however, without further toxicity information this remains unknown.

- Phenanthrene was detected in 4 out of 29 surface soil samples at a maximum concentration of 120 J ug/kg, and 3 out of 32 subsurface soil samples at a maximum concentration of 1800 J ug/kg. The exclusion of phenanthrene could potentially underestimate the carcinogenic and/or noncarcinogenic risk at Site 5. Phenanthrene was detected at concentrations similar to the major PAHs detected in surface soil and subsurface soil. Due to the low levels of risk associated with PAHs at the site, the relative levels of phenanthrene as compared to other PAHs, and the infrequency of detection in surface soil and subsurface soil, the exclusion of phenanthrene is not expected to have a significant impact on the surface soil or subsurface soil risks; however, without further toxicity information this remains unknown.

6.6.4 Uncertainties Associated with Risk Characterization

Major uncertainties associated with the risk characterization are listed below.

- ICRs and HIs are summed for all potential COPCs and for all applicable routes of exposure. Summing the risks implies that no antagonistic or synergistic effects exist between chemicals. It also assumes that similar mechanisms of action and metabolism are prevalent. Therefore, the use of this approach may either underestimate or overestimate the risks, depending on the chemical-specific interactions, which cannot be predicted. The direction of the uncertainty cannot be defined, but the methodology used is based on current EPA guidance.

- Risks to any individual may also be overestimated by summing multiple assumed exposure pathway risks for any single receptor. Although every effort was made to develop reasonable scenarios, not all individual receptors may be exposed via all pathways considered.

- Cancer risks to the lifetime resident may be overestimated because a person will not live in military housing at this site as both an adult and child. A maximum exposure of 10 years would be typical for this receptor assuming a maximum assignment of 2 tours, with each tour lasting 5 years.

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 listed below.

- 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.

6.7 HHRA CONCLUSIONS FOR SITE 5

No estimated carcinogenic risks above EPA's target risk levels of 1.0×10^{-4} were present under the exposure scenarios evaluated for COPCs in surface soil, subsurface soil, sediment, and surface water in this HHRA. Cancer risks for the residential receptors in both surface soil and subsurface soil, and the adult industrial worker in subsurface soil were within EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6}.

However, in the case of the adult industrial worker in surface soil, the cancer risks were below EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6}.

Noncarcinogenic risks to a target organ group were below EPA's target risk level of 1.0 for the residential child in surface soil. In subsurface soil the noncarcinogenic risk to the target organs liver and pancreas was 1.3 for the residential child. This risk marginally exceeds unity (1.0) and was driven by the essential mineral, iron, via ingestion. The noncarcinogenic risks were below EPA's target risk level of 1.0 for the residential adult and adult industrial worker in both surface soil and subsurface soil scenarios.

The carcinogenic risk for the recreational child in sediment was within EPA's target risk range 1.0×10^{-4} to 1.0×10^{-6}. The carcinogenic risk for the recreational child in surface water was below EPA's target risk range of 1.0×10^{-4} to 1.0×10^{-6}. The noncarcinogenic risks in surface water and sediment for the recreational child were less than EPA's target risk level of 1.0. Adverse effects to residential children (age 0 - 6) are not expected from lead concentrations in surface soil and subsurface soil at Site 5.

6.8 ECOLOGICAL RISK ASSESSMENT

Ecological receptors on- or off-base, such as aquatic and semi-aquatic biota, may be at risk from contaminants released from Area B, including Site 5. Accordingly, a screening-level ecological risk assessment (ERA) was performed to characterize the potential risks from site-related contaminants to ecological receptors that inhabit the stream downgradient of the site area. The ERA was conducted for sediments and surface water in the stream in accordance with EPA guidance (EPA, 1994a, 1994b, 1997c, 1998c). Representative exposure point contaminant concentrations in surface water and sediment were compared to benchmark toxicity values (BTVs) that are protective of ecological receptors near the site. Potential risks to ecological receptors were investigated in the form of environmental effects quotients (EEQ) values, which are the ratios of the representative contaminant concentrations to the BTVs. Risks were considered possible when an EEQ value was greater than 1, but other quantitative and qualitative factors were investigated to more fully assess potential risks. A screening food-web model was used to further characterize ecological risks to semi-aquatic receptors.

6.8.1 ERA Approach

This section provides an outline of the general approach that was taken to assess the impacts of site contamination on ecological receptors 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

- Preliminary Problem Formulation (Section 6.8.2) - This is the first phase of an ERA, which discusses the goals, breadth, and focus of the assessment. It includes general descriptions of NAWC Warminster study areas 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 ecological 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 Area B may come into contact with ecological receptors.

- Ecological Effects Characterization (Section 6.8.3) - In this component, medium-specific ecological benchmarks for each 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

- Preliminary Exposure Assessment (Section 6.8.4) - 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 contaminant concentrations from those data.

- Risk Characterization (Section 6.8.5) - In this step, exposure point concentrations are compared to benchmarks in order to characterize potential risk to ecological receptors of concern from contaminant exposure. COPCs found to pose potential risk after these comparisons are placed on a list of ecological contaminants of concern. In addition, the COPCs that are found to pose potential risk to aquatic receptors are evaluated in a conservative food-web model. The receptors evaluated included semi-aquatic (green heron, raccoon, mallard and marsh wren). The inputs in this model assumed that the maximum concentration of each COPC would be ingested in the food by the receptors and the chemicals would be 100 percent bioavailable.

When these two steps are completed, the results can be interpreted and the uncertainties associated with the ERA can be addressed (Section 6.8.6). The above process, described in further detail below, represents the general ERA approach and is a summation of EPA Region III Biological Technical Assistance Group-recommended ERA guidelines (EPA, 1994b), which serve as the basis for the ERA

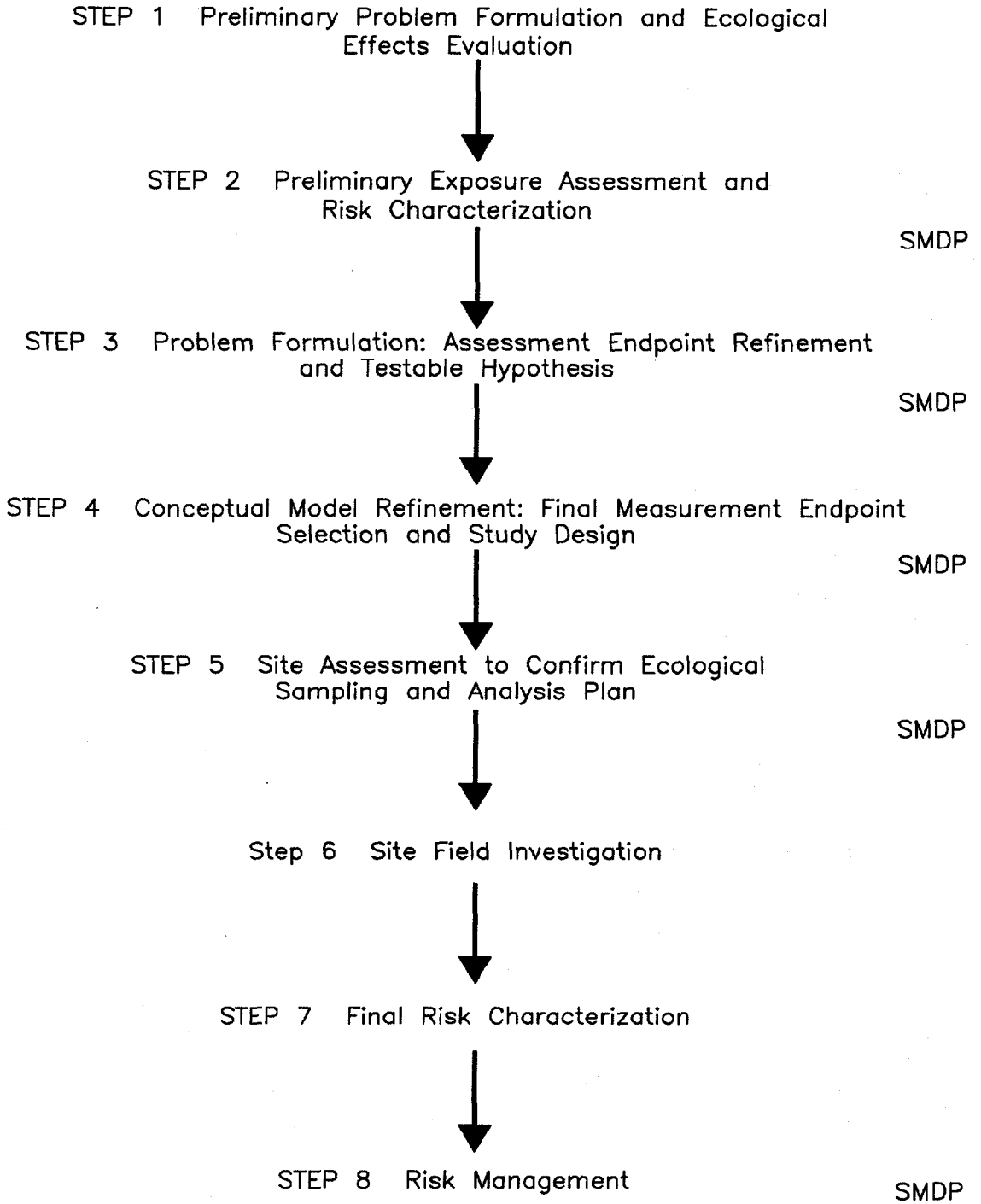
methodology (Figure 6-2). Furthermore, the ERA was conducted in accordance with other available ERA guidance documents (EPA, 1992; Wentsel et al., 1994) and recent publications (Suter, 1993; Calabrese and Baldwin, 1993). Due to the potential complexity of ERAs, they are often conducted using a tiered approach and punctuated with scientific/management decision points (SMDPs; Figure 6-2), 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. This ERA can be considered a "screening-level" assessment, or "Tier 1" assessment, since it is based on only a conservative initial screening of contaminant concentrations against contaminant-specific benchmarks (EPA, 1994b) and a conservative food-web model. Tier 2 and Tier 3 assessments, referred to as "semi-quantitative" and "quantitative" assessments, respectively, are more focused studies that incorporate the initial screening but also encompass detailed laboratory and field studies or extensive modeling (EPA, 1994b). The same process summarized above was used to assess potential ecological risks from Area B.

6.8.2 Preliminary Problem Formulation

6.8.2.1 Environmental Setting

Based on a review of historical aerial photography, an unnamed tributary of Southampton Creek may have extended to within 500 feet of Area B (the area of Sites 5, 6, and 7) through the late 1950's. This tributary may have received at least some surface drainage from the area of Sites 6 and 7 at that time. The portion of this unnamed tributary on NAWC property is no longer evident. A series of subsurface storm drains were installed to collect surface drainage from NAWC Shenandoah Woods housing area constructed in the early 1970's. These storm drains collect stormwater from the housing area, which has a substantial amount of impermeable surface (paving, rooftops, etc.), as well as the area of Sites 6 and 7, particularly during major storm events. Stormwater from the housing area is conveyed to outfall OF10 and a 500-foot subsurface concrete channel which discharges to outfall OF11. Outfall OF11 also receives surface and subsurface drainage from the vicinity of Building 108. The drainage-way below outfall OF11 also receives runoff from offbase residential developments.

Sediment sample B3 was taken from just below Outfall No. 10, while surface water sample B10 was collected from the concrete channel, along with both surface water and sediment samples from sample location B12. The channel flows through the residential subdivision for approximately 1,000 feet and travels through a road culvert before flowing into a natural streambed. This stream flows through a shaded 250-foot reach before entering a small and shallow off-base pond, which overflows into a second small, privately-owned duck pond, which in turn flows into Southampton Creek (Figure 2-4). The pond is



SMDP – Scientific/Management Decision Point

DRAWN BY EEH DATE 3/7/00	Tetra Tech NUS, Inc.	STEPS IN THE ECOLOGICAL RISK ASSESSMENT PROCESS AREA B FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	CONTRACT NO. 7603
CHECKED BY DATE			OWNER NO. 0601
REVISED BY DATE			APPROVED BY DATE 10 Jul 00
SCALE AS NOTED			DRAWING NO. FIGURE 6-2 REV.

SITE_5-OU_10\7603pf01.dwg 3/7/00 EEH

SITE_5-OU_10\7603pf01.dwg

approximately 1,000 feet south of samples B10 and B12. Samples B9 and B11 were collected from the pond because this location appeared to represent the first area of appreciable sedimentation south of the base property boundary.

At this location, Southampton Creek is less than 4 feet wide and 6 inches deep with a rocky substrate; there are mowed and maintained lawns at this point to the water's edge. The base flow rate was 98 gpm, as measured in an area where the creek is contained within a cement culvert (SMC Martin, 1991).

A second drainage channel exists near Building 108, located west of Site 5. Building 108 was not specifically investigated during the RI for OU-10, but has been included in the base-wide environmental baseline survey (EA Engineering, 1996). The building and nearby property was first leased and then transferred to Pennsylvania State University. Samples B1, B6, B7, and B8 were collected along this drainage pathway. This channel collects both stormwater and groundwater that is pumped into a sump to lower the water table in the vicinity of the building. The channel discharges through Outfall No. 11, before being discharged through the same residential neighborhood described above.

As part of the RI, a biological characterization was conducted to support the evaluation of ecological risks. The characterization identified and described the types of ecosystems (e.g., terrestrial, aquatic, and semi-aquatic) and ecological components associated with Area B. The biological characterization also helped to identify any ecologically significant effects that might be apparent and which could be attributable to the base. These types of effects include, but were not limited to, reductions in organism populations, changes in community structure, and changes in ecosystem structure function. The biological characterization was completed on a qualitative, descriptive level, and did not involve biota sampling. The relative abundance of specific vegetation was noted and observations made regarding the occurrence of aquatic and terrestrial animals, including benthic invertebrates, amphibians, reptiles, fish, birds, and mammals.

Based on the biological characterization for Area B, there was very little flow and virtually no biotic component within the approximately 1,000-foot length of the concrete-lined ditch. Amphipods were observed at the point where this channel flows through the road culvert and into the natural streambed. Midge larvae were found in the fine (i.e., silt) sediments at the head end of the first pond. Fish were not observed, but mallard ducks and Canada geese were active in and around each of the ponds. Raccoon tracks were observed along the shore of the pond as well.

Near sample locations B9 and B11, which is representative of the first readily accessible surface water downstream from the base property boundary, Southampton Creek collects stormwater runoff from the subdivision in this neighborhood. The banks were 3 feet high and the Bowmansville silt loam floodplain

soils were classified as hydric. The wetlands assessment indicated that a temporary palustrine, forested, broad-leaved deciduous wetland was adjacent to the creek. The floodplain was characterized by green ash, silver maple, black willow, and box elder, and the understory consisted of green ash saplings and spicebush with an herbaceous layer of jewelweed. Evidence of children playing in the creek was common. Fish up to 6 inches long were seen and gray squirrels, blue jays, and American robins were observed near the creek.

North of Street Road, Southampton Creek was wider (8 feet) and had a rocky bottom. The banks were 4 feet high. Mature silver maple, tulip poplar, and sycamore shaded the banks. The dense subcanopy was dominated by black cherry saplings and spicebush with an herbaceous layer of poison ivy, Virginia creeper, and daylilies. Much of the floodplain and wetlands downstream from the road crossing were filled and only a 20-foot wide vegetation fringe remained. Maintained lawns extended to the edge of the floodplain, but a 20- to 40-foot buffer zone existed throughout much of this area. A green-backed heron was observed near this location.

Additional descriptions of habitat types and ecological receptors downgradient from Area B are presented in Section 3.6. These encompass both aquatic and terrestrial habitats, although aquatic habitats were the only habitats quantitatively assessed in this ERA. Wetlands on and near the installation were assessed in 1994 (HNUS, 1994c), and the results were incorporated into Section 3.6. Data from a base species inventory were also utilized in this ERA (TNC, 1992), as are the results of biological characterizations conducted at the base during 1990 media sampling for this study. An evaluation of threatened and endangered species in the vicinity of the base was also provided, in accordance with Endangered Species Act (ESA) requirements. 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.

6.8.2.2 Ecological Contaminants of Potential Concern

To select ecological COPCs, an initial screen of the stream surface water and sediment sample results was performed. Calcium, magnesium, potassium, iron, and sodium were excluded as COPCs in all media since they are essential nutrients that are toxic only in extremely high concentrations.

6.8.2.3 Contaminant Exposure Pathways

As discussed in Section 5.0, the potential release pathways evaluated for Area B involved atmospheric migration, subsurface contaminant migration, surface water transport, soil surface runoff, and soil migration to groundwater and other media. Combustion and volatilization were assumed to represent a negligible release pathway at all Area B sites since surface soils account for a minor portion of contaminated media and disposal activities have ceased. However, constituents 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 or stormwater outfalls 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. Contaminants found in Area B subsurface soils can leach into groundwater and groundwater associated with Area B may eventually discharge to streams within the Southampton Creek drainage basin (TtNUS, 2000a). However, it does not appear that any potential Area B groundwater contaminants have significantly affected either off-base groundwater quality or stream contaminant concentrations. The available stream and water-table elevations, soil permeability data, groundwater and stream analytical results, and visual observations indicate that Area B groundwater is not contributing to the flow of Southampton Creek south of the base.

The most likely potential pathway for Area B soil to Southampton Creek and related ecological receptors is via surface runoff or stormwater discharges. Precipitation that falls on Sites 5, 6, and 7 may transport soil contaminants to the stream through surface runoff. However, the area lying between Building 108 and Site 5 and downgradient of both Sites 6 and 7 is relatively flat and serves as a recharge area for overland runoff flow from the area of Sites 6 and 7. Ponding of water in this general area was observed during RI work. The distance from Sites 5, 6, and 7 (i.e., greater than 1,000 feet) to the current headwaters of Southampton Creek near Outfall No. 11, along with the relatively flat terrain between the sites and the creek, suggests that overland runoff from these sites to Southampton Creek is not currently a significant transport process. The majority of runoff from Site 5 is diverted to storm drains. At this time, Area B surface soils appear to have minimal potential to migrate to Southampton Creek and associated ecological receptors. The presence of housing units and paved surfaces in the vicinity of Site 5 greatly reduces the potential for rainfall to erode surface soils at this site. In the case of Sites 6 and 7, most surface runoff infiltrates into the ground surface prior to reaching the storm drains.

The disposal activities at Sites 5, 6, and 7 reportedly involved placing wastes (e.g., demolition or construction debris, paints, solvents, oils, and wastewater treatment plant sludges) in pits and trenches followed by backfilling these locations with fill after they were excavated. These types of disposal operations may have resulted in little opportunity for surface runoff to transport waste or soil contaminants due to the presence of fill on top of the disposal.

6.8.2.4 Potential Ecological Receptors

The Area B sites present several possible contaminant exposure routes. For the most part, the relevant contaminant migration pathways are aquatic since insignificant contaminant exposure pathways to terrestrial receptors exist. Since most terrestrial exposure routes were not applicable, the focus of the ecological risk assessment was mainly aquatic environments. However, terrestrial receptors may come into contact with contaminants in surface water by using it for drinking water, although this exposure route represents a negligible portion of total exposure for most receptors. Exposure to contaminants in riparian soils 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.

Aquatic and semi-aquatic organisms inhabiting Southampton Creek and associated drainage pathways 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. Four upper-level receptors (i.e., raccoon, mallard, marsh wren, and green heron) were selected to evaluate potential risks via the food web. Aquatic and semi-aquatic organisms may also be exposed to constituents from contaminated groundwater that flows into surface water; however, there is no evidence of significant groundwater contamination attributable to Area B.

6.8.2.5 Assessment and Measurement Endpoints

As discussed in EPA (1994a) and Wentsel et al. (1994), one of the major tasks in problem formulation 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" (EPA, 1994a). Measurement endpoints are "measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint" (EPA, 1994a). For this ERA, the most appropriate assessment endpoints were the maintenance of aquatic and semi-aquatic receptor populations. Therefore, the specific objectives of this assessment were to determine if exposure to contaminants present in the surface water and sediments near Area B was likely to result in declines in ecological receptor populations or potential adverse food web

concerns. Declines in populations could result in a shift in community structure and possible elimination of resident species from aquatic environments.

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 the three sites investigated in this ERA.

For surface water, the measurement endpoints were contaminant concentrations in surface water associated with adverse effects on growth, survival, and reproduction of aquatic organisms (surface water benchmark values). For sediments, the measurement endpoints were contaminant concentrations in sediment associated with adverse effects on growth, survival, and reproduction of benthic organisms (sediment benchmark values). In addition, measurement endpoints for representative receptor groups were contaminant doses associated with adverse effects on growth, survival, and reproduction of semi-aquatic receptors.

Semi-aquatic receptors, such as piscivorous mammals, may also be exposed to aquatic contaminants. Four upper-level receptors (i.e., raccoon, mallard, marsh wren, and green heron) were selected to evaluate potential risks via the food web. The screening food web modeling process is discussed in Section 6.8.4. The determination of potential risks to aquatic receptors, as reflected in the measurement endpoints described above, may indirectly indicate potential risks to semi-aquatic receptors. For example, potential risks to aquatic receptors from contaminants that bioaccumulate may indicate potential risk to semi-aquatic receptors that feed on them.

A conceptual ecological risk model was formatted 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 Area B 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. The conceptual ecological model for the site is presented in Figure 6-3.

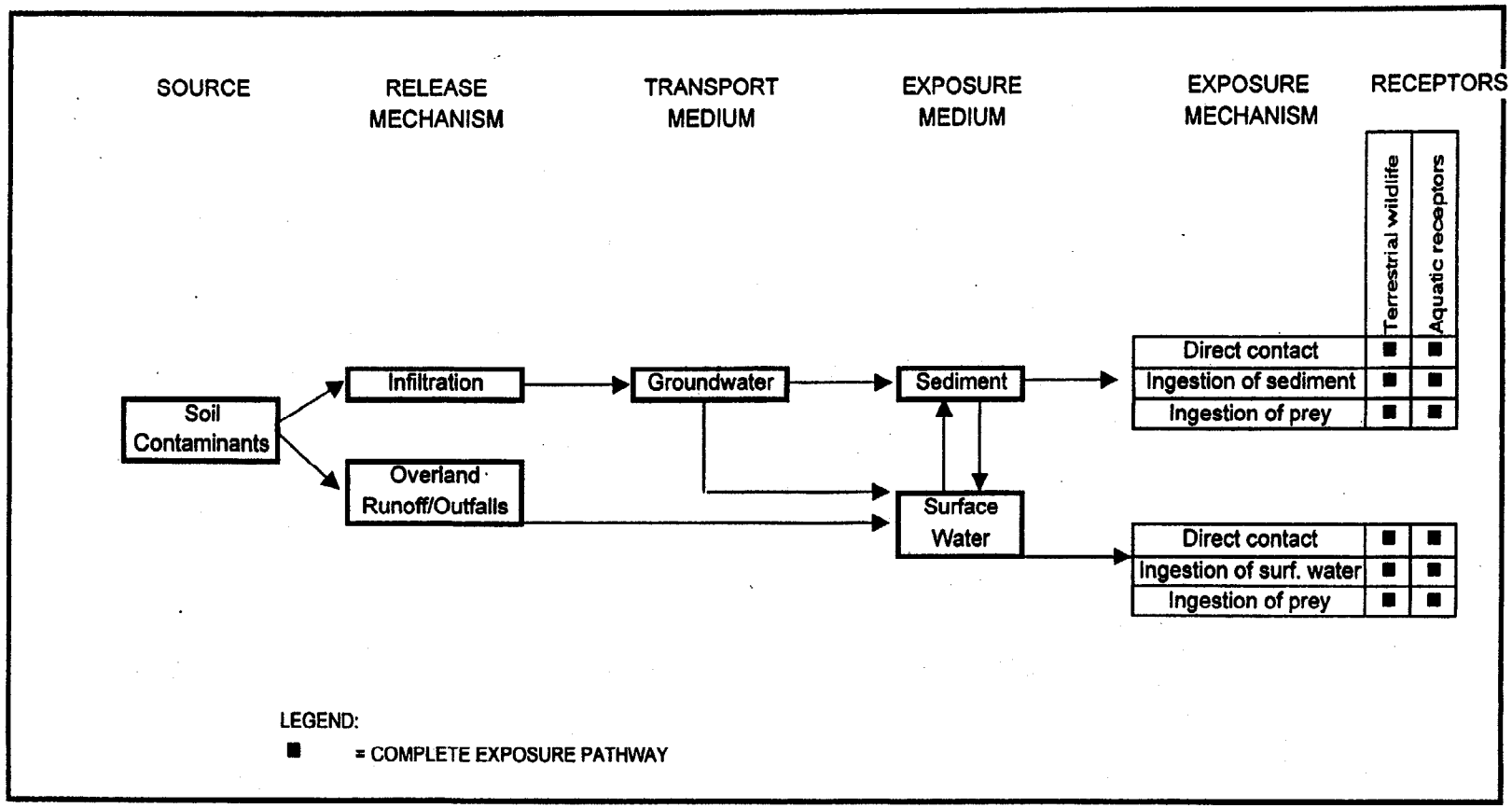


FIGURE 6-3
CONCEPTUAL SITE MODEL - ECOLOGICAL RISK ASSESSMENT
AREA B STREAM
NAWC WARMINSTER, PENNSYLVANIA

6.8.3 Ecological Effects Characterization

For this ERA, ecologically based benchmark toxicity values (BTVs or "benchmarks"), concentrations of contaminants in various media protective of ecological receptors, were selected to screen exposure point concentrations of COPCs in surface water and sediment to determine if they should be retained as COPCs. Methods used for the selection of media-specific benchmarks used in this ERA are provided below.

Actual exposures of aquatic and semi-aquatic receptors to COPCs were assumed to be primarily chronic (long-term) exposures, usually at sublethal concentrations. For this ERA, benchmark values used to identify surface water COCs were chronic screening values, primarily federal AWQCs presented as EPA Region III BTAG screening levels (EPA, 1995) or in 40 CFR Part 131, March 4, 1995. AWQCs are ARARs and are protective of a wide variety of sensitive species. Only organics and total metals in surface water were assessed.

Surface water benchmarks used in this ERA and their sources are presented in Tables 6-61 and 6-62. BTVs for sediment-dwelling organisms were gathered from the most widely accepted guidance. EPA Region III BTAG screening levels were preferentially used; these are primarily Effects Range-Low values from NOAA (Long et al., 1995; Long and Morgan, 1991). When values were not available from these sources, BTVs were obtained from most recent EPA guidance (1996), which includes EPA sediment quality criteria (SQC) and EPA sediment quality benchmarks (SQB) calculated using equilibrium partitioning methods. Other sources include Wisconsin DNR BTVs (1985, 1990), Washington Department of Ecology BTVs (1991), and the Ontario Ministry of the Environment sediment guidelines (MOE, 1993). Sediment benchmarks used in this assessment are summarized in Tables 6-63 and 6-64. Although total organic carbon (TOC) data were available, the calculation of site-specific sediment benchmarks using TOC was beyond the scope of this initial screening. However, site-specific TOC data and their relation to sediment toxicity are discussed qualitatively in Section 6.8.7, along with sediment grain size data.

As identified by EPA, the second step in the ecological risk assessment process compares exposure point contaminant concentrations with benchmark concentrations protective of ecological receptors. Once this step was completed for this study, the results were reviewed to determine whether little or no ecological risk is associated with Area B or additional information must be generated to verify that ecological receptors are at risk. The ratio of the exposure point contaminant concentration to the benchmark value is called the Ecological Effects Quotient (EEQ) and is defined as follows:

TABLE 6-61

DATA SUMMARY FOR SURFACE WATER ORGANICS - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(µg/l)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (µg/l)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	1 / 2	1	1	30 (1)

1: Region III BTAG chronic freshwater fauna screening level (August 9,1995).

TABLE 6-62

DATA SUMMARY FOR SURFACE WATER INORGANICS (TOTAL METALS) - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(µg/l)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (µg/l)* (1)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
BARIUM	2 / 3	92 - 100	3 / 4	80.9 - 94.2	94.2	1000 (2)
MANGANESE	2 / 3	44 - 154	3 / 3	55 - 119	119	14500 (3)
NICKEL	NOT DETECTED	-	1 / 4	20	20	176.92
THALLIUM	NOT DETECTED	-	1 / 4	4.9	4.9	40 (3)
ZINC	1 / 2	30.6	2 / 4	9 - 27.6	27.6	117.65

* = Based on site-specific hardness value (115 mg CaCO3/l) for hardness-dependent metals: nickel and zinc.

1: Benchmarks are for freshwater and represent Ambient Water Quality Criteria (USEPA, 1995, 40 CFR Part 131, Revision of Metals Criteria, dated May 4), unless otherwise indicated.

2: Region III BTAG acute screening level (August 9, 1995): acute screening level/10.

3: Region III BTAG chronic screening level (August 9, 1995).

TABLE 6-63

DATA SUMMARY FOR SEDIMENT ORGANICS - AREA B
NAWC WARMINSTER, PENNSYLVANIA
(µg/kg)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (µg/kg) (1)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
Semivolatile Organic Chemicals						
ACENAPHTHENE	2 / 2	100 - 110	1 / 2	470	470	16 (ER-L) (4)
ANTHRACENE	2 / 2	252.5 - 330	2 / 2	200 - 1400	1400	85.3 (ER-L) (4)
BENZ(A)ANTHRACENE	2 / 2	579.5 - 1300	2 / 2	530 - 5200	5200	261 (ER-L) (4)
BENZO(A)PYRENE	2 / 2	489.5 - 880	2 / 2	450 - 4400	4400	430 (ER-L) (4)
BENZO(B)FLUORANTHENE	2 / 2	829.5 - 1300	2 / 2	690 - 7100	7100	3200 (AET) (4)
BENZO(G,H,I)PERYLENE	2 / 2	267.5 - 720	2 / 2	390 - 2000	2000	670 (AET) (4)
BENZO(K)FLUORANTHENE	2 / 2	362.5 - 1000	2 / 2	250 - 2100	2100	3200 (AET) (2)
BIS(2-ETHYLHEXYL)PHTHALA	2 / 2	91.5 - 1900	2 / 2	580 - 18000	18000	1300 (AET) (2)
BUTYLBENZYLPHTHALATE	NOT DETECTED	-	1 / 2	120	120	63 (AET) (2)
CARBAZOLE	1 / 1	287.5	2 / 2	120 - 1100	1100	NA
CHRYSENE	2 / 2	587.5 - 1500	2 / 2	550 - 5600	5600	384 (ER-L) (4)
DI-N-BUTYLPHTHALATE	NOT DETECTED	-	1 / 2	5100	5100	6200 (AET) (4)
DI-N-OCTYLPHTHALATE	NOT DETECTED	-	1 / 2	79	79	6200 (AET) (4)
DIBENZ(A,H)ANTHRACENE	1 / 2	96	1 / 2	55	55	63.4 (ER-L) (4)
FLUORANTHENE	2 / 2	1630 - 3400	2 / 2	1200 - 17000	17000	600 (ER-L) (4)
FLUORENE	2 / 2	160 - 190	2 / 2	65 - 600	600	19 (ER-L) (4)
INDENO(1,2,3-CD)PYRENE	2 / 2	312.5 - 600	2 / 2	320 - 2400	2400	600 (AET) (4)
4-METHYLPHENOL	NOT DETECTED	-	2 / 2	450 - 560	560	670 (AET) (2)
N-NITROSODIPHENYLAMINE	NOT DETECTED	-	1 / 2	1700	1700	28 (AET) (4)
PYRENE	2 / 2	1380 - 2900	2 / 2	1200 - 9900	9900	665 (ER-L) (4)
Pesticides and PCBs						
4,4'-DDE	NOT DETECTED	-	2 / 5	9 - 24	24	2.2 (ER-L) (4)
4,4'-DDT	NOT DETECTED	-	1 / 5	430	430	1 (ER-L) (3)
ALDRIN	NOT DETECTED	-	3 / 5	3.6 - 4.7	4.7	100 (4)
ALPHA-CHLORDANE	1 / 1	5.85	1 / 5	15	15	7 (LEL) (6)
AROCLOR-1260	NOT DETECTED	-	4 / 5	270 - 1900	1900	5 (LEL) (5)
DELTA-BHC	NOT DETECTED	-	1 / 5	4	4	100 (4)
DIELDRIN	NOT DETECTED	-	1 / 5	13	13	2 (LEL) (5)
METHOXYCHLOR	NOT DETECTED	-	1 / 5	79	79	NA

NA = Benchmark not available.

AET = Apparent Effects Threshold Value as developed for Puget Sound, State of Washington.

ER-L = Effects Range-Low; value from data based on studies conducted primarily on coastal marine and estuarine environments.

LEL = Lowest Effect Level; level of contamination tolerated by the majority of benthic organisms.

1: Benchmarks are for freshwater sediments, unless otherwise indicated.

2: NOAA, 1994. NOAA Screening Guidelines for Organics and Inorganics, Quick Reference Cards, HAZMAT REPORT 94-8.

3: Long and 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

4: Region III BTAG fauna screening level (August 9, 1995).

5: MOE, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, Ministry of Environment and Energy, Ontario, Canada (August).

6: Value for total chlordane, MOE, 1993 (see footnote 5).

TABLE 6-64

DATA SUMMARY FOR SEDIMENT INORGANICS - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

CONTAMINANT OF POTENTIAL CONCERN	BACKGROUND		SITE-RELATED			BENCHMARK (mg/kg) (1)
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	EXPOSURE CONCENTRATION	
ARSENIC	3 / 3	0.31 - 3.7	4 / 4	3.3 - 3.6	3.6	8.2 (ER-L) (2)
BARIUM	2 / 3	43.9 - 53.8	4 / 4	45.6 - 68.5	68.5	500 (3)
BERYLLIUM	2 / 2	0.61 - 0.7	4 / 4	0.63 - 0.88	0.88	NA
CADMIUM	1 / 2	1.4	2 / 2	1.3 - 1.9	1.9	1.2 (ER-L) (4)
CHROMIUM (TOTAL)	3 / 3	1.2 - 16.6	4 / 4	9.3 - 18.3	18.3	26 (LEL) (5)
COBALT	3 / 3	0.3 - 7.2	3 / 3	5.4 - 7.6	7.6	50 (6)
COPPER	2 / 2	17.5 - 18.4	4 / 4	20.6 - 59.5	59.5	34 (ER-L) (2)
LEAD	3 / 3	3.4 - 27.8	4 / 4	38.7 - 168	168	46.7 (ER-L) (2)
MANGANESE	2 / 3	225 - 284	4 / 4	135 - 628	554.78	460 (LEL) (5)
NICKEL	2 / 3	12.9 - 14.2	4 / 4	8.6 - 16.8	16.80	21 (ER-L) (4)
SILVER	NOT DETECTED	-	1 / 2	0.71	0.71	1 (ER-L) (4)
THALLIUM	NOT DETECTED	-	1 / 4	0.96	0.96	NA
VANADIUM	3 / 3	1.4 - 25.4	4 / 4	13.6 - 22.7	22.7	NA
ZINC	3 / 3	26 - 129	4 / 4	111 - 486	486	150 (ER-L) (2)

NA = Benchmark not available.

ER-L = Effects Range-Low; value from data based on studies conducted primarily on coastal marine and estuarine environments.

LEL = Lowest Effect Level; level of contamination tolerated by the majority of benthic organisms.

1: Benchmarks are for freshwater sediments, unless otherwise indicated.

2: Region III BTAG fauna screening level (August 9, 1995).

3: Wisconsin Department of Natural Resources (1985, 1990), Criteria for Sediments from Great Lakes harbors for disposal in water, in: Washington Department of Ecology, 1991, Summary of Criteria and Guidelines for Contaminated Fres

4: NOAA, 1994. NOAA Screening Guidelines for Organics and Inorganics, Quick Reference Cards, HAZMAT REPORT 94-8.

5: MOE, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, Ministry of Environment and Energy, Ontario, Canada (August).

6: Open Water Disposal Guideline, in: MOE, 1993 (see footnote 5).

$EEQ_i = EPC_i/BTV_i$

where: EEQ_i = Ecological Effects Quotient for COPC "i" (unitless)

EPC_i = Exposure Point Concentration for COPC "i" (ug/l or mg/kg)

BTV_i = Benchmark Toxicity Value for COPC "i" (ug/l or mg/kg)

When the ratio of the exposure point concentration to its respective benchmark value exceeded 1.0, adverse impacts were considered possible and the COPC was retained. The EEQ 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 benchmark. When EEQ 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 benchmarks are conservatively derived.

The use of EEQs 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 EEQ 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 "no/maybe" method for relating toxicity to exposure. That is, it uses single values for exposure concentrations and benchmark values and does not account for the variability in both these parameters or for incremental or cumulative toxicity. However, ecological toxicity is not necessarily additive. Multiple contaminants may have synergistic, and even ameliorating, effects. Different types of contaminants also have different target organs and modes of action, confounding additive effects.

The comparisons described above are presented in Tables 6-65 through 6-68 to select COPCs in surface water and sediment downgradient of Area B. Some contaminants were present in some media for which no suitable benchmark values were available. In these instances, these contaminants (i.e., carbazole, beryllium, thallium, and vanadium) were conservatively retained as COPCs.

TABLE 6-65

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SURFACE WATER ORGANICS - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(µg/l)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (µg/l)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
BIS(2-ETHYLHEXYL)PHTHALATE	1	30	0.03	NO

1: COPC was retained as a COC if the benchmark was exceeded or if no benchmark was available

TABLE 6-66

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SURFACE WATER INORGANICS (TOTAL METALS) - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(µg/l)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (µg/l)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
BARIUM	94.2	1000	0.09	NO
MANGANESE	119	14500	0.01	NO
NICKEL	20	176.92	0.11	NO
THALLIUM	4.9	40	0.12	NO
ZINC	27.6	117.65	0.23	NO

1: COPC was retained as a COC if the benchmark was exceeded or if no benchmark was available

TABLE 6-67

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SEDIMENT ORGANICS - AREA B
NAWC WARMINSTER, PENNSYLVANIA
(µg/kg)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (µg/kg)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
Semivolatile Organic Chemicals				
ACENAPHTHENE	470	16	29.38	YES
ANTHRACENE	1400	85.3	16.41	YES
BENZ(A)ANTHRACENE	5200	261	19.92	YES
BENZO(A)PYRENE	4400	430	10.23	YES
BENZO(B)FLUORANTHENE	7100	3200	2.22	YES
BENZO(G,H,I)PERYLENE	2000	670	2.99	YES
BENZO(K)FLUORANTHENE	2100	3200	0.66	NO
BIS(2-ETHYLHEXYL)PHTHALA	18000	1300	13.85	YES
BUTYLBENZYLPHTHALATE	120	63	1.90	YES
CARBAZOLE	1100	NA		YES
CHRYSENE	5600	384	14.58	YES
DI-N-BUTYLPHTHALATE	5100	6200	0.82	NO
DI-N-OCTYLPHTHALATE	79	6200	0.01	NO
DIBENZ(A,H)ANTHRACENE	55	63.4	0.87	NO
FLUORANTHENE	17000	600	28.33	YES
FLUORENE	600	19	31.58	YES
INDENO(1,2,3-CD)PYRENE	2400	600	4.00	YES
4-METHYLPHENOL	560	670	0.84	NO
N-NITROSODIPHENYLAMINE	1700	28	60.71	YES
PYRENE	9900	665	14.89	YES
Pesticides and PCBs				
4,4'-DDE	24	2.2	10.91	YES
4,4'-DDT	430	1	430.00	YES
ALDRIN	4.7	100	0.05	NO
ALPHA-CHLORDANE	15	7	2.14	YES
AROCLOR-1260	1900	5	380.00	YES
DELTA-BHC	4	100	0.04	NO
DIELDRIN	13	2	6.50	YES
METHOXYCHLOR	79	100	0.79	NO

1: COPC was retained as a COC if the benchmark was exceeded or if no benchmark was available
NA = No benchmark available.

TABLE 6-68

SELECTION OF ECOLOGICAL CONTAMINANTS OF CONCERN FOR SEDIMENT INORGANICS - AREA B

NAWC WARMINSTER, PENNSYLVANIA

(mg/kg)

CONTAMINANT OF POTENTIAL CONCERN	EXPOSURE CONCENTRATION	BENCHMARK (mg/kg) (1)	ECOLOGICAL EFFECTS QUOTIENT (EEQ)	RETAINED AS COC? (1)
ARSENIC	3.6	8.2	0.44	NO
BARIUM	68.5	500	0.14	NO
BERYLLIUM	0.88	NA	-	YES
CADMIUM	1.9	1.2	1.58	YES
CHROMIUM (TOTAL)	18.3	26	0.70	NO
COBALT	7.6	50	0.15	NO
COPPER	59.5	34	1.75	YES
LEAD	168	46.7	3.60	YES
MANGANESE	554.78	460	1.21	YES
NICKEL	16.80	21	0.80	NO
SILVER	0.71	1	0.71	NO
THALLIUM	0.96	NA	-	YES
VANADIUM	22.7	NA	-	YES
ZINC	486	150	3.24	YES

1: COPC was retained as COC if the benchmark was exceeded or no benchmark was available

NA = No benchmark available.

6.8.4 Exposure Assessment

Exposure assessment is a key component of risk quantitation, linking contaminants to receptors through complete pathways. Data used to obtain exposure point contaminant concentrations in environmental media used for this ERA were those generated during RI sampling activities. The maximum detected contaminant concentrations or the 95 percent UCL were used as exposure point concentrations in surface water and sediment, in accordance with EPA Region III BTAG guidelines for data usage in ERAs (1994b). Since most of the 95 percent UCL values were less than 80 percent of the maximum detected value, the maximum was used in almost all cases, as recommended by EPA Region III BTAG (1994b). Background data are presented for comparative purposes and were obtained from facility-wide background sampling. Detailed descriptions of sampling locations, data validation, data treatment, and data selection were presented in previous sections. Sampling data for Southampton Creek and associated drainage pathways are summarized in Sections 4.6 and 4.7.

6.8.4.1 Screening Food Web Model

A screening food web model was used to further characterize ecological risks to semi-aquatic receptors. The relevant exposure pathway for semi-aquatic receptors was chronic exposure to sediments and water due to dietary uptake. Four representative upper-level receptors (i.e., raccoon, mallard, marsh wren, and green heron) were selected to evaluate potential risks via the food web. These receptors occupy different feeding guilds, but have diets that contain potential vectors for site-related contaminants.

The exposure assessment was very conservative and was set up such that herbivore receptors consumed 100 percent vegetation and omnivore/carnivore receptors consumed 100 percent of non-vegetation food (e.g., invertebrates and small mammals). Incidental ingestion was included in the food ingestion rate in this assessment.

No site-specific vegetation, invertebrate, or mammal concentrations were available; therefore, food organisms were assumed to have the same concentrations of COPCs as sediment. This exposure was particularly conservative by substituting sediment for other food (vegetation, invertebrates, or mammals) that organisms would typically ingest as their main food items. In addition, it assumed that all food was on a dry-weight basis, but this food is actually consumed on a wet-weight basis; consequently, dietary doses (and risk) are overestimated.

Specific exposure factors such as body weight and food ingestion rate used in the conservative model are summarized by receptor in Appendix K. Where available, data on body weight, food ingestion rate, and soil/sediment ingestion rate were taken directly from Exposure Factors handbook (EPA, 1993).

Dietary receptor exposures were estimated as body-weight-normalized daily doses for comparison to a body-weight-normalized daily dose TRV. The daily dose for a given receptor to a specific COPC was derived by summing the products of feeding rate and food items and multiplying the sum by the total feeding rate and a habitat usage factor (assumed to be 100 percent for this food web). In this food web model, the food ingestion rates are based on 100 percent food items plus incidental sediment ingestion.

$$Dose_{total} = Dose_{food} + Dose_{sediment}$$

where:

$Dose_{total}$	=	Total daily dose of COPC received by receptor; mg COPC/kg-body wt./day
$Dose_{food}$	=	Daily dose of COPC received by receptor; mg COPC/kg-body wt./day from food items (=concentration of sediment)
$Dose_{sediment}$	=	Daily dose of COPC received by receptor; mg COPC/kg-body wt./day from incidentally ingested sediment

The total dose from food is given by:

$$Dose_{food} = \frac{F_f \, x \, U \, x \, C_f}{BW}$$

where:

F_f	=	Total daily feeding rate in kg food/day (wet basis)
U	=	Habitat usage factor (fraction of habitat range represented by site) for receptor; assumed to be 1.0 for this food web
C_f	=	Concentration of COPC in food; assumed to be the same concentration as soil or sediment (mg chemical/kg food)
BW	=	Body weight of ROC (kg)

The total dose from soil is given by:

$$Dose_{sediment} = \frac{F_s \, x \, U \, x \, C_s}{BW}$$

where:

F_s	=	Total daily soil feeding rate in kg soil or sediment/day (wet basis)
U	=	Habitat usage factor (fraction of habitat range represented by site) for receptor; assumed to be 1.0 for this food web
C_s	=	Concentration of COPC in soil or sediment; mg chemical/kg sediment (dry basis)
BW	=	Body weight of ROC (kg)

Lastly, the total daily incidental sediment-feeding rate is given by:

$$F_s = F_f \; x \; FX_{sediment}$$

where:

F_s	=	Total daily sediment feeding rate in kg sediment /day (wet basis)
F_f	=	Total daily feeding rate in kg food/day (wet basis)
$F_{xsediment}$	=	Fraction sediment ingestion as a proportion of food ingestion rate

Information necessary for calculation includes: organism body weight (BW), food ingestion rate (F_f), fraction sediment ingestion as a proportion of food ingestion rate ($F_{xsediment}$), and analyte concentrations of ingested materials. As discussed earlier, vegetation and animal food items were represented by the same concentration as found in soil and sediment (dry weight). Information specifically relevant to the ecology of the receptors (i.e., body weights, food ingestion rates, and sediment ingestion rates) are presented in Appendix K, which provides more information regarding the food web model calculations.

6.8.4.2 Toxicity Reference Values

Based on EPA guidance, screening ecotoxicity values should be equivalent to a documented or best conservatively estimated chronic no observed adverse effect level (NOAEL) (EPA, 1997). A toxicity reference value (TRV) is an estimate of the highest level of a chemical that an ecological receptor can safely ingest in its diet. The TRVs are presented in the form of a body-weight-normalized dose (i.e., mg/kg-bw/day), and are thus directly comparable to the exposure dose calculated in the food web model. The TRVs used were based on Oak Ridge National Laboratory's *Toxicological Benchmarks for Wildlife* (Sample et al., 1996). The TRVs were derived from literature studies of the chronic effects of various chemicals on mammals and birds.

Appropriate TRVs were used for each combination of a specific receptor of concern and COPC. The receptors of concern identified for evaluation in the food-web model included resident mammals and birds

representative of various feeding habits (e.g., herbivore, omnivore, and carnivore). The laboratory studies that provide NOAEL and lowest observed adverse effect level (LOAEL) data for use as TRVs are usually performed on standard test animals and therefore, the results do not directly represent the receptors identified for the ecological risk screening.

Where possible, TRVs were based on NOAEL data (Sample et al. 1996). In some cases, TRVs were developed from other pertinent toxicological literature. Note in particular that very few TRVs are available for specific PAH compounds. In these cases, specific PAH compounds were divided by the TRV for benzo(a)pyrene. This compound is the most toxic of the PAHs and served as a surrogate for specific PAH compounds in the food web screening.

6.8.5 Risk Characterization

6.8.5.1 Environmental Effects Quotient (EEQ) Results

As described in Section 6.8.3, surface water and sediment exposure point contaminant concentrations were compared to benchmark concentrations protective of ecological receptors to develop EEQ ratio values. These comparisons are presented in Tables 6-65 through 6-68 to select COPCs in surface water and sediment downgradient from Area B. Some contaminants were present in some media for which no suitable benchmark values were available. In these instances, these contaminants (i.e., carbazole, beryllium, thallium, and vanadium) were conservatively retained as COPCs.

For surface water total inorganics and organics, there were no COPCs (Tables 6-65 and 6-66). The EEQ values were all less than 1.0. For sediment inorganic COPCs, cadmium, copper, lead, manganese, and zinc exceeded BTVs and were retained as COPCs (Table 6-68). Beryllium, thallium, and vanadium were conservatively retained as sediment COPCs since no suitable BTVs were available. A multitude of sediment organics exceeded BTVs, with the highest EEQs calculated for several PAHs (Table 6-67). Also, 4,4'-DDT and Aroclor-1260 also had elevated EEQs.

The contaminant-specific EEQ values for stream sample locations B10 and B12 were greater than those calculated for stream sample locations B9 and B11 (including the duplicate sample at B11). This difference was primarily associated with the presence of DDE and DDT in samples B10 and B12 sediments. The B10 and B12 sediment samples also contained more PAHs that contributed to the risks associated with these sediments than did samples B9 and B11. These data suggest that risks posed by organically contaminated sediments are greater at samples B10/B12 (the upstream samples); however, these materials either dissipate or are not carried downstream.

As part of the risk characterization and to evaluate the potential contribution of Area B sites to the contamination identified in the stream sediments, the occurrence and levels of the constituents retained as COCs in sediment (see Tables 6-67 and 6-68) were compared to Area B site surface soil results and the established background dataset for NAWC Warminster (Table 2-6). Table 6-69 presents a summary of the Area B surface soil organic results, by site, as well as sediment organic concentrations. Soil analytical data for Sites 6 and 7 were combined due to their proximity to one another (TtNUS, 1999b).

The first evaluation consisted of comparing the maximum Area B surface soil concentration for each COC to the maximum background soil concentration (see Table 2-6) to determine if Area B sites were a significant potential source of this contaminant. The results of this comparison shows that the maximum detected concentrations of DDT and DDE in Area B surface soils, 14 ug/kg and 9.5 ug/kg respectively, were considerably lower than that identified in background soil samples, 1440 ug/kg and 820 ug/kg respectively. In addition, DDT and DDE were found in fewer than 15 percent of the Area B site samples. Based on this comparison, it appears that detected levels of these COCs in sediment may be related to non-site sources.

To further evaluate the potential relationship of Area B sites to the stream sediment quality, the maximum sediment concentration for each COC with an EEQ > 1 was compared to the maximum site soil data. The results of this comparison shows that maximum sediment concentrations for bis(2-ethylhexyl)phthalate (18,000 ug/kg), alpha-chlordane (15 ug/kg), aroclor 1260 (1,900 ug/kg), DDT (430 ug/kg) and DDE (24 ug/kg) are greater than maximum concentrations found in any of the Area B site surface soils; 2,700 ug/kg, 8.2 ug/kg, 1,000 ug/kg, 14 ug/kg, and 9.5 ug/kg respectively. The results of this comparison indicate that Area B sites, considering available data, do not appear to be a current source for these contaminants.

The remaining primary ecological sediment organic COCs (EEQ > 1) consists largely of PAH compounds. PAHs were detected in Area B site surface soils at levels above background and at levels greater than were detected in stream sediments. However, a review of the Area B surface soil data indicates that the occurrence of these compounds was at a relatively low frequency (see Table 6-69). Considering the concentrations of these compounds in Area B soils, Area B may have been a potential source. However, due to their general occurrence in developed urban land, and their presence in stream sediments, no conclusions regarding the potential source of these contaminants in stream sediment can be made.

A similar comparison was conducted for inorganic contaminants identified as ecological COCs in sediment. Table 6-70 presents a summary of the Area B surface soil inorganic results, by site, as well as sediment inorganic concentrations. Among the sediment inorganic ecological COCs, cadmium, copper, lead, manganese, and zinc had EEQs > 1.0. With the exception of cadmium, which was found in about 36 percent of the samples, these same metals were detected in nearly all of the Area B surface soil samples.

TABLE 6-69

DATA SUMMARY FOR ORGANICS - AREA B AND STREAM
NAWC WARMINSTER, PENNSYLVANIA
(µg/kg)

CONTAMINANT OF POTENTIAL CONCERN	SITE 5 SURFACE SOIL		SITE 6 AND 7 SURFACE SOILS		SEDIMENT	
	FREQUENCY OF DETECTION	RANGE OF DETECTION	FREQUENCY OF DETECTION	RANGE OF DETECTION	FREQUENCY OF DETECTION	RANGE OF DETECTION
Semivolatile Organic Chemicals						
ACENAPHTHENE	NOT DETECTED		1 / 29	4100 - 4100	1 / 2	470
ANTHRACENE	NOT DETECTED		2 / 29	100 - 6000	2 / 2	200 - 1400
BENZ(A)ANTHRACENE	3 / 29	74J - 330J	5 / 29	42 - 13000	2 / 2	530 - 5200
BENZO(A)PYRENE	3 / 29	67J - 270J	5 / 29	45 - 11000	2 / 2	450 - 4400
BENZO(B)FLUORANTHENE	3 / 29	50J - 120J	6 / 29	54 - 13000	2 / 2	690 - 7100
BENZO(G,H,I)PERYLENE	3 / 29	52J - 100J	6 / 29	41 - 3700	2 / 2	390 - 2000
BENZO(K)FLUORANTHENE	2 / 29	48J - 90J	4 / 29	360 - 7900	2 / 2	250 - 2100
BIS(2-ETHYLHEXYL)PHTHALATE	6 / 17	39J - 270J	1 / 26	2700 - 2700	2 / 2	580 - 18000
BUTYLBENZYLPHTHALATE	NOT DETECTED		2 / 29	49 - 700	1 / 2	120
CARBAZOLE	NOT DETECTED		NOT DETECTED	NOT DETECTED	2 / 2	120 - 1100
CHRYSENE	3 / 29	100J - 450	5 / 29	53 - 14000	2 / 2	550 - 5600
DI-N-BUTYLPHTHALATE	1 / 24	40J	NOT DETECTED	NOT DETECTED	1 / 2	5100
DI-N-OCTYLPHTHALATE	NOT DETECTED		NOT DETECTED	NOT DETECTED	1 / 2	79
DIBENZ(A,H)ANTHRACENE	1 / 29	48J	3 / 29	44 - 1200	1 / 2	55
FLUORANTHENE	1 / 11	42J - 170J	7 / 29	36 - 28000	2 / 2	1200 - 17000
FLUORENE	NOT DETECTED	160 - 190	1 / 29	2800 - 2800	2 / 2	65 - 600
INDENO(1,2,3-CD)PYRENE	2 / 29	41J - 60J	5 / 29	49 - 4600	2 / 2	320 - 2400
4-METHYLPHENOL	NOT DETECTED		NOT DETECTED	NOT DETECTED	2 / 2	450 - 560
N-NITROSODIPHENYLAMINE	NOT DETECTED		NOT DETECTED	NOT DETECTED	1 / 2	1700
PYRENE	6 / 29	46J - 310J	5 / 29	73 - 25000	2 / 2	1200 - 9900
Pesticides and PCBs						
4,4'-DDE	6 / 35	4K - 9.5J	1 / 16	7.7 - 7.7	2 / 5	9 - 24
4,4'-DDT	5 / 35	4.7J - 14	2 / 16	5.5 - 6.5	1 / 5	430
ALDRIN	1 / 1		/	-	3 / 5	3.6 - 4.7
ALPHA-CHLORDANE	1 / 1	5.85	1 / 17	8.2 - 8.2	1 / 5	15
AROCLOR-1260	NOT DETECTED		6 / 29	13 - 1000	4 / 5	270 - 1900
DELTA-BHC	NOT DETECTED		NOT DETECTED	NOT DETECTED	1 / 5	4
DIELDRIN	1 / 33	25L	NOT DETECTED	NOT DETECTED	1 / 5	13
METHOXYCHLOR	NOT DETECTED		NOT DETECTED	NOT DETECTED	1 / 5	79

TABLE 6-70
DATA SUMMARY FOR INORGANICS - AREA B AND STREAM
NAWC WARMINSTER, PENNSYLVANIA
(mg/kg)

CONTAMINANT OF POTENTIAL CONCERN	SITE 5 SURFACE SOIL		SITE 6 AND 7 SURFACE SOIL		SEDIMENT	
	FREQUENCY OF DETECTION	RANGE OF DETECTION	FREQUENCY OF DETECTION	RANGE OF DETECTION	FREQUENCY OF DETECTION	RANGE OF DETECTION
ARSENIC	35 / 36	0.39 K - 7.9 L	29 / 29	4.6 - 15.1	4 / 4	3.3 - 3.6
BARIUM	36 / 36	40 K - 311	29 / 29	30.2 - 1030	4 / 4	45.6 - 68.5
BERYLLIUM	36 / 36	0.59 - 1.6	29 / 29	0.39 - 1.9	4 / 4	0.63 - 0.88
CADMIUM	18 / 34	0.39 K 10.5	5 / 29	3.3 - 18.9	2 / 2	1.3 - 1.9
CHROMIUM (TOTAL)	36 / 36	12.4 - 49.2 K	29 / 29	13.2 - 2760	4 / 4	9.3 - 18.3
COBALT	36 / 36	5 - 21.3 K	29 / 29	5.1 - 20.9	3 / 3	5.4 - 7.6
COPPER	36 / 36	6.8 - 875	29 / 29	7.3 - 867	4 / 4	20.6 - 59.5
LEAD	36 / 36	7.5 - 1020	29 / 29	8.3 - 278	4 / 4	38.7 - 168
MANGANESE	36 / 36	130 - 2550 J	29 / 29	123 - 3040	4 / 4	135 - 628
NICKEL	36 / 36	6.3 K - 83.2	19 / 29	9.7 - 29.9	4 / 4	8.6 - 16.8
SILVER	27 / 29	0.73 - 87.2 K	14 / 29	0.77 - 123	1 / 2	0.71
THALLIUM	7 36	0.47 K - 2 K	9 / 29	5.1 - 15.1	1 / 4	0.96
VANADIUM	36 / 36	19.5 - 60.9	29 / 29	13.4 - 41.7	4 / 4	13.6 - 22.7
ZINC	36 / 36	18.4 - 4180 L	29 / 29	24.9 - 1840	4 / 4	111 - 486

The maximum concentration identified in Area B surface soil samples was greater than the maximum background result for each of these and all sediment COCs identified. In addition the maximum site surface soil concentration for each of these contaminants was greater than the maximum sediment concentration.

The maximum background soil concentrations for beryllium, manganese, and vanadium were about twice the level found in sediment samples and the background 95th% UCL for each was about equal to the maximum sediment concentration (see Tables 2-6 and 6-70). Beryllium was identified in the background soils at a maximum level of 1.7 mg/kg with a UCL of 0.878 mg/kg and in sediment samples at 0.63 to 0.88 mg/kg. Manganese was identified in the background soils at a maximum level of 2,010 mg/kg with a UCL of 601 mg/kg and in sediment samples at 135 to 628 mg/kg. Vanadium was identified in the background soils at a maximum level of 45 mg/kg with a UCL of 32.1 mg/kg and in sediment samples at 13.6 to 22.7 mg/kg. This comparison indicates that the presence of these contaminants in stream sediments may be attributable to natural soil quality.

This pattern of contamination does not hold true for the other primary inorganic COCs. Cadmium (not detected in background surface soils), copper (maximum background of 30.6 mg/kg and UCL of 15 mg/kg), lead (maximum background of 96.5 mg/kg and UCL of 16.3 mg/kg), thallium (maximum background and UCL of 0.42 mg/kg), and zinc (maximum background of 60 mg/kg and UCL of 32.9 mg/kg) were found in stream sediments at levels higher than in background soils. This comparison indicates that these contaminant levels may be related to other sources including Area B sites.

6.8.5.2 Food-Web Modeling Results

As discussed in Section 6.8.4.1, a screening food web model was used to help evaluate ecological risks to semi-aquatic receptors. Four receptors (i.e., raccoon, mallard, marsh wren, and green heron) were selected to evaluate these potential risks. Various exposure factors (body weight, food ingestion rate, and soil ingestion rate) and TRV values (primarily NOAEL data) were used as input parameters for the food-web model. Other input parameters included maximum sediment concentrations. For purposes of the model, it was assumed that these receptors will ingest 100 percent of the contaminant contamination from prey.

The ecological COPCs that had EEQ values greater than 1.0 included 14 semivolatile organic compounds, five pesticides, one PCB, and nine inorganics. These same COPCs were evaluated using the food-web model. Table 6-71 presents the results of the screening food web model, based on the ecological contaminants of potential concern. The following is a summary of the food-web model results by COPC using the concept of NOAEL hazard quotients (HQs).

TABLE 6-71
AXIMUM CONCENTRATION ECOLOGICAL HAZARD QUOTIENT VALUE FROM FOOD-WEB MODEL
AREA B - NAWC WARMINSTER, PENNSYLVANIA

Ecological Contaminants of Concern	Raccoon NOAEL HQ_n	Wren NOAEL HQ_n	Mallard NOAEL HQ_n	Heron NOAEL HQ_n
Acenaphthene	0.09	NA	NA	NA
Alpha chlordane	0.00	0.00	0.00	0.00
Anthracene	0.25	NA	NA	NA
Aroclor 1260	1.04	2.36	0.54	1.99
Benz(a)anthracene	0.94	NA	NA	NA
Benzo(a)pyrene	0.80	NA	NA	NA
Benzo(b)fluoranthene	1.28	NA	NA	NA
Benzo(g,h,i)perylene	0.36	NA	NA	NA
Beryllium	0.13	NA	NA	NA
bis(2-Ethylhexyl)phthalate	0.18	3.66	0.83	3.09
Butylbenzylphthalate	NA	NA	NA	NA
Cadmium	0.20	0.29	0.07	0.25
Carbazole	NA	NA	NA	NA
Chromium	0.00	4.09	0.93	3.45
Chrysene	1.01	NA	NA	NA
Copper	0.39	0.28	0.06	0.24
DDE	0.00	1.79	0.41	1.51
DDT	0.05	32.05	7.27	27.04
Dieldrin	0.06	0.04	0.01	0.03
Fluoranthene	3.08	NA	NA	NA
Fluorene	0.11	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.43	NA	NA	NA
Lead	2.09	9.76	2.21	8.23
Manganese	0.63	0.12	0.03	0.10
n-nitrosodiphenylamine	NA	NA	NA	NA
Pyrene	1.79	NA	NA	NA
Thallium	12.60	NA	NA	NA
Vanadium	11.57	0.45	0.10	0.38
Zinc	0.30	7.49	1.70	6.32

Refer to Appendix K for supporting documentation

For the raccoon, Aroclor-1260 (1.04), benzo(b)fluoranthene (1.28), chrysene (1.01), fluoranthene (3.08), lead (2.09), pyrene (1.79), thallium (12.60), and vanadium (11.57) had estimated HQs greater than unity. For all other COCs, the HQs were below 1 for the raccoon.

For the three birds evaluated (i.e., marsh wren, mallard, and green heron), HQ values exceeded unity for at least one species with regard to Aroclor-1260, bis(2-ethylhexyl)phthalate, chromium, DDE, DDT, lead, and zinc. Concerning the marsh wren, Aroclor-1260 (2.36), bis(2-Ethylhexy)phthalate (3.66), chromium (4.09), DDE (1.79), DDT (32.05), lead (9.76), and zinc (7.49). All other HQs were less than 1.0 for the wren.

For the mallard, HQs greater than 1.0 were estimated for DDT (7.27), lead (2.21), and zinc (1.70). Concerning the green heron, HQs greater than unity were calculated for Aroclor-1260 (1.99), bis(2-ethylhexyl)phthalate (3.09), chromium (3.45), DDT (27.04), lead (8.23), and zinc (6.32). All other HQs were below 1 for the mallard and the heron.

The values for DDT (ranging from 7.3 to 32.0) were the highest estimated HQs for each bird. Only the HQs associated with DDT were greater than 10.

As noted previously, the stream downgradient from Area B is small and receives storm water runoff from this area. Only a limited number of benthic aquatic organisms were observed in this stream, and no observations were made of aquatic organisms in the pond. [Note: No focused field effort was conducted to verify these observations]. It is likely that the storm water runoff impacts the stream benthic community via scouring, but that organisms inhabiting the pond are not directly affected. Organisms that may feed on stream organisms from this station are also at risk, particularly from food-web exposures to DDE, DDT, alpha-chlordane, methoxychlor, and dieldrin. These compounds exhibit relatively high bioconcentration factors, especially DDT and DDE.

Aquatic organisms and water fowl utilizing the pond at sample locations B9 and B11 are at lesser risk than are organisms inhabiting sample locations B10 and B12. Organic contaminants at locations B10 and B11 consisted of PAHs found only in the sediments. Organisms living in and feeding on the sediments are at the greatest risk of exposure; the elevated sediment PAHs may be adversely impacting the benthic community in this pond. While organisms that feed on benthic organisms in contact with these sediments may be at risk, it is probable that this poses a reduced risk in that PAHs do not generally bioaccumulate.

Based on the comparison of Area B site and background surface soil to sediment contaminant levels presented in Section 6.8.5.1, some of the contaminants that resulted in the highest HQ values may not be

solely related to Area B sites. DDT and DDE, compounds that exhibit relatively high bioconcentration factors and resulted in some of the highest HQ values, were found in background soil samples at levels higher than any Area B site surface soil or stream sediment sample. These contaminants are likely not solely attributable to Area B sites.

In addition, bis(2-ethylhexyl)phthalate, aroclor-1260, DDT, and DDE, which all resulted in HQ values greater than 1 for at least one receptor, were all detected at higher concentrations in stream sediments than in Area B site surface soils. This may indicate that the Area B sites are not currently a source of this contamination. Similarly, vanadium, which resulted in an HQ value of greater than 10 for the raccoon, was detected in stream sediments at levels below the maximum and UCL concentrations for background soil. This indicates that the levels of vanadium may be naturally occurring in the stream sediments.

As presented in Section 6.8.5.1, levels of other contaminants in stream sediments (alpha-chlordane, beryllium and manganese) that resulted in HQ values of less than 1, may also not be related to Area B sites. The remaining contaminants that resulted in an HQ value of greater than 1 are primarily PAHs (benzo(b)fluorathene, chrysene, fluoranthene, and pyrene) and inorganics (lead, thallium, chromium, and zinc). Of these only thallium resulted in an HQ value of greater than 10 (raccoon). The levels of these contaminants may be associated with upstream sources including Area B sites.

Because Southampton Creek is located in and downstream from a residential area and a large distance from Sites 5, 6, and 7, contamination from non-site related sources such as street and other urban runoff is considered to be perhaps more likely here than at other areas at the base. The downstream pond along Southampton Creek from which sediment and surface water samples were collected, functions as a sink for non-site related particle-bound contaminants and any contaminants that may be related to Area B.

6.8.6 Uncertainty Analysis

Uncertainty is associated with all aspects of the ERA process. This section provides a summary of the uncertainties involved in this ERA, with a discussion of how they may affect the final risk values and conclusions. 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 for several different parameters. 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 benchmark values and 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.

6.8.6.1 Uncertainty in the Preliminary Problem Formulation

The site investigated in this ERA receives potential contaminant inputs from more than one source, although initially contaminants are conservatively assumed to stem directly from area-related activities. In general, Area B has multiple contaminant sources of concern specific to the area, but the waterways assessed in this ERA also receive contaminant inputs from roadway and parking lot runoff (e.g., roads, parking lots, and other developed areas near Area B) as well as from off-site sources, including residential developments and commercial businesses. Area B Sites 5, 6, and 7 do not have any open surface water body associated with them or in close proximity. Any relationship between these sites and the waterways assessed in this ERA is limited to overland flow across significant distances and/or through stormwater collection systems that serve a large area that includes urban lands. In addition, the data used in this assessment was collected before remedial actions were taken at Sites 6 and 7. These sites have been remediated and the area containing waste has been covered with an engineered soil cap to prevent exposure and migration of contaminants

from this area. The majority of Site 5 is currently covered with asphalt roadways, parking lots and houses that would prevent the continued erosion or migration of contaminants (if any) of concern.

Since contaminant concentrations may reflect inputs from many sources, uncertainties exist regarding whether risk characterized at a discrete area stems from area-related contaminants. 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.

6.8.6.2 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 BTVs. This uncertainty is reduced when similar effects are observed across species, strain, gender, and exposure route; when the magnitude of the response is clearly dose related; and when postulated mechanisms of toxicity are similar for laboratory and wildlife species. Most benchmark values are based on the most conservative assumptions possible. As such, though an inherent level of conservatism is needed in a screening-level ecological risk assessment to ensure that the most sensitive receptors are protected, conservative BTVs may overestimate potential risks and the resulting EEQ values may be misleading. AWQCs values used in this assessment are based on laboratory studies that do not take into account mitigating or ameliorating physical and chemical conditions in the environment. Therefore, uncertainty is introduced into the assessment, and the results tend to overestimate potential risks.

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 BTVs protective of a wide range of ecological receptors were sought. The underlying assumption associated with the use of these benchmarks is that contaminant concentrations in excess of these BTVs 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 BTVs were available, and as a result, they could not be quantitatively assessed. For these reasons, the use of benchmark values, while necessary, will introduce error into the results of an assessment.

6.8.6.3 Uncertainty in the Exposure Assessment

A source of uncertainty for exposure lies in the limited quantity of data in the stream and the date when samples were collected (pre-1995). Other uncertainties in the exposure assessment arises mainly in the

methods used to obtain exposure point concentrations. The maximum detected contaminant concentrations were generally used to represent the highest contaminant concentrations to which ecological receptors might be exposed. If the samples evaluated in this ERA are representative of contaminant concentrations associated with the station, 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. Again, although use of maximum values is appropriate for screening in an ERA, they may grossly overpredict potential risks.

6.8.6.4 Uncertainty in the Risk Characterization

All aspects of the ERA process described in the above sections affect uncertainty in the risk characterization. Uncertainty in risk characterization also stems, in part, from the fact that this process does not fully or toxicologically consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the contaminants evaluated. As mentioned above, the EEQ is not an additive measure of total potential risk. Toxicity may actually increase, or even decrease, geometrically based on synergistic or antagonistic effects. Additionally, contaminants that account for a large percentage of potential risk may be mitigated by several factors, including a low frequency of detection or elevated concentrations in areas with no significant habitat. For these reasons, the EEQ can be used as a rough estimate of total risk for a specific contaminant, but it contains uncertainty and must be interpreted with caution.

The maximum site-related sediment concentrations were generally screened against ER-Ls. The ecological COPCs that had EEQ values greater than 1.0 included 14 semivolatile organic compounds, five pesticides, one PCB, and nine inorganics. The use of maximum concentrations to determine the relative health of aquatic receptors associated with Southampton Creek is a very conservative process.

In evaluating the ER-Ls that were used for the screening, Long and Morgan (1991) state that some ER-L values have different degrees of confidence. They indicate that the degree of confidence should be moderate for metals and PCBs and low for pesticides and PAHs, and recommend that the ER-L and ER-M values should be screened against average site concentrations to determine if the "site" would have the highest potential for causing potential effects.

If one considers that the background values are not truly background, and they are included as site data, average concentrations can be calculated based on all available sediment data. The average value for all the COPCs that were identified as such in this report (which compared the maximum value to a benchmark - usually the ER-L) were calculated using the analytical results presented in Appendices A-3

and A-4. These values are shown in Table 6-72. Most average values were based on between two to four data points, but some were based on five to seven data points. The average sediment contaminant values were compared to the ER-L values (or AET or LEL if ER-Ls were not available). Those ecological COPCs that had an EEQ value greater than 1.0 were then compared to ER-M values (if available). The results of this comparison are shown in Table 6-72:

As illustrated in this table, the EEQ values using ER-L for the average sediment concentration results in EEQs significantly lower than those used based on the maximum concentration. The EEQ values using ER-M for the average sediment concentration results in EEQs that are generally at or below unity (1) with the exception of DDT and aroclor-1260.

The food-web model used for this characterization was extremely conservative. Animal food items were not sampled and bioaccumulation was assumed to be 100 percent. The extremely conservative assumption was made that all food animals (e.g., benthic invertebrates and fish) were at the same concentration as the maximum sediment concentration. If the mean concentration were used, this would give a more realistic approximation of actual exposure. The area use factor was assumed to be 1 for all the receptors.

If more realistic inputs were used in the model, the HQs would be less than 1.0 for the majority of the ecological COPCs.

The assessment was conducted for all contaminants that presented a potential risk, regardless of source or relationship to Area B sites. Several of the more potentially bioconcentrating contaminants assessed do not appear to be solely related to the Area B sites. Other contaminants were identified at levels that appear to be similar to naturally occurring background levels. This results in an assessment of potential risks that overstates the risk anticipated from the Area B sites.

6.8.7 Conclusions

Area B is located in the southeastern section of NAWC Warminster, and consists of Sites 5, 6, and 7. Sites 6 and 7 have undergone remediation and have been capped with an engineered vegetated soil cover. Site 5 is located in an active residential area and is covered by houses, asphalt roadways, parking lots, and lawns. Presently, there are no surface water bodies in close proximity of Sites 5, 6, and 7. The focus of this ERA is a portion of Southampton Creek and its headwaters that receive runoff, channelized stormwater, and discharges from a large area including Area B sites 5, 6, and 7. The discharge from the collection systems in this area, form the headwaters for this portion of Southampton Creek. The drainage channel south of NAWC Warminster is composed of concrete and contains no significant aquatic habitat along its 1,000-foot

TABLE 6-72
COMPARISON OF ECOLOGICAL COPCs TO ER-M VALUES
NAWC WARMINSTER, PENNSYLVANIA

ECOLOGICAL CONTAMINANT OF CONCERN	Average Sediment Concentration	EEQ (using ER-L values)	EEQ (using ER-M values)
Inorganics			
Cadmium	1.5	1.3	0.005
Copper	30.6	0.9	
Lead	50.7	1.1	0.23
Manganese	269.5	0.6	
Zinc	177.6	1.2	0.43
Organics			
Acenaphthene	226.7	14.2	0.5
Anthracene	545.6	6.4	0.5
Benzo(a)anthracene	1902.4	4.3	1.2
Benzo(a)pyrene	1554.9	3.6	0.97
Benzo(b)fluoranthene	2479.9	0.8	
Benzo(g,h,i)perylene	844.4	1.3 (AET)	no ER-M
Bis(2-ethylhexyl)phthalate	5142.9	4.0(AET)	no ER-M
Butylbenzylphthalate	120 (1)	1.9 (AET)	no ER-M
Chrysene	2059.4	5.4	0.74
Fluoranthene	5807.5	9.7	1.1
Fluorene	253.8	13.4	0.47
Indeno(1,2,3-cd)pyrene	908.1	1.5 (AET)	no ER-M
N-Nitrosodiphenylamine	1700 (1)	60.7 (AET)	no ER-M
Pyrene	38.45	5.8	1.5
DDE	16.5	7.5	0.6
DDT	430 (1)	430	61.4
Alpha-chlordane	10.4	1.5 (LEL)	no ER-M
Aroclor-1260	782.5	34.5	4.3

Sediment concentrations are mg/kg for inorganics and ug/kg for organics.

(1) Average not calculated, only a single detection. Single detected concentration used.

length. Aquatic habitat increases in quantity and quality in the stretches of Southhampton Creek south of the point where the channel enters the natural streambed.

No total inorganics in surface water exceeded their BTVs, and the EEQ values were indicative of low potential risk. For organics in surface water, one phthalate compound was the only organic detected, but it did not exceed its BTV and it was only detected in one sample. Phthalates are also ubiquitous in the environment.

The EEQ values, based on maximum concentrations, for several sediment inorganics were indicative of low potential risk, but most of the inorganic EEQs only slightly exceeded unity (1). EEQ values based on average sediment concentrations resulted in values at or below unity (1). No suitable BTVs were available for beryllium, thallium, and vanadium in sediments, but these compounds were retained for risk evaluation to allow for a conservative assessment of potential risks. Beryllium and vanadium were detected in relatively low concentrations (near detection limits) and at levels below regional background soil concentrations, indicating that risks associated with these contaminants may be at background levels for the area. Thallium was only detected in one of four sediment samples.

EEQ values for several PAHs, two phthalate compounds, and DDE in sediments were indicative of low to moderate potential risk, while EEQ values for DDT and Aroclor-1260 were indicative of high potential risk. The EEQ value for n-nitrosodiphenylamine was indicative of moderate risk when compared to the AET value, no ER-L or ER-M values were available for this compound.

DDT and DDE were detected in background soils at levels higher than were detected in any Area B site or sediment sample, indicating that the risks associated with these compounds may not be solely site related. Aroclor-1260 was contained in sediment samples along the drainage pathway emanating from the Building 108 storm drain discharge point leading to Outfall No. 10. These PCB concentrations decreased in distance away from the discharge point and appear to be confined to a small 250-foot stretch within the base property boundary. Aroclor-1260 was not detected in off-base and downstream samples collected within Southampton Creek. Aroclor-1260 was detected at levels below sediment concentrations in Area B site surface soils, indicating that these sites do not likely present a current major source of this contamination. The same is true for bis(2-ethylhexyl)phthalate.

Maximum concentrations of virtually all PAHs and phthalates in sediment were detected in sample B10, which was collected approximately 500 feet south of outfall OF11. This area of the drainage channel is located in an off-base developed area that contains lesser quality aquatic habitat. Samples B9 and B11 (including its duplicate) were collected further downstream where habitat increases in quantity and quality. Concentrations of PAHs and phthalates in samples B9 and B11 were generally one order of magnitude

lower than those detected upstream and were near or below BTVs, indicating limited migration of these contaminants to better habitats. The roadways and other developments south of the base may also be a source of PAH inputs into the drainageway. The EEQ values used in the assessment were based on maximum sediment detections using ER-L values. Using average sediment concentrations considerable lowers the EEQ value but most generally remain above unity (1).

A screening food-web model was used to evaluate ecological risks to semi-aquatic receptors. The representative upper-level receptors included the raccoon, marsh wren, mallard, and green heron. For the raccoon, both thallium and vanadium had estimated HQs greater than 10.0. Thallium and vanadium levels appear to be at background or naturally occurring levels. For all other COPCs, the NOAEL HQs based on detected concentrations were at or below 3 with most values at or below 1.

For the three birds evaluated (i.e., marsh wren, mallard, and green heron), HQ values exceeded unity for at least one species with regard to Aroclor-1260, bis(2-ethylhexyl)phthalate, chromium, DDE, DDT, lead, and zinc. Only the HQs associated with DDT were greater than 10. As noted above, DDT was detected at the highest levels in regional background soil samples and does not appear to be related to Area B sites.

In summary, all EEQs for surface water were less than 1. For sediment, EEQs and HQs were indicative of low to moderate risks. Both DDT and DDE significantly exceeded BTVs. However, Area B surface soil samples contained lower levels of these compounds than did the sediment and regional background soil samples, indicating that Area B sites may not currently be the source of these contaminants. Several PAHs and a few phthalates had EEQ values indicative of moderate potential risk.

Aroclor-1260 was detected in four sediment samples and all of these sampling locations were located in a drainage ditch near the base boundary. These compounds were not detected in downstream samples, and are not expected to migrate significantly to areas downstream that contain viable aquatic habitat. In addition, surface soil samples from the Area B sites contained a low frequency of detections of aroclor-1260 and levels were below the levels found in the stream sediment samples.

Potential risks to aquatic and semi-aquatic receptors in the natural streambed, ponds, and Southampton Creek appear to be low to moderate. The compounds that present the highest potential risk to these receptors do not appear to be related to contamination identified in surface soils at Area B sites 5, 6, and 7. Sites 6 and 7 are being remediated to preclude migration of contaminants from this area. Site 5 is currently covered by either impermeable structures or vegetation to preclude any migration of contamination through erosion and/or runoff. Southampton Creek and its headwaters originate from and receive runoff and channelized discharges from a large area that includes urbanized land, fields, and lawns as well as Area B

sites 5, 6, and 7. The portion of the stream that contained the highest levels of contamination of concern consists of a drainage channel located in a developed area that contains lesser quality aquatic habitat. Areas downstream from this location, where habitat increases in quantity and quality, contained lower levels of contamination. Most levels were near or below BTVs, indicating a low potential risk to ecological receptors and limited migration of these contaminants to better habitats.

REFERENCES

Army Corps of Engineers, 1987. Wetlands Delineation Manual. Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station. Vicksburg, Mississippi.

Agency for Toxic Substance and Disease Registry (ATSDR). 1988. Toxicological Profile for Arsenic.

ATSDR, 1989. Preliminary Health Assessment for U.S. Naval Air Development Center, Warminster, Pennsylvania. Atlanta, Georgia.

Barnthouse, L. W., G. W. Suter, S. M. Bartell, J. J. Beauchamp, R. H. Gardner, E. Linder, R. V. O'Neill, and A. E. Rosen, 1986. User's Manual for Ecological Risk Assessment. Environmental Sciences Division Publication No. 2679. Oak Ridge National Laboratory, Oak Ridge, TN.

Brown & Root Environmental (B&R Environmental), 1996a. Draft Phase III Remedial Investigation Report, NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. November.

Brownlee, K.A. 1965. Statistical Theory and Methodology in Science and Engineering. New York, New York. John Wiley and Sons, Incorporated.

Calabrese, E. J., and L. A. Baldwin, 1993. Performing Ecological Risk Assessments. Lewis Publishers. Chelsea, Michigan.

Cowardin, L., V. Carter, F. Golet, and E. LaRoe, 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31. Washington, DC.

Cowherd, C., G.E. Muleski, P.J. Englehart, and D.A. Gillette. 1984. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. Midwest Research Institute, Kansas City, MO.

EA Engineering, Science, and Technology, Incorporated (EA), 1995. Base-Wide Environmental Baseline Survey for NAWC Warminster, Aircraft Division, Warminster, Pennsylvania. Berkley Heights, New Jersey. March.

EA, 1999. Phase III Environmental Baseline Survey for NAWC Warminster, Pennsylvania. Berkley Heights, New Jersey. May.

Environmental Photographic Interpretation Center (EPIC), 1994. Aerial Photographic Support, NAWC Warminster, Pennsylvania. Warrenton, Virginia.

Environmental Protection Agency (EPA), 1982. Aquatic Fate Process Data for Organic Priority Pollutants. EPA/440/4-81/014, Office of Drinking Water Regulations and Standards. Washington, DC. December.

EPA, 1985. Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessment. EPA 600/8-85/010. Exposure Assessment Group. Office of Health and Environmental Assessment. Washington, DC.

EPA, 1986a. Quality Criteria for Water 1986. EPA 440/5-86-001. Office of Water Regulations and Standards. Washington, DC 20460.

EPA, 1986b. Air Quality Criteria for Lead. Environmental Criteria and Assessment Office. Research Triangle Park, NC. EPA 600/8-83/028.

EPA, 1986c. Guidelines for the Health Risk Assessment of Chemical Mixtures. Federal Register, Vol. 51, No. 185, p. 34014 et seq. September 24.

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

EPA, 1989b. Guidance Document on the Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities. Interim Final Guidance. EPA 530/SW-89-026. Office of Solid Waste. Washington,DC.

EPA, 1991a. Chemical Concentration Data Near the Detection Limit. Region III Technical Guidance Manual, EPA-3/HWMD/8-91/002.

EPA, 1991b. Exposure Factors Handbook. EPA 600/8-89/043. Office of Health and Environmental Assessment. Washington, DC.

EPA, 1992a. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities; Addendum to Interim Final Guidance. Office of Solid Waste Permits and State Programs Division. Wasington, DC. July.

EPA, 1992b. Methods for Evaluating the Attainment of Cleanup Standards. Volume 3: Reference-Based Standards for Soils and Solid Media. Office of Policy, Planning, and Evaluation. Washington, DC.

EPA, 1992c. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Memorandum from F. Henry Habicht on February 28, 1992. Office of the Administrator. Washington, DC.

EPA, 1992d. Estimating Exposure to Dioxin-Like Compounds. Workshop Review Draft. EPA/600/6-88/0005B. Office of Research and Development, Washington, D.C. August.

EPA, 1997c. Interim Final Ecological Risk Assessment Guidance for Superfun, Process for Designing and Conducting Ecological Risk Assessments. EPA/540/R-97-/006. Office of Emergency and Remedial Response. Washington, DC. June.

EPA, 1992e. Dermal Exposure Assessment: Principles and Applications. Interim Report. EPA 600/8-91/011/B. Office of Health and Environmental Assessment. Washington, DC. January.

EPA, 1992f. Guidelines for Exposure Assessment. Exposure Assessment Group. Office of Health and Environmental Assessment. In Federal Register, Vol. 57, No. 104, p. 22888. Friday, May 29.

EPA, 1994a. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive 9355.4-12. Washington, DC.

EPA, 1994b. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. EPA/540/R-93/081. Office of Emergency and Remedial Response. Washington, D.C. February.

EPA, 1995a. Assessing Dermal Exposure from Soil, EPA Region III Technical Guidance manual, EPA/903-K-95-003. December.

EPA, 1995b. Draft EPA Region III BTAG Screening Levels. Philadelphia, Pennsylvania. August 9.

EPA, 1996a. Guidance for Data Quality Assessment. Pre-Publication Copy. Final. EPA QA/G-9. Quality Assurance Division. Washington, DC. February.

EPA, 1996a. Soil Screening Guidance. EPA/540/R-96/018. Office of Emergency and Remedial Response. Washington, DC. April.

EPA, 1997a. Health Effects Assessment Summary Tables (HEAST). EPA/540/R-95-036. Office of Solid Waste and Emergency Response. May.

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

EPA, 1998a. Risk Assessment Guidance for Superfund: Volume 1. Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments). Office of Emergency and Remedial Response . January.

EPA, 1998b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance. Dermal Risk Assessment (Interim Guidance). November 6.

EPA, 1998c. Guidelines for Ecological Risk Assessment. EPA/1630/R-95/002F. Risk Assessment Forum. Washington, DC. April.

EPA, 1999. Aerial Photographic and Photogrammetric Support for NAWC, Warminster, Pennsylvania. TS-PIC-99034055. Las Vegas, Nevada. July.

EPA, 2000a. Integrated Risk Information System (IRIS). Database.

EPA, 2000b. EPA Region III Risk-Based Concentration (RBC) Tables. Phjladelphia, Pennsylvania. April.

Ernst and Young Real Estate Group, 1998. Economic Development Conveyance Application Plan for NAWC Warminster. Philadelphia, Pennsylvania. April.

Federal Land Reuse Authority (FLRA), 1999. Personal Communication between Neil Teamerson, Tetra Tech NUS, and Steve Rockwell, FLRA. April 30.

Gehan, E.A. 1965. A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-Censored Samples. Biometrika. Volume 52, pp. 203-223.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand and Reinhold, New York, NY.

Halliburton NUS Corporation (HNUS), 1992. Draft Phase II Remedial Investigation Report for NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. November.

HNUS, 1993a. Phase II Remedial Investigation Report for Operable Unit 1, NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. April.

HNUS, 1993b. Focused Feasibility Study Report for Operable Unit 1, NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. April.

HNUS, 1994b. Remedial Investigation Report for Operable Unit 3, NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. August.

HNUS, 1994c. Focused Feasibility Study Report for Operable Unit 3, NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. August.

HNUS, 1994d. Draft Wetlands Assessment for NAWC Warminster, Bucks and Montgomery Counties, Pennsylvania. Aiken, South Carolina.

HNUS, 1995a. Phase III Remedial Investigation Work Plan for NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. January.

HNUS, 1995b. Site 4 Engineering Evaluation and Cost Analysis (EE/CA) Report for NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. July.

HNUS, 1995c. Quality Assurance Project Plan for Phase III Remedial Investigation for NAWC Warminster, Pennsylvania. Wayne, Pennsylvania. February.

JRB Associates, 1981. Hydrogeologic Investigation of the Naval Air Development Center Waste Disposal Sites, Warminster, Pennsylvania; Task 1 – Records Search, Preliminary Site Investigation, and Recommendations for Task 2. McLean, Virginia.

JRB Associates, 1983. Hydrogeologic Investigation of the Naval Air Development Center Waste Disposal Sites, Warminster, Pennsylvania; Task 2 – Final Report: Monitoring Well Installation, Sampling, Analysis of Samples and Groundwater Hydrogeology. McLean, Virginia.

Langard, S., and T. Norseth, 1986, "Chromium." In Handbook on the Toxicology of Metals. Nordberg, and V. B. Vouk, eds., VolII, Elsevier Science Publishers B.V., New York, pp. 185-210.

Long, E. R., and L. G. Morgan. 1989. 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, Washington.

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." In Environmental Management. 19:81-97.

Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt, 1990. Handbook of Chemical Property Estimation Methods. American Chemical Society, Washington, DC.

NUS Corporation, 1985. Preliminary Assessment for NADC Warminster, Pennsylvania. Wayne, Pennsylvania.

Ontario Ministry of Environment (MOE), 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Toronto, Ontario.

Rima, D., H. Meister, and S. Longwill, 1962. Geology and Hydrology of the Stockton Formation in Southeastern Pennsylvania. Bulletin W-14. Pennsylvania Department of Internal Affairs, Topographic and Geologic Survey.

Sloto, R. and D. Davis, U.S. Geological Survey, 1983. Effect of Urbanization on the Water Resources of Warminster Township, Bucks County, Pennsylvania. Water Resources Investigations Report 82-4020. Harrisburg, Pennsylvania.

Sloto, R., R. Conger, and K. Grazul. U.S. Geological Survey, 1978. Geohydrology and Distribution of Volatile Organic Compounds in Groundwater in the Casey Village Area, Bucks County, Pennsylvania. Water Resources Investigations Report 98-4010. Lemoyne, Pennsylvania.

SMC Martin, 1991. Stages I and II – Rough Draft Remedial Investigation Report for NADC Warminster, Pennsylvania. Valley Forge, Pennsylvania. April.

Suter, G. W., 1993. Ecological Risk Assessment. Lewis Publishers. Ann Arbor, Michigan.

The Nature Conservancy (TNC), 1992. An Inventory of Species of Concern and Significant Natural Communities of the Naval Air Warfare Center, Aircraft Division, Warminster, Pennsylvania. Natural Resources Branch, Northern Division Naval Facilities Engineering Command.

Tetra Tech NUS (TtNUS), 1998. Remedial Investigation Report for Area D Sources at NAWC Warminster, Pennsylvania. King of Prussia, Pennsylvania. September.

TtNUS, 1999a. Remedial Investigation (RI) Report, Operable Unit 5 (Site 8 Media other than Groundwater) for NAWC Warminster, Pennsylvania, King of Prussia, Pennsylvania. August.

TtNUS, 1999b. Remedial Investigation Report for Operable Unit 7 (OU-7) Soils and Waste at Sites 6 and 7, Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. November.

TtNUS, 1999c. Feasibility Study Report for Operable Unit 7 (OU-7) Soils/Waste at Sites 6/7, Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. December.

TtNUS, 1999d. Environmental Investigation Report for the Maintenance Area, Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. December.

TtNUS, 2000a. Remedial Investigation Report for Area B Groundwater (OU-1B), Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. May

TtNUS, 2000b. Remedial Investigation and Feasibility Study Report for Area A Groundwater (OU-1A) Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. June.

TtNUS, 2000c. Remedial Investigation and Feasibility Study Report for OU-9 (Area A Media Other than Groundwater), Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. April.

TtNUS, 2000d. Remedial Investigation and Feasibility Study Report for Area D Groundwater (OU-4), Former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. May.

TtNUS, 2000e. Letter Report – Site 5 Supplemental Investigations, former NAWC, Warminster, Pennsylvania. King of Prussia, Pennsylvania. May.

TtNUS, 2000f. Environmental Investigation Report for Quarters A. January.

U. S. Department of Agriculture (USDA), 1975. Soil Survey of Bucks and Philadelphia Counties, Pennsylvania. Soil Conservation Service. Washington, DC.

U. S. Navy, 1980. Navy Shore Activity Disposal Fact Form for NADC Warminster. Warminster, Pennsylvania. December.

U. S. Navy, 1981. Notification of Hazardous Waste Sites (Clay-Law Report) for NADC Warminster. Warminster, Pennsylvania. June.

U. S. Navy, 1990. Emergency Response Plan for NADC Warminster. Warminster, Pennsylvania. August 13.

Versar, Inc., 1979 (for EPA). Water-Related Fate of 129 Priority Pollutants. EPA 440/4-79/029. Monitoring and Data Support Division. Washington, DC.

Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold. New York, New York.

Wentsel, R. S., R.T. Checkai, T. LaPoint, M. Simini, and L. Brewer, 1994. Procedural Guidelines for Ecological Risk Assessments at U.S. Army Sites. ERDEC-TR-221. Aberdeen Proving Grounds, Maryland.

APPENDIX A

ANALYTICAL DATABASE

NAWC WARMINSTER - EGIS
07/11/00

SAMPLE NO.	VO	SVOC	P/P	MTLS	DX	CR6	DEPTH	REMOVED	FORMER SAMPLE NO.	DATE
SURFACE SOIL SAMPLES - SITE 5										
SS-05-01		X	X	X			1-2	N		4/12/95
SS-05-02	X	X	X	X			1-2	N		4/12/95
SS-05-03		X	X	X			1-2	N		4/12/95
SS-05-04	X	X	X	X			1-2	N		4/12/95
SS-05-05		X	X	X			1-2	N		4/12/95
SS-05-06	X	X	X	X			1-2	N	12-24"	4/12/95
SS-05-06D	X	X	X	X			1-2	N	DUP SS-05-06; SS-05-11	4/12/95
SS-05-07	X	X	X	X			1.5	N	14-20"	4/12/95
SS-05-08	X	X	X	X			1.5	N	14-20"	4/12/95
SS-05-09		X	X	X			1	N	6-12"	4/12/95
SS-05-10		X	X	X			1	N	8-16"	4/12/95
SS-05-11	X	X	X	X			1-2	N	SS-05-17	9/7/95
SS-05-12	X	X	X	X			1-2	N		9/7/95
SS-05-13	X	X	X	X			1-2	N		9/7/95
SS-05-14	X	X	X	X			1-2	N		9/7/95
SS-05-15	X	X	X	X			1-2	N		9/7/95
SS-05-16	X	X	X	X			1-2	N		9/7/95
SS-05-16D	X	X	X	X			1-2	N	DUP SS-05-16; SS-05-18	9/7/95
SS-05-17	X	X	X	X		X	0.5-2	N		12/8/99
SS-05-18	X	X	X	X		X	0.5-2	N		12/8/99
SS-05-19									NOT COLLECTED	
SS-05-20									NOT COLLECTED	
SS-05-21	X	X	X	X		X	0-0.5	N		12/9/99
SS-05-22	X	X	X	X		X	0-0.5	N		12/9/99
SS-05-23	X	X	X	X		X	0.5-1.5	N		12/9/99
SS-05-24	X	X	X	X		X	0.5-1.5	N		12/9/99
SS-05-25	X	X	X	X		X	0.5-1.5	N		12/9/99
SS-05-26	X	X	X	X		X	0.5-1.25	N		12/9/99
SS-05-27	X	X	X	X		X	1-3	N		12/9/99
SS-05-28	X	X	X	X		X	1-3	N		12/9/99
SS-05-29	X	X	X	X		X	1-3	N		12/9/99

NAWC WARMINSTER - EGIS
07/11/00

SAMPLE NO.	VO	SVOC	P/P	MTLS	DX	CR6	DEPTH	REMOVED	FORMER SAMPLE NO.	DATE
SURFACE SOIL SAMPLES - SITE 5										
SS-05-30	X	X	X	X		X	1-2	N		12/10/99
SS-05-31	X	X	X	X		X	1-2	N		12/10/99
SS-05-32	X	X	X	X		X	0.5-2	N		12/10/99
SS-05-33	X	X	X	X		X	0.5-2	N		12/10/99
SS-05-34	X	X	X	X		X	1-1.5	N		12/13/99
SS-05-35	X	X	X	X		X	1-1.5	N		12/13/99
SS-05-36	X	X	X	X		X	0.8-1.5	N		12/13/99
SS-05-36D	X	X	X	X		X	0.8-1.5	N	DUP SS-05-101	12/13/99
SOIL BORING SAMPLES - SITE 5										
SB-05-01	X			X(b)			5.5	N	WH-SB-01	9/19/95
SB-05-02	X			X(b)			7.5	N	WH-SB-02	9/19/95
SB-05-02D	X			X(b)			7.5	N	DUP SB-05-02; SB-05-03	9/19/95
SB-05-03 (TPH & BTEX also)	X	X	X	X			2.5	N	Phase II RI (W-SB-05); SB-05-22	6/17/92
SB-05-04	X			X(b)			7	N	WH-SB-04	9/19/95
SB-05-05	X			X(b)			4.0'	N	WH-SB-05	9/19/95
SB-05-06	X			X(b)			6.0'	N	WH-SB-06	9/19/95
SB-05-07	X			X(b)			8.0'	N	WH-SB-07	9/19/95
SB-05-08	X			X(b)			6.0'	N	WH-SB-08	9/19/95
SB-05-09	X			X(b)			5.0'	N	WH-SB-09	9/19/95
SB-05-10	X			X(b)			5.0'	N	WH-SB-10	9/20/95
SB-05-11	X			X(b)			3.0'	N	WH-SB-11	9/20/95
SB-05-12	X			X(b)			3.0'	N	WH-SB-12	9/20/95
SB-05-13	X	X	X	X(b)			4.8'	N	WH-SB-13	9/20/95
SB-05-13D	X	X	X	X(b)			4.8	N	DUP SB-05-13; SB-05-14	9/20/95
SB-05-14 (TPH & BTEX also)	X	X	X	X			4	N	Phase II RI (W-SB-06); SB-05-23	9/20/95
SB-05-15	X	X	X	X(b)			5.5	N	WH-SB-15	9/20/95
SB-05-16	X	X	X	X(b)			6	N	WH-SB-16	9/20/95
SB-05-17	X	X	X	X(b)			5.5	N	WH-SB-17	9/20/95
SB-05-18	X			X(b)			10	N	WH-SB-18	9/20/95
SB-05-19	X			X(b)			7.5	N	WH-SB-19	9/20/95

NAWC WAR .STER - EGIS
07/11/00

SAMPLE NO.	VO	SVOC	P/P	MTLS	DX	CR6	DEPTH	REMOVED	FORMER SAMPLE NO.	DATE
SOIL BORING SAMPLES - SITE 5										
SB-05-20	X	X	X	X(b)			6	N	WH-SB-20	9/28/95
SB-05-21		X	X	X(b)			8	N	WH-SB-21	9/28/95
SB-05-22 (TPH & BTEX also)	X	X	X	X			2.5	N	Phase II RI (W-SB-07); SB-05-24	6/17/92
SB-05-23				X(b)			8	N	WH-SB-26; SB-05-25	10/31/95
SB-05-24	X	X	X	X		X	2-4	N		12/8/99
SB-05-25	X	X	X	X		X	2-5	N		12/8/99
SB-05-26	X	X	X	X		X	3-5	N		12/8/99
SB-05-27	X	X	X	X		X	5-7	N		12/8/99
SB-05-28	X	X	X	X		X	2-6	N		12/8/99
SB-05-28D	X	X	X	X		X	2-6	N	DUP SB-05-100	12/8/99
SB-05-29	X	X	X	X		X	2-4	N		12/8/99
SB-05-30	X	X	X	X		X	4-6	N		12/8/99
SB-05-31	X	X	X	X		X	6-7.5	N		12/8/99
SB-05-32	X	X	X	X		X	6-7	N		12/8/99
SB-05-33	X	X	X	X		X	3-5	N		12/9/99
SB-05-34	X	X	X	X		X	3-5	N		12/9/99
SB-05-35	X	X	X	X		X	2-5	N		12/9/99
SB-05-36	X	X	X	X		X	5-7	N		12/9/99
SB-05-36D	X	X	X	X		X	5-7	N	DUP SB-05-36	12/9/99
SB-05-37	X	X	X	X		X	2-4	N		12/9/99
SB-05-38	X	X	X	X		X	3.5-5.5	N		12/9/99
SB-05-39	X	X	X	X		X	3-5	N		12/9/99
SB-05-40	X	X	X	X		X	3-5	N		12/9/99
SB-05-41	X	X	X	X		X	3-5	N		12/9/99
SB-05-42	X	X	X	X		X	3-5	N		12/10/99
SB-05-43	X	X	X	X		X	2-4	N		12/10/99
SB-05-44	X	X	X	X		X	3.5-6	N		12/10/99
SB-05-45	X	X	X	X		X	3.5-5.5	N		12/10/99
SB-05-46	X	X	X	X		X	2-5	N		12/10/99
SB-05-47	X	X	X	X		X	5-6	N		12/10/99
SB-05-48	X	X	X	X		X	2-4	N		12/10/99

NAWC WARMINSTER - EGIS
07/11/00

SB-05-49	X	X	X	X		X	2-5	N		12/21/99
SAMPLE NO.	**VO**	**SVOC**	**P/P**	**MTLS**	**DX**	**CR6**	**DEPTH**	**REMOVED**	**FORMER SAMPLE NO.**	**DATE**
SOIL BORING SAMPLES - SITE 5										
SB-05-50	X	X	X	X		X	2-6	N		12/21/99
SB-05-50D	X	X	X	X		X	2-6	N	DUP SB-05-102	12/21/99
SB-05-51	X	X	X	X		X	3-6	N		12/21/99
SB-05-52	X	X	X	X		X	3-5	N		12/21/99
SB-05-53	X	X	X	X		X	6-9	N		12/21/99
SB-05-54	X	X	X	X		X	2-4	N	SS-05-19	12/8/99
SB-05-55	X	X	X	X		X	2-5	N	SS-05-20	12/8/99

b = cyanide analysis

Appendix A-1

Surface Soil Results

Sample ID:	SS-05-01		SS-05-02		SS-05-03		SS-05-04		SS-05-05		SS-05-06		SS-05-06-DUP		SS-05-07		SS-05-08	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	13300		11900		9570		17000		9440		11600		11800		14400		10400	
Antimony	10	UL	10.2	UL	9.1	UL	8.7	UL	8.7	UL	9.7	UL	9	UL	9.4	UL	10.2	UL
Arsenic	7.9	L	2.1		4		6.7		4.5		4.6		4.1		4.8		5.4	L
Barium	195		43.7		56.9		70.6		89		98		83.1		152		133	
Beryllium	0.94		0.73		0.7		0.84		0.88		0.81		0.89		1.1		0.59	
Cadmium	7.4	J	0.61	UJ	0.55	UJ	0.52	UJ	0.52	UJ	1.9	B	0.95	B	5.1		10.5	
Calcium	3520		783		1160		881		1340		1780		1610		4800		4700	
Chromium	32.5		14		16.4		22.7		12.4		18.1		15.7		26.3		25.2	
Cobalt	12.5		8.4		10		13.2		7.2		9.3		9.6		12		8.5	
Copper	421		10.8	K	11.5	K	12.7		24.9		94.5		121		875		505	
Cyanide	1.1	U	1.1	U	1.1	U	1.1	U	1	U	1.2	U	1.1	U	1.2	U	1.3	U
Hexavalent Chromium	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron	48300		16000		17400		25300		13400		18800		17800		22800		26400	
Lead	496		7.5		12.6		10.5		20.5		67.6		36.4		170		271	
Magnesium	2410		2040		1840		2420		1650		2130		2090		4170		2470	
Manganese	807		175		492		1380		1070		604		463		632		706	
Mercury	0.7		0.05	U	0.05	U	0.05	U	0.1		0.12	L	0.1	L	0.65		12	
Nickel	27.7		9	K	8.5	K	13.2	K	9.4	K	14.5	K	13.2	K	35.1		83.2	
Potassium	845		1130		557		698		361		802		782		1530		760	
Selenium	0.96	K	0.82	U	0.73	U	0.7	U	0.7	U	0.78	UL	0.72	UL	0.76	UL	1.7	L
Silver	12.7	L	0.82	UR	0.73	UR	0.7	UR	0.7	UR	2.6	L	3.5	L	11.3		16.7	
Sodium	169		195		93.4	B	83	B	72.5	B	115	B	123	B	142	B	176	B
Thallium	2	K	1	U	0.91	U	1.3	K	0.87	U	1		0.9	U	0.96		1	U
Vanadium	37.1		22.3		23.3		37.1		19.5		32.3		26.7		31.7		23.1	
Zinc	539		18.4		27.4		37.1		48.5		116		154		321		895	
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
1,2-Dichlorobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
1,3-Dichlorobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
1,4-Dichlorobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,2'-Oxybis(1-chloropropane)	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,4,5-Trichlorophenol	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
2,4,6-Trichlorophenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,4-Dichlorophenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,4-Dimethylphenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,4-Dinitrophenol	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
2,4-Dinitrotoluene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2,6-Dinitrotoluene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2-Chloronaphthalene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2-Chlorophenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2-Methylnaphthalene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	160	J
2-Methylphenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
2-Nitroaniline	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
2-Nitrophenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
3,3'-Dichlorobenzidine	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
3-Nitroaniline	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U

Sample ID:	SS-05-09		SS-05-10		SS-05-11		SS-05-12		SS-05-13		SS-05-14		SS-05-15		SS-05-16		SS-05-16-DUP		SS-05-17		SS-05-18	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	10900		13700		10300		8590		10200		10200		10100		9450		12500		11700		14500	
Antimony	9.5	UL	8.8	UL	7.6	UR	7.3	UR	7.2	L	9	UR	9.3	UR	8.8	L	8.5	UR	2.7	L	1.5	L
Arsenic	6.4	L	6	L	5		5.8		6.4		3.9		4.4		4.3		4.5		2.7		2.4	
Barium	97.7		96.1		53.2		52.6		97.8		56.6		54.2		50.8		60.8		131		88.1	
Beryllium	1.2		1.3		0.64		0.64		0.85		0.64		0.74		0.67		0.81		0.89		0.71	
Cadmium	0.78	B	0.53	U	0.54	U	0.52	U	0.97	K	0.64	U	0.66	U	0.63	K	0.61	U	1.8		0.05	U
Calcium	35400		2870		972		764		1190		696		1100		1020		1120		1820	K	1380	K
Chromium	38.6		30.8		18.4		14.7		21.9		20		14.7		12.7		28.8		28.8	K	30.7	K
Cobalt	13		10.9		6.5		5		9.1		6.6		6.5		6.5		8.4		10	K	5.7	K
Copper	32.8		34.8		16.5		6.8		165		7.4		19		16.8		19.4		216	L	51	L
Cyanide	0.93	U	1.1	U	0.55	UL	0.55	UL	0.56	UL	0.54	UL	0.57	UL	0.56	L	0.56	UL	NA		NA	
Hexavalent Chromium	NA		NA		NA		NA		NA		NA		NA		NA		NA		0.46	U	0.5	U
Iron	30300		25500		14600		12900		20100		16500		15500		14500		17900		28700		40400	
Lead	15.2		17		19.7		17.3		63.6		10		12.8		16.4		13.9		92.9	K	32.4	K
Magnesium	16000		3870		1620		1290		1480		1390		1590		1490		1920		2220		1890	
Manganese	641		270		283		130		690		293		564		527		417		469		206	
Mercury	0.04	UL	0.05	UL	0.28	B	0.27	B	0.2	B	0.06	B	0.08	B	0.18	B	0.11	B	0.35		0.16	
Nickel	25.4		14	K	13.2	K	6.3	K	13.3	K	9.6	K	9.1	K	7.1	K	10	K	20.9	L	19.9	L
Potassium	4660		1800		547		307		444		384		463		413		596		920	K	846	K
Selenium	0.76	UL	0.71	UL	NA		NA		NA		NA		NA		NA		NA		1.7	UR	2.3	UR
Silver	0.76	UR	0.71	UR	0.73		0.7	U	3.4		1		0.89	U	0.83		2		19.5		11.5	
Sodium	392		831		95.2	B	62.3	B	87.5	U	77.5	B	93.2	B	87.1	B	87.6	B	100	L	98.7	L
Thallium	1.5	K	0.88	U	0.54	U	0.52	U	0.47	K	0.64	U	0.66	U	0.63	K	0.61	U	0.37	U	0.48	U
Vanadium	60.9		40.4		25.4		22.8		33.3		23.5		23.6		21.8		28.6		46.6		35.8	
Zinc	70		67.2		37.6		29		155		24.9		31.5		29.6		51.8		252	L	109	L
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
1,2-Dichlorobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
1,3-Dichlorobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
1,4-Dichlorobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,2'-Oxybis(1-chloropropane)	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,4,5-Trichlorophenol	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	U	490	U	520	U
2,4,6-Trichlorophenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,4-Dichlorophenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,4-Dimethylphenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,4-Dinitrophenol	25000	U	940	U	880	U	880	U	910	U	880	U	910	UJ	890	U	890	UJ	490	U	520	U
2,4-Dinitrotoluene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2,6-Dinitrotoluene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2-Chloronaphthalene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2-Chlorophenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2-Methylnaphthalene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2-Methylphenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
2-Nitroaniline	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	U	490	U	520	U
2-Nitrophenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
3,3'-Dichlorobenzidine	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	UJ	390	U	410	U
3-Nitroaniline	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	UJ	490	U	520	U

Sample ID:	SS-05-21		SS-05-22		SS-05-23		SS-05-24		SS-05-25		SS-05-26		SS-05-27		SS-05-28		SS-05-29		SS-05-30		SS-05-31	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	10500		12600		11500		10200		12800		13200		12900		16700		12800		14300		9310	
Antimony	0.81	L	1	L	0.27	L	5.5	UR	0.4	L	1.5	L	0.36	L	1.7	L	0.67	L	0.48	K	0.78	K
Arsenic	3.7		4.4		2.5	K	3.6		4.5		5.1		0.92	K	7.6		0.9	U	0.39	K	1.2	K
Barium	115		118		83.9		75.5		89		109		139		133		92.8		91.5	K	40	K
Beryllium	0.88		1.1		0.94		1.1		0.88		1		1.1		1.6		0.84		0.88		0.72	
Cadmium	3.4		0.91	K	0.4	U	0.5	U	1.4	K	1.8		0.5	U	1	K	2.2	U	2.6	U	2.7	U
Calcium	3340	J	2210	J	1310	K	857	K	1450	K	2720	J	1750	J	2420	J	2020	J	849	J	644	J
Chromium	24.7		26.3		20.2		19.8		21		25.1		18.4		21.1		23.3		25.3	K	20.1	K
Cobalt	8.1	K	10.6	K	11.6	K	7.3	K	8.8	K	8.6	K	21.3	K	11	K	14.7	K	12.9		7.5	
Copper	168	L	80.1	L	13.3	L	12.8	L	380	L	122	L	23.3	L	55.1	L	8.3	L	9.8	L	12.8	L
Cyanide	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	0.53	U	0.5	U	0.47	U	0.48	U	0.49	U	0.48	U	0.47	U	0.53	U	0.46	U	0.48	U	0.46	U
Iron	18600		23600		18700		14200		18900		19800		19100		17600		25700		38800	J	20100	J
Lead	109		62.7		15.1		15.3		45.1		74.5		26.6		88.4		17.1		32		18.7	
Magnesium	2180		2540		2550		1740		2270		2400		4350		1680		4990		2720	J	1990	J
Manganese	617	K	586	K	696	K	485	K	543	K	565	K	727	K	1100	K	581	K	854	J	215	J
Mercury	0.54		0.12		0.03	U	0.03	U	0.08		0.85		0.07		0.17		0.02	U	0.03	UR	0.03	UR
Nickel	23.6	L	17.5	L	12.7	L	10.7	L	14.4	L	20.7	L	17.4	L	17.8	L	16.8	L	10.2	L	11.3	L
Potassium	937		1460		1250		541		907		754		2450		691		2680		1710		619	
Selenium	0.9	B	0.67	B	0.4	U	0.33	B	0.42	B	0.32	B	0.21	B	0.99	B	0.4	UL	0.84	B	0.46	B
Silver	15.9		8.1		4.7		3.5		6.4		10.1		6.1		8.3		6.4		10	K	5.8	B
Sodium	162	B	91.1	B	94.2	B	72.7	B	83.3	B	122	B	175	B	151	B	148	B	85.7	L	146	L
Thallium	1	U	0.9	U	0.9	U	0.9	U	1	U	0.9	U	0.9	U	1.1	U	0.9	U	1.1	UL	1.1	UL
Vanadium	39.3		39.8		25.3		22.2		29.4		36.6		23		41.3		24.8		33	J	35.5	J
Zinc	315	K	163	K	40.7	K	37.5	K	156	K	182	K	66.5	K	148	K	47	K	28.7	L	19.4	L
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
1,2-Dichlorobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
1,3-Dichlorobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
1,4-Dichlorobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2,2'-Oxybis(1-chloropropane)	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2,4,5-Trichlorophenol	900	U	420	U	390	UR	580	UL	410	UR	420	U	390	U	440	U	400	U	390	U	400	U
2,4,6-Trichlorophenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
2,4-Dichlorophenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
2,4-Dimethylphenol	440	U	200	UL	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
2,4-Dinitrophenol	900	U	420	U	390	UR	580	UL	410	UR	420	U	390	U	440	U	400	U	390	U	400	U
2,4-Dinitrotoluene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2,6-Dinitrotoluene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2-Chloronaphthalene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2-Chlorophenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
2-Methylnaphthalene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
2-Methylphenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
2-Nitroaniline	900	U	420	U	390	UR	580	UR	410	UR	420	UR	390	UR	440	UR	400	UR	390	U	400	U
2-Nitrophenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
3,3'-Dichlorobenzidine	440	U	200	UR	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
3-Nitroaniline	900	U	420	UL	390	UR	580	UR	410	UR	420	UR	390	UR	440	UR	400	UR	390	U	400	U

Sample ID:	SS-05-32		SS-05-33		SS-05-34		SS-05-35		SS-05-36		SS-05-36-D		SS-05-37		SS-05-38	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	16700		18500		11900		14700		13700		16500		14000		13100	
Antimony	1.2	K	2.7	K	0.84	K	2.9	K	3	K	5.7	K	1.6	K	1	K
Arsenic	5.2	K	2.2	K	5	K	3.1	K	5.8	K	5.1	K	5.4	K	4.5	K
Barium	110	K	182	K	90.4	K	131	K	238	K	311	K	122	K	105	K
Beryllium	1.3		1.3		0.87		1.1		0.94		1		0.93		0.81	
Cadmium	1.2	K	3.3	K	0.97	K	3.3	K	7.1	K	6.2	K	5.4	K	1.2	K
Calcium	1900	J	3720	J	1130	J	1820	J	1690	J	1960	J	1700	J	2410	J
Chromium	24.5	K	32.4	K	17.4	K	27	K	35.7	K	49.2	K	21.8	K	24	K
Cobalt	9.2		13.3		8		9.6		10.7		11.3		8.7		7.8	
Copper	82.7	L	316	L	61.4	L	149	L	333	L	293	L	367	L	84.1	L
Cyanide	NA		NA		NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	0.49	U	0.49	U	0.47	U	0.47	U	0.5	U	0.49	U	0.49	U	0.47	U
Iron	21500	J	37000	J	17900	J	26100	J	46900	J	36400	J	21200	J	21000	J
Lead	69.7		108		34		90.5		233		1020		217		78.9	
Magnesium	2460	J	4490	J	1820	J	2580	J	2280	J	2680	J	2110	J	2060	J
Manganese	574	J	774	J	369	J	492	J	1630	J	609	J	2550	J	374	J
Mercury	0.18	L	0.15	L	0.09	L	0.87	L	1.4	L	0.4	L	0.79	L	0.23	L
Nickel	27.5	L	35.2	L	10.9	L	17.5	L	30.7	L	40.6	L	18.4	L	13.5	L
Potassium	1190		2730		595		1490		961		1420		1020		1060	
Selenium	1.1	B	0.9	B	0.77	B	1	B	1.5	B	0.81	B	2.6	L	0.37	B
Silver	9.8	K	22.7	K	8.3	K	54.9	K	87.2	K	46.8	K	14.6	K	15.5	K
Sodium	113	L	106	L	35.8	B	92.3	L	71.4	B	89	L	129	L	172	L
Thallium	1	UL	5.6	UL	1.1	UL	1.1	UL	1	UL	1.1	UL	5.6	UL	1.1	UL
Vanadium	44	J	37.9	J	29.9	J	39.1	J	40.5	J	48.4	J	34.6	J	32.2	J
Zinc	125	L	310	L	80.4	L	251	L	961	L	565	L	4180	L	93.7	L
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
1,2-Dichlorobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
1,3-Dichlorobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
1,4-Dichlorobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2,2'-Oxybis(1-chloropropane)	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2,4,5-Trichlorophenol	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
2,4,6-Trichlorophenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2,4-Dichlorophenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2,4-Dimethylphenol	200	U	200	U	190	U	200	U	200	U	200	U	200	UR	190	U
2,4-Dinitrophenol	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
2,4-Dinitrotoluene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2,6-Dinitrotoluene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2-Chloronaphthalene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2-Chlorophenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2-Methylnaphthalene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2-Methylphenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
2-Nitroaniline	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
2-Nitrophenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
3,3'-Dichlorobenzidine	200	U	200	U	190	U	200	U	200	U	200	U	200	UR	190	U
3-Nitroaniline	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U

ANALYTICAL RESULTS FOR SITE 5 SURFACE SOIL SAMPLES
NAWC WARMINSTER, PENNSYLVANIA

Sample ID:	SS-05-01		SS-05-02		SS-05-03		SS-05-04		SS-05-05		SS-05-06		SS-05-06-DUP		SS-05-07		SS-05-08	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,6-Dinitro-2-methylphenol	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
4-Bromophenyl Phenyl Ether	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
4-Chloro-3-methylphenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
4-Chloroaniline	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
4-Chlorophenyl Phenyl Ether	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
4-Methylphenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
4-Nitroaniline	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
4-Nitrophenol	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
Acenaphthene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Acenaphthylene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Anthracene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Benz(a)anthracene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	180	J	330	J	390	U	410	U
Benzo(a)pyrene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	140	J	270	J	390	U	410	U
Benzo(b)fluoranthene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	50	J	120	J	390	U	410	U
Benzo(g,h,i)perylene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	52	J	100	J	390	U	410	U
Benzo(k)fluoranthene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	46	J	390	U	410	U
Bis(2-chloroethoxy)methane	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Bis(2-chloroethyl)ether	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Bis(2-ethylhexyl)phthalate	140	J	390	UJ	380	UJ	110	J	380	UJ	380	U	63	J	62	J	270	J
Butylbenzylphthalate	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Carbazole	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Chrysene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	240	J	450		390	U	410	U
Di-n-butylphthalate	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	46	J	390	U	410	U
Di-n-octylphthalate	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Dibenz(a,h)anthracene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Dibenzofuran	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Diethylphthalate	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Dimethylphthalate	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Fluoranthene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	55	J	42	J	410	U
Fluorene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Hexachlorobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Hexachlorobutadiene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Hexachlorocyclopentadiene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Hexachloroethane	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Indeno(1,2,3-cd)pyrene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Isophorone	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
N-Nitroso-di-n-propylamine	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
N-Nitrosodiphenylamine (1)	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Naphthalene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	47	J
Nitrobenzene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Pentachlorophenol	940	UJ	940	UJ	920	UJ	930	UJ	930	UJ	930	U	970	U	950	U	1000	U
Phenanthrene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	54	J	120	J	390	U	410	U
Phenol	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	380	U	400	U	390	U	410	U
Pyrene	390	UJ	390	UJ	380	UJ	380	UJ	380	UJ	170	J	310	J	390	U	47	J

Sample ID:	SS-05-09		SS-05-10		SS-05-11		SS-05-12		SS-05-13		SS-05-14		SS-05-15		SS-05-16		SS-05-16-DUP		SS-05-17		SS-05-18	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,6-Dinitro-2-methylphenol	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	U	490	U	520	U
4-Bromophenyl Phenyl Ether	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
4-Chloro-3-methylphenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	390	U	410	U
4-Chloroaniline	10000	U	390	U	360	UJ	360	UJ	370	UJ	360	UJ	380	U	370	UJ	370	UJ	390	U	410	U
4-Chlorophenyl Phenyl Ether	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
4-Methylphenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
4-Nitroaniline	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	UJ	490	U	520	U
4-Nitrophenol	25000	U	940	U	880	UR	880	UR	910	UR	880	UR	910	U	890	UR	890	U	490	U	520	U
Acenaphthene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Acenaphthylene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Anthracene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Benz(a)anthracene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Benzo(a)pyrene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Benzo(b)fluoranthene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Benzo(g,h,i)perylene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Benzo(k)fluoranthene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Bis(2-chloroethoxy)methane	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Bis(2-chloroethyl)ether	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Bis(2-ethylhexyl)phthalate	10000	U	39	J	180	B	170	B	350	B	150	B	150	B	200	B	140	B	190	U	200	U
Butylbenzylphthalate	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Carbazole	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Chrysene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Di-n-butylphthalate	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Di-n-octylphthalate	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	310	U	320	U
Dibenz(a,h)anthracene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Dibenzofuran	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Diethylphthalate	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Dimethylphthalate	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Fluoranthene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Fluorene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Hexachlorobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Hexachlorobutadiene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Hexachlorocyclopentadiene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Hexachloroethane	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Indeno(1,2,3-cd)pyrene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Isophorone	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
N-Nitroso-di-n-propylamine	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
N-Nitrosodiphenylamine (1)	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Naphthalene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Nitrobenzene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Pentachlorophenol	25000	U	940	U	880	U	880	U	910	U	880	U	910	U	890	U	890	U	490	U	520	U
Phenanthrene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Phenol	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U
Pyrene	10000	U	390	U	360	U	360	U	370	U	360	U	380	U	370	U	370	U	190	U	200	U

ANALYTICAL RESULTS FOR SITE 5 SURFACE SOIL SAMPLES
NAWC WARMINSTER PENNSYLVANIA

Sample ID:	SS-05-21		SS-05-22		SS-05-23		SS-05-24		SS-05-25		SS-05-26		SS-05-27		SS-05-28		SS-05-29		SS-05-30		SS-05-31	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,6-Dinitro-2-methylphenol	900	U	420	U	390	UR	580	UL	410	UR	420	U	390	U	440	U	400	U	390	U	400	U
4-Bromophenyl Phenyl Ether	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
4-Chloro-3-methylphenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
4-Chloroaniline	440	U	200	UR	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
4-Chlorophenyl Phenyl Ether	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
4-Methylphenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
4-Nitroaniline	900	U	420	U	390	UR	580	UR	410	UR	420	UR	390	UR	440	UR	400	UR	390	U	400	U
4-Nitrophenol	900	U	420	U	390	UR	580	UL	410	UR	420	U	390	U	440	U	400	U	390	U	400	U
Acenaphthene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Acenaphthylene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Anthracene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Benz(a)anthracene	440	U	74	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Benzo(a)pyrene	440	U	67	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Benzo(b)fluoranthene	440	U	92	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Benzo(g,h,i)perylene	440	U	64	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Benzo(k)fluoranthene	440	U	90	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Bis(2-chloroethoxy)methane	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Bis(2-chloroethyl)ether	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Bis(2-ethylhexyl)phthalate	490	B	44	B	260	B	280	UR	200	UR	68	B	190	UR	210	UR	190	UR	190	U	200	U
Butylbenzylphthalate	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Carbazole	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Chrysene	440	U	100	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Di-n-butylphthalate	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Di-n-octylphthalate	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Dibenz(a,h)anthracene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Dibenzofuran	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Diethylphthalate	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Dimethylphthalate	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Fluoranthene	110	J	170	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Fluorene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Hexachlorobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Hexachlorobutadiene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Hexachlorocyclopentadiene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Hexachloroethane	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Indeno(1,2,3-cd)pyrene	440	U	60	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Isophorone	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
N-Nitroso-di-n-propylamine	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
N-Nitrosodiphenylamine (1)	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Naphthalene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Nitrobenzene	440	U	200	U	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Pentachlorophenol	900	U	420	U	390	UR	580	UL	410	UR	420	U	390	U	440	U	400	U	390	U	400	U
Phenanthrene	440	U	54	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U
Phenol	440	U	200	U	190	UR	280	UL	200	UR	200	U	190	U	210	U	190	U	190	U	200	U
Pyrene	120	J	140	J	190	UR	280	UR	200	UR	200	UR	190	UR	210	UR	190	UR	190	U	200	U

Sample ID:	SS-05-32		SS-05-33		SS-05-34		SS-05-35		SS-05-36		SS-05-36-D		SS-05-37		SS-05-38	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,6-Dinitro-2-methylphenol	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
4-Bromophenyl Phenyl Ether	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
4-Chloro-3-methylphenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
4-Chloroaniline	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
4-Chlorophenyl Phenyl Ether	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
4-Methylphenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
4-Nitroaniline	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
4-Nitrophenol	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
Acenaphthene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Acenaphthylene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Anthracene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Benz(a)anthracene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	110	J
Benzo(a)pyrene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	92	J
Benzo(b)fluoranthene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	50	J
Benzo(g,h,i)perylene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	91	J
Benzo(k)fluoranthene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Bis(2-chloroethoxy)methane	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Bis(2-chloroethyl)ether	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Bis(2-ethylhexyl)phthalate	200	U	74	B	190	U	200	U	52	B	150	B	60	B	140	B
Butylbenzylphthalate	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Carbazole	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Chrysene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	160	J
Di-n-butylphthalate	61	B	48	B	51	B	200	U	50	B	200	U	50	B	53	B
Di-n-octylphthalate	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Dibenz(a,h)anthracene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	40	J
Dibenzofuran	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Diethylphthalate	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Dimethylphthalate	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Fluoranthene	200	U	200	U	190	U	51	J	200	U	200	U	200	U	190	U
Fluorene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Hexachlorobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Hexachlorobutadiene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Hexachlorocyclopentadiene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Hexachloroethane	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Indeno(1,2,3-cd)pyrene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	41	J
Isophorone	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
N-Nitroso-di-n-propylamine	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
N-Nitrosodiphenylamine (1)	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Naphthalene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Nitrobenzene	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Pentachlorophenol	410	U	400	U	400	U	400	U	410	U	410	U	410	U	380	U
Phenanthrene	200	U	200	U	190	U	42	J	200	U	200	U	200	U	43	J
Phenol	200	U	200	U	190	U	200	U	200	U	200	U	200	U	190	U
Pyrene	200	U	200	U	190	U	46	J	200	U	200	U	200	U	140	J

Sample ID:	SS-05-01		SS-05-02		SS-05-03		SS-05-04		SS-05-05		SS-05-06		SS-05-06-DUP		SS-05-07		SS-05-08	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES			ug/kg				ug/kg				ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,1,2,2-Tetrachloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
1,1,2-Trichloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,1-Dichloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,1-Dichloroethene	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,2-Dichloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,2-Dichloroethene (Total)	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
1,2-Dichloropropane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
2-Butanone	NA		12	U	NA		12	U	NA		12	U	12	U	35		12	U
2-Hexanone	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
4-Methyl-2-pentanone	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
Acetone	NA		12	U	NA		12	U	NA		12	U	12	U	170		89	B
Benzene	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	2	J
Bromodichloromethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Bromoform	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Bromomethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Carbon Disulfide	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Carbon Tetrachloride	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Chlorobenzene	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
Chloroethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Chloroform	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Chloromethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
cis-1,3-Dichloropropene	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Dibromochloromethane	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Ethylbenzene	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
Methylene Chloride	NA		2	J	NA		2	J	NA		12	U	12	U	4	B	12	U
Styrene	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
Tetrachloroethene	NA		12	U	NA		12	U	NA		12	U	12	U	12	UJ	12	U
Toluene	NA		12	U	NA		12	U	NA		12	U	12	U	2	J	12	U
trans-1,3-Dichloropropene	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Trichloroethene	NA		5	J	NA		7	J	NA		30		33		20		11	J
Vinyl Chloride	NA		12	U	NA		12	U	NA		12	U	12	U	12	U	12	U
Xylene (Total)	NA		6	J	NA		12	U	NA		12	U	12	U	12	UJ	12	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
4,4'-DDE	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
4,4'-DDT	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
Aldrin	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Alpha-BHC	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Alpha-Chlordane	2.6	J	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.9	J
Aroclor-1016	39	UJ	39	UJ	38	UJ	38	UJ	38	UJ	38	U	40	U	390	U	41	U
Aroclor-1221	78	UJ	79	UJ	77	UJ	78	UJ	78	UJ	78	U	81	U	790	U	83	U
Aroclor-1232	39	UJ	39	UJ	38	UJ	38	UJ	38	UJ	38	U	40	U	390	U	41	U
Aroclor-1242	39	UJ	39	UJ	38	UJ	38	UJ	38	UJ	38	U	40	U	390	U	41	U
Aroclor-1248	39	UJ	39	UJ	38	UJ	38	UJ	38	UJ	38	U	40	U	390	U	41	U
Aroclor-1254	110	J	39	UJ	38	UJ	38	UJ	38	UJ	43	J	69		24000		120	J
Aroclor-1260	39	UJ	39	UJ	38	UJ	38	UJ	38	UJ	38	U	40	U	390	U	41	U
Beta-BHC	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Delta-BHC	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Dieldrin	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
Endosulfan I	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Endosulfan II	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	230	R	4.1	U
Endosulfan Sulfate	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
Endrin	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4.1	J	810	J	7.5	
Endrin Aldehyde	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
Endrin Ketone	3.9	UJ	3.9	UJ	3.8	UJ	3.8	UJ	3.8	UJ	3.8	U	4	U	39	U	4.1	U
Gamma-BHC (Lindane)	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Gamma-Chlordane	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	71	R	2.1	U
Heptachlor	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Heptachlor Epoxide	2	UJ	2	UJ	1.9	UJ	2	UJ	2	UJ	2	U	2.1	U	20	U	2.1	U
Methoxychlor	20	UJ	20	UJ	19	UJ	20	UJ	20	UJ	20	U	21	U	200	U	21	U
Toxaphene	200	UJ	200	UJ	190	UJ	200	UJ	200	UJ	200	U	210	U	2000	U	210	U

Sample ID:	SS-05-09		SS-05-10		SS-05-11		SS-05-12		SS-05-13		SS-05-14		SS-05-15		SS-05-16		SS-05-16-DUP		SS-05-17		SS-05-18	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES					ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,1,2,2-Tetrachloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,1,2-Trichloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,1-Dichloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,1-Dichloroethene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,2-Dichloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
1,2-Dichloroethene (Total)	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	10	U	12	U
1,2-Dichloropropane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
2-Butanone	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	2	B	12	U
2-Hexanone	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	10	U	12	U
4-Methyl-2-pentanone	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	10	U	12	U
Acetone	NA		NA		16	B	11	U	11	U	11	U	11	U	11	U	11	U	28	B	11	B
Benzene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	2	J	6	U
Bromodichloromethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Bromoform	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Bromomethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Carbon Disulfide	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Carbon Tetrachloride	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Chlorobenzene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Chloroethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Chloroform	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Chloromethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
cis-1,3-Dichloropropene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Dibromochloromethane	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Ethylbenzene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Methylene Chloride	NA		NA		32	B	320		7	B	5	B	6	B	5	B	5	B	1	B	4	B
Styrene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Tetrachloroethene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Toluene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	1	J	6	U
trans-1,3-Dichloropropene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Trichloroethene	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Vinyl Chloride	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	5	U	6	U
Xylene (Total)	NA		NA		11	U	11	U	11	U	11	U	11	U	11	U	11	U	14	U	18	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	3.3	U	3.9	U	3.6	U	3.6	U	4.1	J	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
4,4'-DDE	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	4	K	4.1	U
4,4'-DDT	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	4.7	J	4.1	U
Aldrin	3.8	R	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Alpha-BHC	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Alpha-Chlordane	1.7	U	2	U	1.9	U	1.9	U	2.3		1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Aroclor-1016	33	U	39	U	36	U	36	U	37	U	36	U	38	U	37	U	37	U	38	U	41	U
Aroclor-1221	67	U	79	U	74	U	74	U	76	U	72	U	76	U	74	U	74	U	78	U	84	U
Aroclor-1232	33	U	39	U	36	U	36	U	37	U	36	U	38	U	37	U	37	U	38	U	41	U
Aroclor-1242	33	U	39	U	36	U	36	U	37	U	36	U	38	U	37	U	37	U	38	U	41	U
Aroclor-1248	33	U	39	U	36	U	36	U	37	U	36	U	38	U	37	U	37	U	38	U	41	U
Aroclor-1254	33	U	39	U	36	U	36	U	71	J	36	U	38	U	37	U	37	U	38	J	41	U
Aroclor-1260	33	U	39	U	36	U	36	U	37	U	36	U	38	U	37	U	37	U	38	U	41	U
Beta-BHC	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Delta-BHC	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Dieldrin	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Endosulfan I	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Endosulfan II	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Endosulfan Sulfate	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Endrin	3.3	U	3.9	U	3.6	U	3.6	U	5.5		3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Endrin Aldehyde	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Endrin Ketone	3.3	U	3.9	U	3.6	U	3.6	U	3.7	U	3.6	U	3.8	U	3.7	U	3.7	U	3.8	U	4.1	U
Gamma-BHC (Lindane)	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Gamma-Chlordane	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Heptachlor	1.7	U	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Heptachlor Epoxide	2.7	R	2	U	1.9	U	1.9	U	1.9	U	1.8	U	1.9	U	1.9	U	1.9	U	2	U	2.1	U
Methoxychlor	17	U	20	U	19	U	19	U	19	U	18	U	19	U	19	U	19	U	20	U	21	U
Toxaphene	170	U	200	U	190	U	190	U	190	U	180	U	190	U	190	U	190	U	200	U	210	U

Sample ID:	SS-05-21		SS-05-22		SS-05-23		SS-05-24		SS-05-25		SS-05-26		SS-05-27		SS-05-28		SS-05-29		SS-05-30		SS-05-31	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,1,2,2-Tetrachloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,1,2-Trichloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,1-Dichloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,1-Dichloroethene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,2-Dichloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
1,2-Dichloroethene (Total)	15	U	12	U	11	U	16	U	11	U	12	U	9	U	13	UJ	11	U	11	U	11	U
1,2-Dichloropropane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
2-Butanone	8	B	8	B	3	B	11	B	12	B	11	B	9	U	42	J	11	U	11	U	4	B
2-Hexanone	51		31		11	U	3	B	11	U	12	U	9	U	13	UJ	11	U	11	U	1	B
4-Methyl-2-pentanone	15	U	12	U	11	U	16	U	11	U	12	U	9	U	6	J	11	U	11	U	11	U
Acetone	120		94		53	B	110	B	170		120		11	B	240	B	10	B	15	B	46	B
Benzene	7	U	6	U	5	U	8	U	6	U	1	J	5	U	7	UJ	5	U	5	U	6	U
Bromodichloromethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Bromoform	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Bromomethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Carbon Disulfide	7	U	6	U	5	U	8	U	6	U	6	U	5	U	1	J	5	U	5	U	6	U
Carbon Tetrachloride	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Chlorobenzene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Chloroethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Chloroform	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Chloromethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
cis-1,3-Dichloropropene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Dibromochloromethane	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Ethylbenzene	3	J	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Methylene Chloride	3	B	2	B	2	B	6	B	4	B	5	B	4	B	5	B	4	B	6	B	7	B
Styrene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Tetrachloroethene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Toluene	40		5	J	2	J	8	U	1	J	13		1	J	2	J	1	J	5	U	6	U
trans-1,3-Dichloropropene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Trichloroethene	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Vinyl Chloride	7	U	6	U	5	U	8	U	6	U	6	U	5	U	7	UJ	5	U	5	U	6	U
Xylene (Total)	19	J	18	U	16	U	24	U	17	U	3	J	14	U	20	UJ	16	U	16	U	17	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	6.4	J	4.1	U	3.9	UL	5.8	UL	4	UL	11	J	3.9	UL	8	L	27	L	11	R	4	U
4,4'-DDE	7.9	J	9	J	3.9	UL	5.8	UL	4	UL	9.5	J	3.9	UL	6	L	4	UL	3.9	U	4	U
4,4'-DDT	4.5	U	5	J	3.9	UL	5.8	UL	4	UL	5.3		3.9	UL	4.4	UL	4	UL	3.9	U	4	U
Aldrin	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Alpha-BHC	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Alpha-Chlordane	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Aroclor-1016	45	U	41	U	39	UL	58	UL	40	UL	42	U	39	UL	44	UL	40	UL	39	U	40	U
Aroclor-1221	91	U	84	U	78	UL	120	UL	82	UL	85	U	79	UL	89	UL	82	UL	80	U	80	U
Aroclor-1232	45	U	41	U	39	UL	58	UL	40	UL	42	U	39	UL	44	UL	40	UL	39	U	40	U
Aroclor-1242	45	U	41	U	39	UL	58	UL	40	UL	42	U	39	UL	38	L	40	UL	260		40	U
Aroclor-1248	45	U	41	U	39	UL	58	UL	40	UL	42	U	39	UL	44	UL	40	UL	39	U	40	U
Aroclor-1254	84	J	20	J	39	UL	58	UL	40	UL	88		39	UL	33	L	390	L	190		40	U
Aroclor-1260	45	U	41	U	39	UL	58	UL	40	UL	42	U	39	UL	44	UL	40	UL	39	U	40	U
Beta-BHC	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	5.6	L	2.1	UL	2	U	2	U
Delta-BHC	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Dieldrin	4.5	U	4.1	U	3.9	UL	5.8	UL	4	UL	4.2	U	3.9	UL	4.4	UL	25	L	3.9	U	4	U
Endosulfan I	2.3	UL	2.1	UL	2	UL	3	UL	2.1	UL	2.2	UL	2	UL	2.3	UL	2.1	UL	2	U	2	U
Endosulfan II	4.5	U	4.1	U	3.9	UL	5.8	UL	4	UL	4.2	U	3.9	UL	4.4	UL	4	UL	3.9	U	4	U
Endosulfan Sulfate	10	J	4.1	U	3.9	UL	5.8	UL	4	UL	4.3	J	3.9	UL	4.4	UL	4	UL	3.9	U	4	U
Endrin	4.5	U	4.1	U	3.9	UL	5.8	UL	4	UL	4.2	U	3.9	UL	4.4	UL	4	UL	3.9	U	4	U
Endrin Aldehyde	4.5	U	4.1	U	3.9	UL	5.8	UL	4	UL	4.2	U	3.9	UL	4.4	UL	5.7	L	3.9	U	4	U
Endrin Ketone	4.5	U	4.1	U	3.9	UL	5.8	UL	4	UL	4.2	U	3.9	UL	4.4	UL	4	UL	3.9	U	4	U
Gamma-BHC (Lindane)	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Gamma-Chlordane	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	4	L	9.3	R	2	U
Heptachlor	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Heptachlor Epoxide	2.3	U	2.1	U	2	UL	3	UL	2.1	UL	2.2	U	2	UL	2.3	UL	2.1	UL	2	U	2	U
Methoxychlor	23	U	21	U	20	UL	30	UL	21	UL	22	U	20	UL	23	UL	21	UL	20	U	20	U
Toxaphene	230	U	210	U	200	UL	300	UL	210	UL	220	U	200	UL	230	UL	210	UL	200	U	200	U

Sample ID:	SS-05-32		SS-05-33		SS-05-34		SS-05-35		SS-05-36		SS-05-36-D		SS-05-37		SS-05-38	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,1,2,2-Tetrachloroethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,1,2-Trichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,1-Dichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,1-Dichloroethene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,2-Dichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
1,2-Dichloroethene (Total)	10	U	10	U	10	U	10	U	11	U	10	U	11	U	9	U
1,2-Dichloropropane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
2-Butanone	8	B	10	B	9	B	10	U	10	B	10	U	5	B	7	B
2-Hexanone	10	U	10	U	10	U	10	U	1	B	10	U	11	U	9	U
4-Methyl-2-pentanone	10	U	10	U	10	U	10	U	1	B	10	U	11	U	9	U
Acetone	110	J	96	B	100	B	110	J	110	J	55	B	100	J	110	J
Benzene	5	U	1	J	5	U	5	U	5	U	5	U	6	U	5	U
Bromodichloromethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Bromoform	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Bromomethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Carbon Disulfide	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Carbon Tetrachloride	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Chlorobenzene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Chloroethane	5	U	5	U	5	U	5	U	5	U	5	U	2	J	5	U
Chloroform	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Chloromethane	5	U	5	U	1	J	5	U	5	U	5	U	5	J	5	U
cis-1,3-Dichloropropene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Dibromochloromethane	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Ethylbenzene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Methylene Chloride	4	B	2	B	3	B	2	B	4	B	6	B	5	B	3	B
Styrene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Tetrachloroethene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Toluene	5	U	2	J	3	J	2	J	2	J	5	U	1	J	4	J
trans-1,3-Dichloropropene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Trichloroethene	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Vinyl Chloride	5	U	5	U	5	U	5	U	5	U	5	U	6	U	5	U
Xylene (Total)	15	U	15	U	14	U	1	J	16	U	16	U	17	U	14	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	13	R	6.1	R	5.5	R	4	U	130	R	140	R	5.7		8.9	R
4,4'-DDE	4.1	U	4	U	4	U	11	R	4.1	U	4.1	U	4.7	K	3.9	U
4,4'-DDT	4.1	U	4	U	4	U	14		15	R	13	R	6.6	K	3.9	U
Aldrin	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Alpha-BHC	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Alpha-Chlordane	2.1	U	2.1	U	2	R	2.1	U	16	R	15	R	4.9	R	13	R
Aroclor-1016	41	U	40	U	40	U	40	U	41	U	41	U	40	U	39	U
Aroclor-1221	83	U	82	U	81	U	82	U	83	U	83	U	82	U	78	U
Aroclor-1232	41	U	40	U	40	U	40	U	41	U	41	U	40	U	39	U
Aroclor-1242	41	U	16	J	40	U	40	U	41	U	41	U	40	U	39	U
Aroclor-1248	41	U	40	U	40	U	40	U	41	U	41	U	40	U	39	U
Aroclor-1254	85		57		30	J	220		990		1100	J	120	J	48	
Aroclor-1260	41	U	40	U	40	U	40	U	41	U	41	U	40	U	39	U
Beta-BHC	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Delta-BHC	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Dieldrin	4.1	U	4.1	R	4	U	14	R	48	R	4.1	U	9.1	R	3.9	U
Endosulfan I	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Endosulfan II	4.1	U	4	U	4	U	4	U	4.1	U	4.1	U	4	U	3.9	U
Endosulfan Sulfate	4.1	U	4	U	4	U	4	U	4.1	U	4.1	U	5.9	R	3.9	U
Endrin	4.1	U	4	U	4	U	4	U	4.1	U	4.1	U	4	U	3.9	U
Endrin Aldehyde	4.1	U	4	U	4	U	6.5	R	21	R	19	R	6.7	L	7.6	R
Endrin Ketone	4.1	U	4	U	4	U	4	U	4.1	U	4.1	U	4	U	3.9	U
Gamma-BHC (Lindane)	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Gamma-Chlordane	2.3	R	2.1	U	2.1	U	5.2	R	12	R	11	R	3.5	J	6.1	
Heptachlor	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2	U
Heptachlor Epoxide	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.1	U	2.7	R
Methoxychlor	21	U	21	U	21	U	21	U	21	U	21	U	21	U	20	U
Toxaphene	210	U	210	U	210	U	210	U	210	U	210	U	210	U	200	U

Data Qualifier

B -- Positive result is considered to be an artifact of blank contamination, and should not be considered present.
J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
K -- Positive result is considered biased high due to exceedance of technical quality control criteria.
L -- Positive result is considered biased low due to exceedance of technical quality control criteria.
R -- Positive result is considered unusable due to exceedance of technical quality control criteria.
U -- Value is a non-detected result as reported by the laboratory.
UJ -- Non-detected result is considered estimated due to exceedance of technical quality control criteria.
UL -- Non-detected result is considered biased low due to exceedance of technical quality control criteria.
UR -- Non-detected result is considered unusable due to exceedance of technical quality control criteria.
NA -- No result is available/applicable for this parameter in this sample.

Database source file: D:\AASTRSK\FOXDATSUM2\WA05SS.DBF data retrieved on: 06/20/00

Appendix A-2

Subsurface Soil Results

Sample ID:	SB-05-01		SB-05-02		SB-05-02-DUP		SB-05-03		SB-05-04		SB-05-05		SB-05-06		SB-05-07		SB-05-08		SB-05-09	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	10300		9820		13500		12100		10200		14100		11800		9430		13000		11200	
Antimony	6.8	UR	7.3	UR	7.1	UR	10.7	UL	7.3	UR	8.8	UR	8.1	UR	9	UR	7.6	UR	7.3	J
Arsenic	5.5		1.7		1.9		1.3	B	1.2		6.6		2		0.68		6.2		2.5	
Barium	97.2		135		76.2		30.3	B	97.7		103		128		85.5		666		38.2	
Beryllium	1.6		1.6		1.4		1.1	B	2.1		1.3		1.1		1.4		3.7		0.57	
Cadmium	0.49	U	0.52	U	0.51		2.8	B	0.52	U	0.63	U	0.58	U	0.64	U	0.55	U	0.51	U
Calcium	669		2550		2130		1050	B	2170		1980		1370		2820		2580		843	
Chromium	10.9		17.1		23.4		25.5	K	16.7		15.2		16.7		15		30		15.1	
Cobalt	23.9		10.1		10.7		6.8	B	13.8		6.9		14.9		11.8		25.7		8.4	
Copper	14.6		3.7	B	11		9.8	B	61.5		15.9		7.2	B	3	B	4.9	B	11.3	
Cyanide	NA		NA		NA		1.7	U	NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron	18000		21300		28500		26900		19100		12600		16400		14200		42100		15000	
Lead	7	J	14.4	J	14	J	7.8		8.6	J	65.5	J	15.8	J	6.3	J	19.5	J	9.4	J
Magnesium	2060		4970		4380		1820	B	6220		1710		4600		5660		5620		1860	
Manganese	948	J	244	J	285	J	155		272	J	547	J	293	J	82.2	J	9240	J	248	J
Mercury	0.05	U	0.05	U	0.06	U	0.12	U	0.05	U	0.11		0.05	U	0.05	U	0.12		0.05	U
Nickel	17.4		18.4		16.8		6.3		21.3		13.4	K	17.1		21.3		48		7.6	K
Potassium	303		2500		2400		947		3080		598		2960		2800		4180		959	
Selenium	0.49	U	0.52	U	0.51	U	1.1	UJ	0.52	U	1.3	K	0.56	U	0.64	U	0.55	U	0.51	U
Silver	0.65	U	0.7	U	0.68	U	2.2	U	0.69	U	0.84	U	0.77	U	0.86	U	0.73	U	0.68	U
Sodium	111		117		135		860	B	122		132		249		105		128		90.7	
Thallium	0.87	B	0.92	B	0.61	B	0.46	UL	0.52	U	0.63	U	0.58	U	0.64	U	0.57	B	0.51	U
Vanadium	18.6		19.4		22.9		35.7		15.5		26.9		19.5		13		39.2		19.2	
Zinc	18.7		37		31.7		19.8	B	47.1		100		51.9		41.5		57.8		21.9	
SEMIVOLATILES							ug/kg													
1,2,4-Trichlorobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
1,2-Dichlorobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
1,3-Dichlorobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
1,4-Dichlorobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,2'-Oxybis(1-chloropropane)	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,4,5-Trichlorophenol	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
2,4,6-Trichlorophenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,4-Dichlorophenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,4-Dimethylphenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,4-Dinitrophenol	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
2,4-Dinitrotoluene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2,6-Dinitrotoluene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2-Chloronaphthalene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2-Chlorophenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2-Methylnaphthalene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2-Methylphenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
2-Nitroaniline	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
2-Nitrophenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
3,3'-Dichlorobenzidine	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	

Sample ID:	SB-05-10		SB-05-11		SB-05-12		SB-05-13		SB-05-13-DUP		SB-05-14		SB-05-15		SB-05-16		SB-05-17		SB-05-18		SB-05-19		SB-05-20	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	11300		7000		8510		9220		9910		16400		3490		10400		12700		9190		12300		9370	
Antimony	8.9	UR	6.6	UR	8.1	UR	9.4	UR	9	UR	18.6	B	7.1	UR	9.2	UR	6.9	UR	7.7	UL	7	UL	8.6	UL
Arsenic	2.1		2.2		3.2		1.6		1.7		4.1	B	0.74		0.65		1.3		0.88		2	L	12.9	
Barium	30.1		39.2		38.9		43.9		27.7		468		40		112		107		118		123		373	
Beryllium	0.6		0.44		0.53		0.74		0.83		1.5	B	0.42		0.87		1.5		1.3		2.5		0.63	
Cadmium	0.64	U	0.47	U	0.58	U	0.67	U	0.64	U	17.6	L	0.5	U	0.66	U	0.49	U	0.55	UJ	0.5	UJ	15.7	
Calcium	1050		956		793		930		933		4470	B	516		2150		1670		6330		1220		22000	
Chromium	16.9		10.7		14.2		15.3		13.2		48.1	K	1.9	K	15.5		17.6		24.6		21.2		305	
Cobalt	5.3		3.1		7.3		8.2		6.4		30.1		8.3		10.3		17.9		9		12.8		13.6	L
Copper	15.4		6.6	B	11.2		7.4	B	6	B	1280		4.4	B	3.8	B	2.9	B	1.2	B	3.7	B	639	J
Cyanide	NA		NA		NA		NA		NA		2.2	U	NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron	12600		11300		15100		15700		19400		59000		2690		13300		19600		24100		29700		64200	
Lead	3.8	J	5.7	J	9.3	J	10.5	J	9.7	J	15.3		1.4	B	6.8	J	12.3	J	7.9		13.3		726	
Magnesium	1110		1330		1360		3290		3200		4530	B	639		5950		5900		5680		4850		7420	
Manganese	125	J	75.7	J	254	J	186	J	120	J	811		467	J	91.1	J	551	J	544	L	290	L	1360	L
Mercury	0.06		0.05	U	0.18		0.05	U	0.05	U	1.5		0.05	U	0.12		0.05	U	0.1	L	0.06	UL	0.14	L
Nickel	6.5	K	5.2	K	7.9	K	12.1	K	10.7	K	45.9		4.5	K	19.6		19.8		22.6		17.4	K	625	
Potassium	229		438		491		1320		1450		1910		85.7	B	2170		2940		1650		3010		1420	
Selenium	0.64	K	0.47	U	0.58	U	0.67	U	0.64	U	1.1	UJ	0.5	U	0.66	U	0.49	U	0.55	U	0.5	U	0.61	U
Silver	0.85	U	0.63	U	0.77	U	0.9	U	0.86	U	90.2		0.67	U	0.88	U	0.66	U	0.73	UL	0.66	UL	11.3	J
Sodium	73.5		46.1		50.4		102		127		2170	B	89.7		154		152		128		149		578	
Thallium	0.64	U	0.47	U	0.58	U	0.67	U	0.64	U	0.45	UL	0.5	U	0.66	U	0.49	U	1.1	K	0.91	K	0.61	U
Vanadium	20.6		17.6		23.1		19.6		21.4		34.7		3	B	16		22.9		33.1		29.7		6510	
Zinc	9.1	B	12.7		19.1		27.7		25.8		1040		3.7	B	44		47.5		29		49.6		1070	
SEMIVOLATILES							ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg						ug/kg	
1,2,4-Trichlorobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
1,2-Dichlorobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
1,3-Dichlorobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
1,4-Dichlorobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,2'-Oxybis(1-chloropropane)	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,4,5-Trichlorophenol	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
2,4,6-Trichlorophenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,4-Dichlorophenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,4-Dimethylphenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,4-Dinitrophenol	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
2,4-Dinitrotoluene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2,6-Dinitrotoluene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2-Chloronaphthalene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2-Chlorophenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2-Methylnaphthalene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2-Methylphenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
2-Nitroaniline	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
2-Nitrophenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
3,3'-Dichlorobenzidine	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U

Sample ID:	SB-05-21		SB-05-22		SB-05-23		SB-05-24		SB-05-25		SB-05-26		SB-05-27		SB-05-28		SB-05-28-D		SB-05-29		SB-05-30		SB-05-31	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	13100		15900		9980		14800		7400		11300		8820		12700		14600		20700		12500		11900	
Antimony	50.4	J	11.6		8.7	UJ	0.59	L	0.24	UL	0.24	UL	0.45	L	0.55	L	0.29	L	3.9	L	0.24	UL	0.55	L
Arsenic	0.66	J	1.8		3		6		2.5		2		0.67		0.74		0.43		4.8		1.1		0.46	
Barium	498		88.8		105		45.7		55.3		130		67		230		121		1030		84.2		97.1	
Beryllium	0.78		1.2		1.6		0.75		0.9		0.84		1.5		1.5		1.4		1.2		0.98		1.2	
Cadmium	17.1		1.7		0.62	U	0.36	U	0.04	U	0.31	K	0.04	U	0.44	U	0.36	U	137		0.04	U	0.38	U
Calcium	6990		1340		1020		361	K	538	K	1770	K	1640	K	1880	K	1760	K	9550	K	992	K	1540	K
Chromium	46		26.8		10.6		28.6	K	9.6	K	27.9	K	12.5	K	25.6	K	26.6	K	67.3	K	19	K	21	K
Cobalt	12.4	L	5.7		9.7		9	K	9	K	14.3	K	11.5	K	15.4	K	23.3	K	22.5	K	12.4	K	14.5	K
Copper	19300	J	11.1		63.6		13.8	L	17	L	127	L	50.8	L	4.7	L	6.4	L	1120	L	38.2	L	10.4	L
Cyanide	NA		1.5		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	NA		NA		NA		0.48	U	0.44	U	0.48	U	0.44	U	0.48	U	0.46	U	0.56	U	0.45	U	0.43	U
Iron	60100		19700		15800		28800		13400		62700		12800		20800		24200		82100		18300		21300	
Lead	907		13.3		2.4	K	8.5		4.1	K	2400	K	27.2	K	11.1	K	14.8		705	K	30.3	K	18.5	K
Magnesium	2750		2660		1890		2360		1250		1880		3750		4710		4560		3100		4020		4730	
Manganese	585	L	42.9		845		274		523		859		144		441		774		629		203		570	
Mercury	1.8	L	0.12		0.05	U	0.03	U	0.02	U	0.08		0.02	U	0.02	U	0.03	U	2		0.03	U	0.02	U
Nickel	160		11.4		15		12.7	L	10.4	L	19	L	17.5	L	20.4	L	19.1	L	81.5	L	17.1	L	20.2	L
Potassium	1330		1190		302		932	K	366	K	713	K	1720	K	2120	K	2320	K	1690	K	1540	K	3510	K
Selenium	0.67	U	1.2		0.62	U	1.8	UR	0.19	UR	1.9	UR	0.21	UR	2.1	UR	1.8	UR	4.1	UR	2	UR	1.8	UR
Silver	44	J	2.4		0.83	UJ	7.6		3.5		24.8		3.3	B	5.3		6.4		69.8		6.5		5.7	
Sodium	316		677		100		64.5	B	77.7	B	128	L	131	L	114	L	104	L	496	L	153	L	155	L
Thallium	1	K	0.46		0.62	U	0.37	U	0.41	U	4	U	0.44	U	0.45	U	0.37	U	8.6	U	0.41	U	0.39	U
Vanadium	68.3		22		18		44.1		18.1		30.4		14.3		25.5		28.9		48.5		20.7		17.9	
Zinc	936		30.1		16.2		35.1	L	17.8	L	372	L	37	L	39.4	L	38.9	L	4760	L	137	L	58.5	L
SEMIVOLATILES	ug/kg		ug/kg				ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
1,2-Dichlorobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
1,3-Dichlorobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
1,4-Dichlorobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,2'-Oxybis(1-chloropropane)	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,4,5-Trichlorophenol	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
2,4,6-Trichlorophenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,4-Dichlorophenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,4-Dimethylphenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,4-Dinitrophenol	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
2,4-Dinitrotoluene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2,6-Dinitrotoluene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2-Chloronaphthalene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2-Chlorophenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2-Methylnaphthalene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2-Methylphenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
2-Nitroaniline	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
2-Nitrophenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
3,3'-Dichlorobenzidine	4000	U	390	U	NA		400	U	370	U	400	U	1800	U	400	U	400	U	950	U	370	U	370	U

Sample ID:	SB-05-32		SB-05-33		SB-05-34		SB-05-35		SB-05-36		SB-05-37		SB-05-38		SB-05-39		SB-05-40		SB-05-41		SB-05-42		SB-05-43	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	12900		11900		12200		10800		14200		10800		10400		14100		11900		15600		15100		20700	
Antimony	1.1	L	0.31	L	0.26	L	7.5	L	0.54	L	5.6	UR	0.41	L	0.56	L	0.8	L	0.42	L	0.89	K	0.78	K
Arsenic	0.31	U	0.46	K	0.96	K	2.3	K	1	U	1.3	K	0.47	K	0.37	K	7.8		0.8	U	1.2	U	1.1	U
Barium	421		72.9		133		214		99.9		42.7	K	121		161		96		118		117	K	212	K
Beryllium	1.8		1		1.5		0.8		1.7		0.72		1.6		1.7		1.4		1.5		1.4		2.2	
Cadmium	0.38	U	2.5	U	2.2	U	6.9		2.5	U	0.5	U	2.5	U	2.4	U	0.39	K	1.9	U	2.9	U	2.8	U
Calcium	2150	K	1580	J	1200	K	5850	J	2060	J	1460	J	4960	J	2050	J	2900	J	2420	J	1730	J	2480	J
Chromium	34	K	16.2		18.1		39.6		21.6		13.4		23		22.6		15.6		28.6		24.1	K	36	K
Cobalt	18.7	K	13.5	K	14	K	11.4	K	18.8	K	12.1	K	11.6	K	16	K	6.4	K	18	K	13		16.7	
Copper	581	L	10.8	L	15.7	L	313	L	69.5	L	7.7	L	3.4	B	3.5	L	16.7	L	3.2	B	5.6	L	3.6	L
Cyanide	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	0.44	U	0.45	U	0.46	U	0.5	U	0.48	U	0.46	U	0.48	U	0.46	U	0.58	U	0.48	U	0.47	U	0.46	U
Iron	35200		20300		25100		50600		26300		16000		21300		18100		11900		24400		29000	J	40200	J
Lead	69.3	K	20.5		8.3		220		18.8		8.2		12		14.9		73.6		16.6		15.8		18.4	
Magnesium	6420		3130		2410		1840		5440		3180		6430		7010		1680		6820		4440	J	8660	J
Manganese	2620		286	K	1550	K	499	K	502	K	344	K	106	K	554	K	457	K	601	K	1050	J	970	J
Mercury	0.02	U	0.02	U	0.03	U	0.92		0.02	U	0.02	U	0.03	U	0.03	U	0.1		0.06		0.03	UR	0.05	L
Nickel	33.8	L	15	L	16.6	L	34.6	L	23.9	L	12.7	L	20.7	L	24.1	L	12.1	L	22.9	L	19.1	L	25.1	L
Potassium	5870	K	1780		1200		582		3690		1590		2260		4460		682		4460		3270		6950	
Selenium	0.18	UR	0.5	UL	0.74	B	0.5	UL	0.5	UL	0.5	UL	0.5	UL	0.26	B	0.96	B	1.1	B	0.58	B	1	B
Silver	10.3		4.9		6.4		81.5		6.7		3.8		5		4		3.2		5.8		7.3	K	9.8	K
Sodium	237	L	119	B	104	B	154	B	152	B	144	B	185	B	227	K	238	B	190	B	139	L	200	L
Thallium	3.8	U	0.46		0.9	U	0.6		1	U	0.9	U	0.45		1	U	1.1	U	0.8	U	1.2	UL	1.1	UL
Vanadium	35.1		17.2		22.1		29.5		22.5		18.5		30.1		22.5		29.3		28.9		25.3	J	41.5	J
Zinc	105	L	30.4	K	30.5	K	661	K	74.9	K	31.9	K	43.3	K	65.7	K	106	K	55.5	K	41.3	L	60.6	L
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
1,2-Dichlorobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
1,3-Dichlorobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
1,4-Dichlorobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2,2'-Oxybis(1-chloropropane)	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2,4,5-Trichlorophenol	470	U	330	U	390	U	410	UR	380	UR	370	UL	390	UL	420	UR	400	U	400	U	390	U	390	U
2,4,6-Trichlorophenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
2,4-Dichlorophenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
2,4-Dimethylphenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
2,4-Dinitrophenol	470	U	330	U	390	U	410	UR	380	UR	370	UL	390	UL	420	UR	400	U	400	U	390	U	390	U
2,4-Dinitrotoluene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2,6-Dinitrotoluene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2-Chloronaphthalene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2-Chlorophenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
2-Methylnaphthalene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
2-Methylphenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
2-Nitroaniline	470	U	330	UR	390	UR	410	UR	380	UR	370	UR	390	UR	420	UR	400	UR	400	UR	390	U	390	U
2-Nitrophenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
3,3'-Dichlorobenzidine	370	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U

Sample ID:	SB-05-44		SB-05-45		SB-05-46		SB-05-47		SB-05-48		SB-05-49		SB-05-50		SB-05-50-D		SB-05-51		SB-05-52		SB-05-53		SB-05-54		SB-05-55	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
INORGANICS	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Aluminum	14400		12500		16400		15600		17600		10200		12100		11700		18400		14200		16700		19200		12300	
Antimony	0.5	K	0.45	K	1.2	K	0.66	K	0.91	K	0.29	UR	0.27	UR	0.24	UR	13.7	L	0.43	L	4.6	UR	7.1	L	6.6	L
Arsenic	1	U	0.56	K	3.5	K	1.1	U	0.47	K	3.9	K	1.4	K	1.7	K	0.51	K	4.5	K	0.75	K	3.5		3.7	
Barium	101	K	136	K	132	K	96.3	K	126	K	58.1		79.5		80.4		258		68		143		1020		596	
Beryllium	1.7		1.7		2.1		2		1.8		0.8		1.2		1.2		0.96		1		1.7		1.8		0.86	
Cadmium	2.6	U	0.5	U	0.52	K	0.6	U	0.5	U	0.6	U	2.6	U	2.4	U	10.1		0.4	U	1.9	U	15.7		7.3	
Calcium	2310	J	1880	J	2330	J	2600	J	1610	J	704	K	1330	K	1350	K	3000	K	761	K	1730	K	14300	K	5080	K
Chromium	24.7	K	18.3	K	23.4	K	27.4	K	28	K	17.4		17		16.1		42.4		19.7		19.6		71.5	K	32.5	K
Cobalt	14.8		14.9		12.3		13.4		25.8		8.5		13.4		13.5		13.8		8.8		17.1		17.6	K	10.7	K
Copper	2.5	L	23.9	L	33.7	L	35.4	L	21.1	L	11.4	L	13.6	L	13.4	L	395	L	12.6	L	26.6	L	1970	L	326	L
Cyanide	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Hexavalent Chromium	0.46	U	0.47	U	0.5	U	0.47	U	0.46	U	0.48	U	0.47	U	0.46	U	0.5	U	0.47	U	0.47	U	0.53	U	0.48	U
Iron	25200	J	21500	J	21800	J	34400	J	35000	J	17500		20800		19900		92600		18600		27500		78500		43600	
Lead	10.2		10.9		42.3		12		29		12.6		10.1		9.6		263		11.9		17		1240	K	186	K
Magnesium	6540	J	6840	J	5150	J	6770	J	4220	J	1520		3260		3140		2060		2060		3840		4170		2870	
Manganese	259	J	930	J	491	J	218	J	1740	J	462		524		508		772		463		1460		1040		756	
Mercury	0.03	UR	0.03	UR	0.05	L	0.03	UR	0.03	UR	0.03	U	0.03	U	0.03	U	2.6		0.05		0.07		0.63		1	
Nickel	21.4	L	23.5	L	19.6	L	22.1	L	21.7	L	9.6	K	14.2	K	14.5	K	186	K	12.4	L	18.6	L	167	L	26.6	L
Potassium	3830		3000		3780		4440		3240		491	K	1930	K	1890	K	751	K	643	K	2860	K	1410	K	1180	K
Selenium	0.44	B	0.72	B	0.73	B	0.31	B	1.4	B	0.48	B	0.32	B	0.5	U	3.4	B	0.45		0.67	B	2	UR	1.9	UR
Silver	6.2	K	5.3	B	6.8	B	8.6	K	10.2	K	4.5		4.9		4.7		57.3		4.9		7.7		62.8		111	
Sodium	126	L	135	L	202	L	207	L	127	L	70.6	B	119	B	103	B	122	B	58.6	B	110	B	593	L	177	L
Thallium	1	UL	1	UL	1.1	UL	1.1	UL	5.5	UL	1.1	U	1	U	0.9	U	0.9	U	0.8	U	0.8	U	4.2	U	0.39	U
Vanadium	21.7	J	20.3	J	28.8	J	35.8	J	30.9	J	26.4		20.5		20.3		28.7		29.6		24		740		46.7	
Zinc	49	L	54.6	L	106	L	48.7	L	59.2	L	41.8	K	38.9	K	36.9	K	903	K	35.6	K	55	K	1430	L	514	L
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,2,4-Trichlorobenzene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
1,2-Dichlorobenzene	190	U	190	U	200	U	190	U	190	U	190	U	190	U	190	U	330	U	190	U	190	U	4300	U	1000	U
1,3-Dichlorobenzene	190	U	190	U	200	U	190	U	190	U	190	U	190	U	190	U	330	U	190	U	190	U	4300	U	1000	U
1,4-Dichlorobenzene	190	U	190	U	200	U	190	U	190	U	190	U	190	U	190	U	220	J	190	U	190	U	4300	U	1000	U
2,2'-Oxybis(1-chloropropane)	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2,4,5-Trichlorophenol	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
2,4,6-Trichlorophenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2,4-Dichlorophenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2,4-Dimethylphenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2,4-Dinitrophenol	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
2,4-Dinitrotoluene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2,6-Dinitrotoluene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2-Chloronaphthalene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2-Chlorophenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2-Methylnaphthalene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2-Methylphenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
2-Nitroaniline	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
2-Nitrophenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
3,3'-Dichlorobenzidine	190	U	190	U	200	U	190	U	190	U	780	UR	800	UR	780	UR	1400	UR	810	UR	780	UR	8900	U	2100	U

Sample ID:	SB-05-01		SB-05-02		SB-05-02-DUP		SB-05-03		SB-05-04		SB-05-05		SB-05-06		SB-05-07		SB-05-08		SB-05-09	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES							ug/kg													
3-Nitroaniline	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
4,6-Dinitro-2-methylphenol	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
4-Bromophenyl Phenyl Ether	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
4-Chloro-3-methylphenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
4-Chloroaniline	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
4-Chlorophenyl Phenyl Ether	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
4-Methylphenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
4-Nitroaniline	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
4-Nitrophenol	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
Acenaphthene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Acenaphthylene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Anthracene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Benz(a)anthracene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Benzo(a)pyrene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Benzo(b)fluoranthene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Benzo(g,h,i)perylene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Benzo(k)fluoranthene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Bis(2-chloroethoxy)methane	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Bis(2-chloroethyl)ether	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Bis(2-ethylhexyl)phthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Butylbenzylphthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Carbazole	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Chrysene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Di-n-butylphthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Di-n-octylphthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Dibenz(a,h)anthracene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Dibenzofuran	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Diethylphthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Dimethylphthalate	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Fluoranthene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Fluorene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Hexachlorobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Hexachlorobutadiene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Hexachlorocyclopentadiene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Hexachloroethane	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Indeno(1,2,3-cd)pyrene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Isophorone	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
N-Nitroso-di-n-propylamine	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
N-Nitrosodiphenylamine (1)	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Naphthalene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Nitrobenzene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Pentachlorophenol	NA		NA		NA		910	U	NA		NA		NA		NA		NA		NA	
Phenanthrene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Phenol	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	
Pyrene	NA		NA		NA		370	U	NA		NA		NA		NA		NA		NA	

Sample ID:	SB-05-10		SB-05-11		SB-05-12		SB-05-13		SB-05-13-DUP		SB-05-14		SB-05-15		SB-05-16		SB-05-17		SB-05-18		SB-05-19		SB-05-20	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES							ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg						ug/kg	
3-Nitroaniline	NA		NA		NA		890	U	880	UJ	820	U	880	UJ	940	UJ	960	U	NA		NA		10000	U
4,6-Dinitro-2-methylphenol	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
4-Bromophenyl Phenyl Ether	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
4-Chloro-3-methylphenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
4-Chloroaniline	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
4-Chlorophenyl Phenyl Ether	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
4-Methylphenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
4-Nitroaniline	NA		NA		NA		890	U	880	UJ	820	U	880	UJ	940	UJ	960	U	NA		NA		10000	U
4-Nitrophenol	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
Acenaphthene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Acenaphthylene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Anthracene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Benz(a)anthracene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Benzo(a)pyrene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Benzo(b)fluoranthene	NA		NA		NA		370	U	360	U	38	J	360	U	390	U	400	U	NA		NA		4200	U
Benzo(g,h,i)perylene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Benzo(k)fluoranthene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Bis(2-chloroethoxy)methane	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Bis(2-chloroethyl)ether	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Bis(2-ethylhexyl)phthalate	NA		NA		NA		370	U	360	U	80	B	360	U	390	U	400	U	NA		NA		480	BJ
Butylbenzylphthalate	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Carbazole	NA		NA		NA		370	U	360	UJ	340	U	360	UJ	390	UJ	400	U	NA		NA		4200	U
Chrysene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Di-n-butylphthalate	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Di-n-octylphthalate	NA		NA		NA		370	UJ	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Dibenz(a,h)anthracene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Dibenzofuran	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Diethylphthalate	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Dimethylphthalate	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Fluoranthene	NA		NA		NA		370	U	360	U	38	J	360	U	390	U	400	U	NA		NA		4200	U
Fluorene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Hexachlorobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Hexachlorobutadiene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Hexachlorocyclopentadiene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Hexachloroethane	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Indeno(1,2,3-cd)pyrene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Isophorone	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
N-Nitroso-di-n-propylamine	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
N-Nitrosodiphenylamine (1)	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Naphthalene	NA		NA		NA		370	U	360	U	120	J	360	U	390	U	400	U	NA		NA		4200	U
Nitrobenzene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Pentachlorophenol	NA		NA		NA		890	U	880	U	820	U	880	U	940	U	960	U	NA		NA		10000	U
Phenanthrene	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Phenol	NA		NA		NA		370	U	360	U	340	U	360	U	390	U	400	U	NA		NA		4200	U
Pyrene	NA		NA		NA		370	U	360	U	37	J	360	U	390	U	400	U	NA		NA		4200	U

Sample ID:	SB-05-21		SB-05-22		SB-05-23		SB-05-24		SB-05-25		SB-05-26		SB-05-27		SB-05-28		SB-05-28-D		SB-05-29		SB-05-30		SB-05-31	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg				ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
3-Nitroaniline	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
4,6-Dinitro-2-methylphenol	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
4-Bromophenyl Phenyl Ether	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
4-Chloro-3-methylphenol	4000	U	390	U	NA		400	U	370	U	400	U	1800	U	400	U	400	U	950	U	370	U	370	U
4-Chloroaniline	4000	U	390	U	NA		400	U	370	UR	400	U	1800	U	400	U	400	U	950	U	370	U	370	U
4-Chlorophenyl Phenyl Ether	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
4-Methylphenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
4-Nitroaniline	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
4-Nitrophenol	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
Acenaphthene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Acenaphthylene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Anthracene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Benz(a)anthracene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Benzo(a)pyrene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Benzo(b)fluoranthene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Benzo(g,h,i)perylene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Benzo(k)fluoranthene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Bis(2-chloroethoxy)methane	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Bis(2-chloroethyl)ether	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Bis(2-ethylhexyl)phthalate	650	BJ	49	B	NA		190	U	180	U	200	U	860	U	190	U	190	U	170	J	48	J	180	U
Butylbenzylphthalate	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Carbazole	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Chrysene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Di-n-butylphthalate	4000	U	390	U	NA		190	U	180	U	41	J	860	U	190	U	190	U	460	U	180	U	180	U
Di-n-octylphthalate	4000	U	390	U	NA		310	U	290	U	320	U	1400	U	310	U	310	U	750	U	290	U	290	U
Dibenz(a,h)anthracene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Dibenzofuran	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Diethylphthalate	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Dimethylphthalate	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Fluoranthene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	110	J	180	U	180	U
Fluorene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Hexachlorobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Hexachlorobutadiene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Hexachlorocyclopentadiene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Hexachloroethane	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Indeno(1,2,3-cd)pyrene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Isophorone	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
N-Nitroso-di-n-propylamine	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
N-Nitrosodiphenylamine (1)	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Naphthalene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Nitrobenzene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Pentachlorophenol	9700	U	940	U	NA		510	U	470	U	510	U	2300	U	510	U	510	U	1200	U	470	U	470	U
Phenanthrene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	110	J	180	U	180	U
Phenol	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	460	U	180	U	180	U
Pyrene	4000	U	390	U	NA		190	U	180	U	200	U	860	U	190	U	190	U	100	J	180	U	180	U

Sample ID:	SB-05-32		SB-05-33		SB-05-34		SB-05-35		SB-05-36		SB-05-37		SB-05-38		SB-05-39		SB-05-40		SB-05-41		SB-05-42		SB-[illegible]	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
3-Nitroaniline	470	U	330	UR	390	UR	410	UR	380	UR	370	UR	390	UR	420	UR	400	UR	400	UR	390	U	390	U
4,6-Dinitro-2-methylphenol	470	U	330	U	390	U	410	UR	380	UR	370	UL	390	UL	420	UR	400	U	400	U	390	U	390	U
4-Bromophenyl Phenyl Ether	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
4-Chloro-3-methylphenol	370	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
4-Chloroaniline	370	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
4-Chlorophenyl Phenyl Ether	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
4-Methylphenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
4-Nitroaniline	470	U	330	UR	390	UR	410	UR	380	UR	370	UR	390	UR	420	UR	400	UR	400	UR	390	U	390	U
4-Nitrophenol	470	U	330	U	390	U	410	UR	380	UR	370	UL	390	UL	420	UR	400	U	400	U	390	U	390	U
Acenaphthene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Acenaphthylene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Anthracene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Benz(a)anthracene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Benzo(a)pyrene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Benzo(b)fluoranthene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Benzo(g,h,i)perylene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Benzo(k)fluoranthene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Bis(2-chloroethoxy)methane	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Bis(2-chloroethyl)ether	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Bis(2-ethylhexyl)phthalate	76	J	94	B	67	B	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	1000	B
Butylbenzylphthalate	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Carbazole	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Chrysene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Di-n-butylphthalate	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	57	J	210	UR	190	UR	200	UR	190	U	190	U
Di-n-octylphthalate	290	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Dibenz(a,h)anthracene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Dibenzofuran	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Diethylphthalate	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Dimethylphthalate	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Fluoranthene	180	U	36	L	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Fluorene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Hexachlorobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Hexachlorobutadiene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Hexachlorocyclopentadiene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Hexachloroethane	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Indeno(1,2,3-cd)pyrene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Isophorone	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
N-Nitroso-di-n-propylamine	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
N-Nitrosodiphenylamine (1)	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Naphthalene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Nitrobenzene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Pentachlorophenol	470	U	330	U	390	U	410	UR	380	UR	370	UL	390	UL	420	UR	400	U	400	U	390	U	390	U
Phenanthrene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U
Phenol	180	U	160	U	190	U	200	UR	190	UR	180	UL	190	UL	210	UR	190	U	200	U	190	U	190	U
Pyrene	180	U	160	UR	190	UR	200	UR	190	UR	180	UR	190	UR	210	UR	190	UR	200	UR	190	U	190	U

Sample ID:	SB-05-44		SB-05-45		SB-05-46		SB-05-47		SB-05-48		SB-05-49		SB-05-50		SB-05-50-D		SB-05-51		SB-05-52		SB-05-53		SB-05-54		SB-05-55	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
3-Nitroaniline	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
4,6-Dinitro-2-methylphenol	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
4-Bromophenyl Phenyl Ether	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
4-Chloro-3-methylphenol	190	U	190	U	200	U	190	U	190	U	780	U	800	U	780	U	1400	U	810	U	780	U	8900	U	2100	U
4-Chloroaniline	190	U	190	U	200	U	190	U	190	U	780	UR	800	U	780	U	1400	U	810	U	780	U	8900	U	2100	U
4-Chlorophenyl Phenyl Ether	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
4-Methylphenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
4-Nitroaniline	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
4-Nitrophenol	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
Acenaphthene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Acenaphthylene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Anthracene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Benz(a)anthracene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	1100	J	1000	U
Benzo(a)pyrene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	920	J	1000	U
Benzo(b)fluoranthene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	130	J	400	U	380	U	1000	J	1000	U
Benzo(g,h,i)perylene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	960	J	1000	U
Benzo(k)fluoranthene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Bis(2-chloroethoxy)methane	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Bis(2-chloroethyl)ether	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Bis(2-ethylhexyl)phthalate	190	U	190	U	200	U	49	B	190	U	390	U	390	U	380	U	180	J	400	U	380	U	4300	U	1000	U
Butylbenzylphthalate	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Carbazole	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Chrysene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	77	J	400	U	380	U	2000	J	1000	U
Di-n-butylphthalate	190	U	190	U	42	B	40	B	52	B	87	B	120	B	92	B	110	B	120	B	83	B	4300	U	1000	U
Di-n-octylphthalate	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	7000	U	1600	U
Dibenz(a,h)anthracene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Dibenzofuran	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Diethylphthalate	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Dimethylphthalate	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Fluoranthene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	130	J	400	U	380	U	1500	J	1000	U
Fluorene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Hexachlorobenzene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Hexachlorobutadiene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Hexachlorocyclopentadiene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Hexachloroethane	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Indeno(1,2,3-cd)pyrene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Isophorone	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
N-Nitroso-di-n-propylamine	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
N-Nitrosodiphenylamine (1)	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Naphthalene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Nitrobenzene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Pentachlorophenol	390	U	380	U	410	U	390	U	380	U	2000	U	2000	U	2000	U	3500	U	2000	U	2000	U	11000	U	2600	U
Phenanthrene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	86	J	400	U	380	U	1800	J	1000	U
Phenol	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	670	U	400	U	380	U	4300	U	1000	U
Pyrene	190	U	190	U	200	U	190	U	190	U	390	U	390	U	380	U	120	J	400	U	380	U	2500	J	1000	U

Sample ID:	SB-05-01		SB-05-02		SB-05-02-DUP		SB-05-03		SB-05-04		SB-05-05		SB-05-06		SB-05-07		SB-05-08		SB-05-09	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,1,2,2-Tetrachloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,1,2-Trichloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,1-Dichloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,1-Dichloroethene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,2-Dichloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,2-Dichloroethene (Total)	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
1,2-Dichloropropane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
2-Butanone	11	U	12	U	12	U	12	U	11	U	91		13	U	12	U	12	U	11	U
2-Hexanone	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
4-Methyl-2-pentanone	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Acetone	11	U	12	U	12	U	12	U	11	U	260	B	75	B	12	U	12	U	11	U
Benzene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Bromodichloromethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Bromoform	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Bromomethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Carbon Disulfide	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Carbon Tetrachloride	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Chlorobenzene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Chloroethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Chloroform	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Chloromethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
cis-1,3-Dichloropropene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Dibromochloromethane	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Ethylbenzene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Methylene Chloride	33	B	32	B	6	B	12	U	8	B	14	B	25	B	18	B	4	B	4	B
Styrene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Tetrachloroethene	11	U	4	J	14		12	U	11	U	28	U	13	U	12	U	12	U	11	U
Toluene	11	U	12	U	12	U	12	U	15		3	J	13	U	12	U	12	U	11	U
trans-1,3-Dichloropropene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Trichloroethene	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Vinyl Chloride	11	U	12	U	12	U	12	U	11	U	28	U	13	U	12	U	12	U	11	U
Xylene (Total)	11	U	12	U	12	U	12	U	6	J	10	J	13	U	12	U	12	U	11	U
PESTICIDES/PCBS							ug/kg													
4,4'-DDD	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
4,4'-DDE	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
4,4'-DDT	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Aldrin	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Alpha-BHC	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Alpha-Chlordane	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Aroclor-1016	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Aroclor-1221	NA		NA		NA		76	U	NA		NA		NA		NA		NA		NA	
Aroclor-1232	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Aroclor-1242	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Aroclor-1248	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Aroclor-1254	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Aroclor-1260	NA		NA		NA		38	U	NA		NA		NA		NA		NA		NA	
Beta-BHC	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Delta-BHC	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Dieldrin	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Endosulfan I	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Endosulfan II	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Endosulfan Sulfate	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Endrin	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Endrin Aldehyde	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Endrin Ketone	NA		NA		NA		3.8	U	NA		NA		NA		NA		NA		NA	
Gamma-BHC (Lindane)	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Gamma-Chlordane	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Heptachlor	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Heptachlor Epoxide	NA		NA		NA		1.9	U	NA		NA		NA		NA		NA		NA	
Methoxychlor	NA		NA		NA		19	U	NA		NA		NA		NA		NA		NA	
Toxaphene	NA		NA		NA		190	U	NA		NA		NA		NA		NA		NA	

Sample ID:	SB-05-10		SB-05-11		SB-05-12		SB-05-13		SB-05-13-DUP		SB-05-14		SB-05-15		SB-05-16		SB-05-17		SB-05-18		SB-05-19		SB-05-20	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,1,2,2-Tetrachloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,1,2-Trichloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,1-Dichloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,1-Dichloroethene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,2-Dichloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,2-Dichloroethene (Total)	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
1,2-Dichloropropane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
2-Butanone	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
2-Hexanone	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
4-Methyl-2-pentanone	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Acetone	12	U	11	U	11	U	12	U	6	B	11	B	9	B	12	U	12	U	13	U	11	U	11	B
Benzene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Bromodichloromethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Bromoform	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Bromomethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Carbon Disulfide	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Carbon Tetrachloride	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Chlorobenzene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Chloroethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Chloroform	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Chloromethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
cis-1,3-Dichloropropene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Dibromochloromethane	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Ethylbenzene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Methylene Chloride	4	B	6	B	21	B	5	B	6	B	14	U	5	B	5	B	5	B	20	B	11	U	12	B
Styrene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Tetrachloroethene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Toluene	12	U	11	U	11	U	12	U	12	U	4	J	11	U	12	U	12	U	13	U	11	U	13	U
trans-1,3-Dichloropropene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Trichloroethene	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Vinyl Chloride	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
Xylene (Total)	12	U	11	U	11	U	12	U	12	U	14	U	11	U	12	U	12	U	13	U	11	U	13	U
PESTICIDES/PCBS							ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg						ug/kg	
4,4'-DDD	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		9.6	J
4,4'-DDE	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
4,4'-DDT	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Aldrin	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Alpha-BHC	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Alpha-Chlordane	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Aroclor-1016	NA		NA		NA		37	UJ	36	U	200	U	36	U	39	U	40	U	NA		NA		42	U
Aroclor-1221	NA		NA		NA		74	UJ	74	U	410	U	74	U	79	U	81	U	NA		NA		85	U
Aroclor-1232	NA		NA		NA		37	UJ	36	U	200	U	36	U	39	U	40	U	NA		NA		42	U
Aroclor-1242	NA		NA		NA		37	UJ	36	U	200	U	36	U	39	U	40	U	NA		NA		42	U
Aroclor-1248	NA		NA		NA		37	UJ	36	U	315		36	U	39	U	40	U	NA		NA		42	U
Aroclor-1254	NA		NA		NA		37	UJ	36	U	395		36	U	39	U	40	U	NA		NA		26	J
Aroclor-1260	NA		NA		NA		37	UJ	36	U	200	U	36	U	39	U	40	U	NA		NA		42	U
Beta-BHC	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Delta-BHC	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Dieldrin	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Endosulfan I	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Endosulfan II	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Endosulfan Sulfate	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Endrin	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Endrin Aldehyde	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Endrin Ketone	NA		NA		NA		3.7	UJ	3.6	U	20	U	3.6	U	3.9	U	4	U	NA		NA		4.2	U
Gamma-BHC (Lindane)	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Gamma-Chlordane	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Heptachlor	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Heptachlor Epoxide	NA		NA		NA		1.9	UJ	1.9	U	10	U	1.9	U	2	U	2	U	NA		NA		2.1	U
Methoxychlor	NA		NA		NA		19	UJ	19	U	100	U	19	U	20	U	20	U	NA		NA		21	U
Toxaphene	NA		NA		NA		190	UJ	190	U	1000	U	190	U	200	U	200	U	NA		NA		210	U

Sample ID:	SB-05-21		SB-05-22		SB-05-23		SB-05-24		SB-05-25		SB-05-26		SB-05-27		SB-05-28		SB-05-28-D		SB-05-29		SB-05-30		SB-0[illegible]	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES			ug/kg				ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,1,2,2-Tetrachloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,1,2-Trichloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,1-Dichloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,1-Dichloroethene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,2-Dichloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
1,2-Dichloroethene (Total)	NA		12	U	NA		10	U	9	U	10	U	9	U	11	U	10	U	18	UJ	10	U	10	U
1,2-Dichloropropane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
2-Butanone	NA		12	U	NA		10	U	2	B	5	B	2	B	11	U	1	B	26	J	10	U	1	B
2-Hexanone	NA		12	U	NA		1	B	9	U	10	U	9	U	11	U	10	U	2	J	10	U	10	U
4-Methyl-2-pentanone	NA		12	U	NA		10	U	9	U	10	U	4	J	11	U	10	U	4	J	10	U	10	U
Acetone	NA		12	U	NA		18	B	14	B	33	B	20	B	10	B	7	B	300	J	7	B	11	B
Benzene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	16	J	5	U	5	U
Bromodichloromethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Bromoform	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Bromomethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Carbon Disulfide	NA		12	U	NA		5	U	5	U	13		5	U	6	U	5	U	5	J	5	U	5	U
Carbon Tetrachloride	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Chlorobenzene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Chloroethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Chloroform	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Chloromethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
cis-1,3-Dichloropropene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Dibromochloromethane	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Ethylbenzene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	3	J	5	U	5	U
Methylene Chloride	NA		12	U	NA		10	B	3	B	3	B	3	B	4	B	3	B	6	B	2	B	3	B
Styrene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Tetrachloroethene	NA		2	B	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Toluene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	J	5	U	5	U
trans-1,3-Dichloropropene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Trichloroethene	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Vinyl Chloride	NA		12	U	NA		5	U	5	U	5	U	5	U	6	U	5	U	9	UJ	5	U	5	U
Xylene (Total)	NA		12	U	NA		1	J	14	U	15	U	14	U	17	U	15	U	3	J	15	U	15	U
PESTICIDES/PCBS	ug/kg		ug/kg				ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	54	J	3.7	U	3.7	U
4,4'-DDE	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	13	K	3.7	U	3.7	U
4,4'-DDT	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Aldrin	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Alpha-BHC	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Alpha-Chlordane	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Aroclor-1016	40	U	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	47	U	37	U	37	U
Aroclor-1221	81	U	78	U	NA		82	U	74	U	82	U	72	U	81	U	81	U	96	U	75	U	75	U
Aroclor-1232	40	U	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	47	U	37	U	37	U
Aroclor-1242	40	U	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	47	U	37	U	37	U
Aroclor-1248	40	U	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	47	U	37	U	37	U
Aroclor-1254	31	J	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	90		37	U	37	U
Aroclor-1260	40	U	38	U	NA		40	U	36	U	40	U	35	U	40	U	40	U	47	U	37	U	37	U
Beta-BHC	1.9	J	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Delta-BHC	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Dieldrin	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Endosulfan I	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Endosulfan II	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Endosulfan Sulfate	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Endrin	4	U	3.8	U	NA		4	U	3.6	UL	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Endrin Aldehyde	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Endrin Ketone	4	U	3.8	U	NA		4	U	3.6	U	4	U	3.5	U	4	U	4	U	4.7	U	3.7	U	3.7	U
Gamma-BHC (Lindane)	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Gamma-Chlordane	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Heptachlor	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Heptachlor Epoxide	2.1	U	2	U	NA		2.1	U	1.9	U	2.1	U	1.8	U	2	U	2	U	2.4	U	1.9	U	1.9	U
Methoxychlor	21	U	20	U	NA		21	U	19	U	21	U	18	U	20	U	20	U	24	U	19	U	19	U
Toxaphene	210	U	200	U	NA		210	U	190	U	210	U	180	U	200	U	200	U	240	U	190	U	190	U

Sample ID:	SB-05-32		SB-05-33		SB-05-34		SB-05-35		SB-05-36		SB-05-37		SB-05-38		SB-05-39		SB-05-40		SB-05-41		SB-05-42		SB-05-43	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,1,2,2-Tetrachloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,1,2-Trichloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,1-Dichloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,1-Dichloroethene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,2-Dichloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
1,2-Dichloroethene (Total)	9	U	8	U	10	U	12	UJ	9	U	9	U	12	U	11	U	14	UJ	10	U	10	U	9	U
1,2-Dichloropropane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
2-Butanone	9	U	2	B	5	B	4	B	2	B	2	B	12	U	2	B	27	J	10	U	10	U	9	U
2-Hexanone	9	U	8	U	1	J	12	UJ	9	U	9	U	12	U	11	U	14	UJ	10	U	10	U	1	B
4-Methyl-2-pentanone	9	U	8	U	10	U	12	UJ	1	J	1	J	1	J	11	U	2	J	10	U	10	U	1	B
Acetone	9	B	13	B	51	B	130	B	28	B	27	B	15	B	26	B	180	J	8	B	50	B	13	B
Benzene	5	U	4	U	5	U	2	J	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Bromodichloromethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Bromoform	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Bromomethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Carbon Disulfide	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	5	J	5	U	5	U	5	U
Carbon Tetrachloride	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Chlorobenzene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Chloroethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Chloroform	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Chloromethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
cis-1,3-Dichloropropene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Dibromochloromethane	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Ethylbenzene	5	U	4	U	5	U	2	J	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Methylene Chloride	3	B	3	B	4	B	3	B	4	B	4	B	5	B	4	B	6	B	4	B	7	B	6	B
Styrene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Tetrachloroethene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Toluene	5	U	1	J	5	U	9	J	4	J	3	J	3	J	2	J	6	J	5	U	5	U	5	U
trans-1,3-Dichloropropene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Trichloroethene	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Vinyl Chloride	5	U	4	U	5	U	6	UJ	5	U	5	U	6	U	5	U	7	UJ	5	U	5	U	5	U
Xylene (Total)	14	U	12	U	15	U	34	J	14	U	14	U	17	U	16	U	20	UJ	15	U	16	U	14	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	16	J	4.1	U	3.9	U	3.9	U
4,4'-DDE	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	11	J	4.1	U	3.9	U	3.9	U
4,4'-DDT	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	32		4.1	U	3.9	U	3.9	U
Aldrin	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Alpha-BHC	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Alpha-Chlordane	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	5.7	J	2.1	U	2	U	2	U
Aroclor-1016	37	U	33	UL	39	UL	41	UL	38	UL	37	UL	39	UL	42	UL	40	U	41	U	39	U	39	U
Aroclor-1221	76	U	66	UL	78	UL	83	UL	78	UL	76	UL	80	UL	85	UL	81	U	83	U	79	U	79	U
Aroclor-1232	37	U	33	UL	39	UL	41	UL	38	UL	37	UL	39	UL	42	UL	40	U	41	U	39	U	39	U
Aroclor-1242	37	U	33	UL	39	UL	41	UL	38	UL	37	UL	39	UL	42	UL	40	U	41	U	39	U	39	U
Aroclor-1248	37	U	33	UL	39	UL	41	UL	38	UL	37	UL	39	UL	42	UL	40	U	41	U	39	U	39	U
Aroclor-1254	37	U	33	UL	39	UL	24	L	38	UL	37	UL	39	UL	42	UL	260		41	U	39	U	39	U
Aroclor-1260	37	U	33	UL	39	UL	41	UL	38	UL	37	UL	39	UL	42	UL	40	U	41	U	39	U	39	U
Beta-BHC	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Delta-BHC	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Dieldrin	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	4	U	4.1	U	3.9	U	3.9	U
Endosulfan I	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	UL	2.1	UL	2	U	2	U
Endosulfan II	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	4	U	4.1	U	3.9	U	3.9	U
Endosulfan Sulfate	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	25	J	4.1	U	3.9	U	3.9	U
Endrin	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	4	U	4.1	U	3.9	U	3.9	U
Endrin Aldehyde	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	4	U	4.1	U	3.9	U	3.9	U
Endrin Ketone	3.7	U	3.3	UL	3.9	UL	4.1	UL	3.8	UL	3.7	UL	3.9	UL	4.2	UL	4	U	4.1	U	3.9	U	3.9	U
Gamma-BHC (Lindane)	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Gamma-Chlordane	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	6.8	J	2.1	U	2	U	2	U
Heptachlor	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Heptachlor Epoxide	1.9	U	1.7	UL	2	UL	2.1	UL	2	UL	1.9	UL	2	UL	2.1	UL	2.1	U	2.1	U	2	U	2	U
Methoxychlor	19	U	17	UL	20	UL	70	L	20	UL	19	UL	20	UL	21	UL	21	U	21	U	20	U	20	U
Toxaphene	190	U	170	UL	200	UL	210	UL	200	UL	190	UL	200	UL	210	UL	210	U	210	U	200	U	200	U

Sample ID:	SB-05-44		SB-05-45		SB-05-46		SB-05-47		SB-05-48		SB-05-49		SB-05-50		SB-05-50-D		SB-05-51		SB-05-52		SB-05-53		SB-05-54		SB-05-55	
	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL	RESULT	QUAL
VOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
1,1,1-Trichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
1,1,2,2-Tetrachloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
1,1,2-Trichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
1,1-Dichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
1,1-Dichloroethene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	2	J	5	U	2	J	8	U	6	U
1,2-Dichloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
1,2-Dichloroethene (Total)	9	U	9	U	10	U	10	U	9	U	10	U	9	U	10	U	11	U	10	U	9	U	16	U	13	U
1,2-Dichloropropane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
2-Butanone	9	U	2	B	12	B	10	U	6	J	7	J	2	J	4	J	11	U	11		2	J	16	U	13	U
2-Hexanone	9	U	9	U	10	U	10	U	9	U	10	U	9	U	2	B	11	U	10	U	9	U	16	U	13	U
4-Methyl-2-pentanone	9	U	9	U	10	U	10	U	9	U	10	U	9	U	10	U	11	U	10	U	9	U	16	U	13	U
Acetone	10	B	28	B	77	B	16	B	120	J	94		37	B	52	B	61	B	78	B	36	B	36	B	19	B
Benzene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	3	J	6	U
Bromodichloromethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Bromoform	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Bromomethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Carbon Disulfide	5	U	5	U	5	U	5	U	5	U	3	J	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Carbon Tetrachloride	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Chlorobenzene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Chloroethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Chloroform	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Chloromethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
cis-1,3-Dichloropropene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Dibromochloromethane	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Ethylbenzene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Methylene Chloride	5	B	5	B	2	B	5	B	3	B	8	B	9	B	6	B	2	B	8	B	8	B	8	B	1	B
Styrene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Tetrachloroethene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Toluene	5	U	5	U	5	U	5	U	1	J	5	U	5	U	5	U	5	U	5	U	5	U	2	J	6	U
trans-1,3-Dichloropropene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Trichloroethene	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	8	U	6	U
Vinyl Chloride	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	7	J	6	U
Xylene (Total)	14	U	14	U	15	U	15	U	14	U	15	U	14	U	15	U	16	U	16	U	14	U	13	J	19	U
PESTICIDES/PCBS	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	
4,4'-DDD	3.8	U	3.8	U	9.7		3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	12000		4.1	U
4,4'-DDE	3.8	U	3.8	U	5.6		3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	42	R	4	U	3.9	U	2600	K	26	K
4,4'-DDT	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	13		4	U	3.9	U	6300		6.2	
Aldrin	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Alpha-BHC	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Alpha-Chlordane	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2.3	R	46	U	4.6	J
Aroclor-1016	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	33	U	40	U	39	U	890	U	41	U
Aroclor-1221	78	U	77	U	83	U	78	U	78	U	80	U	79	U	78	U	67	U	81	U	78	U	1800	U	83	U
Aroclor-1232	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	33	U	40	U	39	U	890	U	41	U
Aroclor-1242	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	100	J	40	U	39	U	890	U	41	U
Aroclor-1248	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	33	U	40	U	39	U	890	U	41	U
Aroclor-1254	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	340		40	U	22	J	890	U	190	
Aroclor-1260	38	U	38	U	41	U	39	U	38	U	39	U	39	U	38	U	33	U	40	U	39	U	890	U	41	U
Beta-BHC	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Delta-BHC	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Dieldrin	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	8.8		4	U	3.9	U	89	U	4.1	U
Endosulfan I	2	U	2	U	2.1	U	2	U	2	U	2	UL	2	UL	2	UL	15	R	2	UL	2	UL	46	U	2.1	U
Endosulfan II	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	89	U	4.1	U
Endosulfan Sulfate	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	89	U	5.5	J
Endrin	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	89	U	4.1	U
Endrin Aldehyde	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	89	U	4.1	U
Endrin Ketone	3.8	U	3.8	U	4.1	U	3.9	U	3.8	U	3.9	U	3.9	U	3.8	U	3.3	U	4	U	3.9	U	89	U	4.1	U
Gamma-BHC (Lindane)	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Gamma-Chlordane	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	4.7	J
Heptachlor	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Heptachlor Epoxide	2	U	2	U	2.1	U	2	U	2	U	2	U	2	U	2	U	1.7	U	2	U	2	U	46	U	2.1	U
Methoxychlor	20	U	20	U	21	U	20	U	20	U	20	U	20	U	20	U	17	U	20	U	20	U	460	U	21	U
Toxaphene	200	U	200	U	210	U	200	U	200	U	200	U	200	U	200	U	170	U	200	U	200	U	4600	U	210	U

Data Qualifiers:

B -- Positive result is considered to be an artifact of blank contamination, and should not be considered present.
BJ -- Positive result reported at less than CRQL (estimated value). Laboratory reported same compound in associated blank.
J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
K -- Positive result is considered biased high due to exceedance of technical quality control criteria.
L -- Positive result is considered biased low due to exceedance of technical quality control criteria.
R -- Positive result is considered unusable due to exceedance of technical quality control criteria.
U -- Value is a non-detected result as reported by the laboratory.
UJ -- Non-detected result is considered estimated due to exceedance of technical quality control criteria.
UL -- Non-detected result is considered biased low due to exceedance of technical quality control criteria.
UR -- Non-detected result is considered unusable due to exceedance of technical quality control criteria.
NA -- No result is available/applicable for this parameter in this sample.

Database source file: D:\AASTRSK\FOXDATSUM2\WA05SB.DBF data retrieved on: 06/20/00

Appendix A-3

Surface Water Results

SUMMARY OF ANALYTICAL TESTING
AREA B - SURFACE WATER
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	CR^{+6}	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/PCBs				
B1-SW	X	X	X	X[a]			
B2-SW	X			X[a]			
B4-SW B4-SW-D	X			X[a]			Background for Area B DUP is B5-SW Phase III RI
B9-SW	X	X	X	X			8-SW Phase I RI 8A Phase III RI Background for Area B
B10-SW	X	X	X	X[a]			SW-7 Phase II RI 7B Phase III RI
B11-SW B11-SW-D	X	X	X	X[a]			SW-8 Phase II RI 8B Phase III RI DUP is SW-8-D Phase II RI Background for Area B
B12-SW	X	X	X	X			7-SW Phase I RI 7A Phase III RI

[a] Also TAL metals (filtered).

INORGANIC RESULTS FOR SURFACE WATER SITE B (TOTAL)

UG/L

SAMPLE NUMBER:	~~IA~~ B12		~~IB~~ B10		~~BA~~ B9		~~BB~~ B11		B1-SW		B2-SW		B4-SW	
INORGANICS														
ALUMINUM	1000	U	87.0	B	1000	U	109	B	37.5	B	24.0	B	76.9	B
ANTIMONY	10.0	U	49.0	U	10.0	U	49.0	U	32.0	UL	32.0	UL	32.0	UL
ARSENIC	2.0	U	3.0	U	2.0	U	3.0	U	2.0	U	2.0	U	2.0	U
BARIUM	500	U	92.0		500	U	92.0		80.9		94.2		100	
BERYLLIUM	0.50	U	1.0	U	0.50	U	1.0	U	1.0	U	1.0	U	1.0	U
CADMIUM	2.0	U	3.0	U	2.0	U	4.0	B	3.0	U	3.0	U	3.0	U
CALCIUM	24000	B	22600		22000	B	28000		21800		24300		28100	
CHROMIUM	2.0	B	8.0	B	2.0	U	6.0	B	5.0	U	5.0	U	5.0	U
COBALT	2.0	U	6.0	U	2.0	U	6.0	U	3.0	U	3.0	U	3.0	U
COPPER	25.0	U	9.0	B	25.0	U	9.0	B	2.0	U	2.0	U	2.3	
IRON	430	B	388		100	U	389		31.3	B	325	B	895	
LEAD	2.0	U	3.0	B	2.0	U	3.8	B	1.0	U	1.0	U	1.0	U
MAGNESIUM	9300	B	9030		9700	B	11200		8270		9090		10500	
MANGANESE	100		55.0		100	U	44.0		7.6	B	119		154	
MERCURY	0.20	U	0.20	R	0.20	U	0.20	R	0.12	UL	0.13	UL	0.13	UL
NICKEL	10.0	U	20.0		10.0	U	17.0	U	7.0	UL	7.0	UL	7.0	UL
POTASSIUM	1200	B	1180		1400	B	1550		910		1150		1450	
SELENIUM	2.0	U	5.0	U	2.0	U	5.0	U	2.0	UL	2.0	UL	2.0	UL
SILVER	2.0	U	10.0	U	2.0	U	10.0	U	4.0	UR	4.0	UR	4.0	UR
SODIUM	11000	B	13600		12000	B	16200		9760		12900		14600	
THALLIUM	2.0	U	2.0	UL	2.0	U	2.0	UL	3.0	U	4.9		3.0	U
VANADIUM	10.0	U	5.0	U	10.0	U	5.0	U	1.0	U	1.0	U	1.0	U
ZINC	50.0	B	19.0	B	20.0	U	22.0	B	9.0	L	27.6	L	30.6	L

TABLE 4

07/26/96

NAWC WARMINSTER, WARMINSTER, PENNSYLVANIA

INORGANIC RESULTS FOR SURFACE WATER SITE B (DISSOLVED)

UG/L

DRAFT

SAMPLE NUMBER:	~~7B~~ B10		~~8B~~ B11		B1-SW		B2-SW		B4-SW			
INORGANICS												
ALUMINUM	113	B	74.0	B	14.0	U	14.0	U	31.7	B		
ANTIMONY	49.0	U	49.0	U	32.0	UL	32.0	UL	32.0	L		
ARSENIC	3.0	U	3.0	U	2.0	U	2.0	U	2.0	U		
BARIUM	90.0		83.5		88.3		94.7		85.2			
BERYLLIUM	3.0	B	4.0	B	1.0	U	1.0	U	1.0	U		
CADMIUM	3.0	UJ	3.0	B	3.0	U	3.0	U	3.0	U		
CALCIUM	23000	J	26800	J	26000		24900		25800			
CHROMIUM	6.0	B	8.0	B	5.0	U	5.0	U	5.0	U		
COBALT	6.0	U	6.0	U	3.0	U	3.0	U	3.0	U		
COPPER	4.0	B	5.0	B	14.7	B	24.9	B	3.9	B		
IRON	180	B	119	B	10.8	B	238	B	175	B		
LEAD	1.0	UL	1.0	UL	1.0	U	1.0	U	1.0	U		
MAGNESIUM	8550	J	9850	J	9660		9380		9720			
MANGANESE	49.0		24.0		9.5	B	123		132			
MERCURY	0.20	U	0.20	U	0.13	UL	0.20	L	0.14	UL		
NICKEL	17.0	U	17.0	U	7.0	UL	7.0	UL	7.0	UL		
POTASSIUM	1320	B	1520	B	1150		1200		1350			
SELENIUM	5.0	U	5.0	U	2.0	UL	2.0	UL	2.0	UL		
SILVER	10.0	U	10.0	U	4.0	UR	4.0	UR	4.0	UR		
SODIUM	12100		7680		11200		13400		13700			
THALLIUM	2.0	UL	2.0	UL	3.4		3.0	U	3.3			
VANADIUM	5.0	U	5.0	U	1.0	U	1.0	U	1.0	U		
ZINC	13.0	B	18.0	B	5.8	L	18.8	L	12.5	L		

PESTICIDE/PCB RESULTS FOR SURFACE WATER SITE B

UG/L

SAMPLE NUMBER:	~~7A~~ B12		~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SW			
PESTICIDES												
4,4'-DDD	0.10	UJ	0.10	U	0.10	UJ	0.10	UL	0.10	U		
4,4'-DDE	0.10	UJ	0.10	U	0.10	UJ	0.10	UL	0.10	U		
4,4'-DDT			0.10	U			0.10	UL	0.10	U		
ALDRIN	0.050	U	0.050	U	0.050	U	0.050	UL	0.050	U		
ALPHA-BHC	0.050	U	0.050	U	0.050	U	0.050	UL	0.050	U		
ALPHA-CHLORDANE			0.050	U			0.050	UL	0.050	U		
AROCLOR-1016	0.50	U	1.0	U	0.50	U	1.0	UL	1.0	U		
AROCLOR-1221	0.50	U	2.0	U	0.50	U	2.0	UL	2.0	U		
AROCLOR-1232	0.50	U	1.0	U	0.50	U	1.0	UL	1.0	U		
AROCLOR-1242	0.50	U	1.0	U	0.50	U	1.0	UL	1.0	U		
AROCLOR-1248	0.50	U	1.0	U	0.50	U	1.0	UL	1.0	U		
AROCLOR-1254	1.0	U	1.0	U	1.0	U	1.0	UL	1.0	U		
AROCLOR-1260	1.0	U	1.0	U	1.0	U	1.0	UL	1.0	U		
BETA-BHC	0.050	U	0.050	U	0.050	U	0.050	UL	0.050	U		
DELTA-BHC	0.050	UJ	0.050	U	0.050	UJ	0.050	UL	0.050	U		
DIELDRIN	0.10	U	0.10	U	0.10	U	0.10	UL	0.10	U		
ENDOSULFAN I	0.050	UJ	0.050	U	0.050	UJ	0.050	UL	0.050	U		
ENDOSULFAN II	0.10	U	0.10	U	0.10	U	0.10	UL	0.10	U		
ENDOSULFAN SULFATE	0.10	UJ	0.10	U	0.10	UJ	0.10	UL	0.10	U		
ENDRIN	0.10	U	0.10	U	0.10	U	0.10	UL	0.10	U		
ENDRIN ALDEHYDE			0.10	U			0.10	UL	0.10	U		
ENDRIN KETONE	0.10	U	0.10	U	0.10	U	0.10	UL	0.10	U		
GAMMA-BHC (LINDANE)	0.050	U	0.050	U	0.050	U	0.050	UL	0.050	U		
GAMMA-CHLORDANE			0.050	U			0.050	UL	0.050	U		
HEPTACHLOR	0.050	UJ	0.050	U	0.050	UJ	0.050	UL	0.050	U		
HEPTACHLOR EPOXIDE	0.050	UJ	0.050	U	0.050	UJ	0.050	UL	0.050	U		
METHOXYCHLOR	0.050	UJ	0.50	U	0.050	UJ	0.50	UL	0.50	U		
TOXAPHENE	1.0	U	5.0	U	1.0	U	5.0	UL	5.0	U		

TABLE 4

07/26/96

NAWC WARMINSTER, WARMINSTER, PENNSYLVANIA

SEMIVOLATILE ORGANIC RESULTS FOR SURFACE WATER SITE B

UG/L

DRAFT

SAMPLE NUMBER:	~~7A~~ B12		~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SW		B2-SW	B4-SW
SEMIVOLATILES												
1,2,4-TRICHLOROBENZENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
1,2-DICHLOROBENZENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
1,3-DICHLOROBENZENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U		
1,4-DICHLOROBENZENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2,2'-OXYBIS(1-CHLOROPROPANE)			10.0	U			10.0	U	10.0	U		
2,4,5-TRICHLOROPHENOL	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
2,4,6-TRICHLOROPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2,4-DICHLOROPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2,4-DIMETHYLPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2,4-DINITROPHENOL	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
2,4-DINITROTOLUENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2,6-DINITROTOLUENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2-CHLOROETHYLVINYL ETHER	10.0	U			10.0	U						
2-CHLORONAPHTHALENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2-CHLOROPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2-METHYLPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
2-NITROANILINE	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
2-NITROPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
3,3'-DICHLOROBENZIDINE	20.0	U	10.0	U	20.0	U	10.0	U	10.0	U		
3-NITROANILINE	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
4,6-DINITRO-2-METHYLPHENOL	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
4-BROMOPHENYL PHENYL ETHER	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
4-CHLORO-3-METHYLPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
4-CHLOROANILINE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
4-CHLOROPHENYL PHENYL ETHER	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
4-METHYLPHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
4-NITROANILINE	50.0	U	25.0	UJ	50.0	U	25.0	UJ	25.0	U		
4-NITROPHENOL	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
ACENAPHTHENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
ACENAPHTHYLENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
ANTHRACENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BENZ(A)ANTHRACENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BENZIDINE	80.0	U			80.0	U						
BENZO(A)PYRENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BENZO(B)FLUORANTHENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		

SEMIVOLATILE ORGANIC RESULTS FOR SURFACE WATER SITE B

UG/L

SAMPLE NUMBER:	~~7A~~ B12		~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SW		B2-SW	B4-SW
SEMIVOLATILES												
BENZO(G,H,I)PERYLENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BENZO(K)FLUORANTHENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BENZOIC ACID	50.0	U			50.0	U						
BENZYL ALCOHOL	10.0	U			10.0	U						
BIS(2-CHLOROETHOXY)METHANE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BIS(2-CHLOROETHYL)ETHER	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
BIS(2-ETHYLHEXYL)PHTHALATE	0.30	B	1.0	J	0.30	B	10.0	U	10.0	U		
BUTYLBENZYLPHTHALATE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
CARBAZOLE			10.0	U			10.0	U	10.0	U		
CHRYSENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
DI-N-BUTYLPHTHALATE	0.30	B	10.0	U	0.70	B	10.0	U	10.0	U		
DI-N-OCTYLPHTHALATE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
DIBENZ(A,H)ANTHRACENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
DIBENZOFURAN	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
DIETHYLPHTHALATE	10.0	U	10.0	U	0.20	J	10.0	U	10.0	U		
DIMETHYLPHTHALATE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
FLUORANTHENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
FLUORENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
HEXACHLOROBENZENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
HEXACHLOROBUTADIENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
HEXACHLOROCYCLOPENTADIENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
HEXACHLOROETHANE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
INDENO(1,2,3-CD)PYRENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
ISOPHORONE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
N-NITROSO-DI-N-PROPYLAMINE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
N-NITROSODIMETHYLAMINE	10.0	U			10.0	U						
N-NITROSODIPHENYLAMINE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
NAPHTHALENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
NITROBENZENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
PENTACHLOROPHENOL	50.0	U	25.0	U	50.0	U	25.0	U	25.0	U		
PHENANTHRENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
PHENOL	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		
PYRENE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U		

TABLE 4

07/26/96

NAWC WARMINSTER, WARMINSTER, PENNSYLVANIA

VOLATILE ORGANIC RESULTS FOR SURFACE WATER SITE B

UG/L

DRAFT

SAMPLE NUMBER:	~~7A~~ B12		~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SW		B2-SW		B4-SW	
VOLATILES														
1,1,1-TRICHLOROETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,1,2,2-TETRACHLOROETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,1,2-TRICHLOROETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,1-DICHLOROETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,1-DICHLOROETHENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,2-DICHLOROETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,2-DICHLOROETHENE (TOTAL)	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
1,2-DICHLOROPROPANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
2-BUTANONE			10.0	U			10.0	U	10.0	U	10.0	U	10.0	U
2-HEXANONE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
4-METHYL-2-PENTANONE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
ACETONE	4.0	B	10.0	U	10.0	UJ	10.0	U	10.0	B	10.0	B	24.0	B
BENZENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
BROMOFORM	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
BROMOMETHANE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
CARBON DISULFIDE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	2.0	J
CARBON TETRACHLORIDE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
CHLOROBENZENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
CHLOROETHANE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
CHLOROFORM	5.0	U	10.0	U	12.0		10.0	U	10.0	U	10.0	U	10.0	U
CHLOROMETHANE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
CIS-1,3-DICHLOROPROPENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
DIBROMOCHLOROMETHANE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
ETHYLBENZENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
METHYLENE CHLORIDE	5.0	B	4.0	B	5.0	B	10.0	U	2.0	B	3.0	B	2.0	B
STYRENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
TETRACHLOROETHENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
TOLUENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
TRANS-1,3-DICHLOROPROPENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
TRICHLOROETHENE	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U
TRICHLOROFLUOROMETHANE	5.0	U			5.0	U								
VINYL ACETATE	10.0	U			10.0	U								
VINYL CHLORIDE	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
XYLENE (TOTAL)	5.0	U	10.0	U	5.0	U	10.0	U	10.0	U	10.0	U	10.0	U

Appendix A-4

Sediment Results

SUMMARY OF ANALYTICAL TESTING
AREA B - SEDIMENT
NAWC, WARMINSTER

SAMPLE NO.	TCL			TAL METALS/ CYANIDE	DIOXIN	CR^{+6}	COMMENTS
	VOLATILE ORGANICS	SEMIVOLATILE ORGANICS	PESTICIDES/ PCBs				
B1-SD	X	X	X	X			
B2-SD	X			X			
B3-SD	X			X			
B4-SD B4-SD-D	X			X			DUP is B5-SD Phase III RI Background for Area B
B6-SD			X				[a]
B7-SD			X				[a]
B8-SD			X				[a]
B9-SD	X	X	X	X			8-SED Phase I RI 8A Phase III RI Background for Area B Stream
B10-SD	X	X	X	X			SD-7 Phase II RI 7B Phase III RI
B11-SD B11-SD-D	X	X	X	X			SD-8 Phase II RI 8B Phase III RI DUP is B12-SD Phase III RI Background for Area B Stream

[a] Includes TOC and grain size results

INORGANIC RESULTS FOR SEDIMENT SITE B

MG/KG

SAMPLE NUMBER:	~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SD		B2-SD		B3-SD		B4/B5-SD	
INORGANICS														
ALUMINUM	4870		500		4410		4770		4780		8090		5810	
ANTIMONY	16.2	U	1.0	U	12.2	U	7.4	UL	5.6	UL	17.0	UL	7.4	UL
ARSENIC	3.4		0.31		1.9		3.3		3.5		3.6		3.7	
BARIUM	62.1		50.0	U	43.9		45.6		68.5		64.0		53.8	
BERYLLIUM	0.68		0.15	B	0.61		0.63		0.86		0.88		0.70	
CADMIUM	3.0	B	0.20	U	1.5	B	1.3	K	1.7	R	1.9	K	1.4	K
CALCIUM	3490		125	B	2240		2390	J	2670	J	1270	J	8300	J
CHROMIUM	16.5		1.2		16.6		18.3		9.3	L	13.8		13.8	
COBALT	6.9		0.30		5.3		5.4		7.6		6.0	B	7.2	L
COPPER	26.1		3.0	B	18.4		59.5	K	41.3	K	20.6	K	17.5	K
IRON	13600		900		13300		10900		21300		11800		15800	
LEAD	38.7	K	3.4		15.6		45.4	J	168	J	66.1	J	27.8	J
MAGNESIUM	2410		92.0	B	2450		2640	J	2580	J	1750	J	5170	J
MANGANESE	204	K	10.0	U	225		141	K	628	K	135	K	284	K
MERCURY	0.16	U	0.070	U	0.11	U	0.050	UL	0.050	UL	0.13	UL	0.060	UL
NICKEL	15.9		1.0	U	14.2		8.6	L	16.8		10.1	L	12.9	L
POTASSIUM	592		50.0	U	710		645		767		397		1330	
SELENIUM	1.8	U	0.20	U	1.3	U	0.46	UL	0.35	UL	1.1	UL	0.46	UL
SILVER	3.3	U	0.20	U	2.5	U	0.92	UR	0.71	K	2.1	UR	0.92	UR
SODIUM	167	B	50.0	U	97.8	B	106	B	102	B	163	B	483	
THALLIUM	0.71	U	0.20	U	0.49	U	1.0		0.52	U	1.6	U	0.69	U
VANADIUM	21.5		1.4	K	17.6		18.1	L	13.6		22.7	L	25.4	L
ZINC	262		26.0		129		116	J	486	J	111	J	113	J

TABLE 3

07/26/96

NAWC WARMINSTER, WARMINSTER, PENNSYLVANIA

DRAFT

VOLATILE ORGANIC RESULTS FOR SEDIMENT SITE B

UG/KG

SAMPLE NUMBER:	~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SD		B2-SD		B3-SD		B4/B5-SD	
VOLATILES														
1,1,1-TRICHLOROETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,1,2,2-TETRACHLOROETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,1,2-TRICHLOROETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,1-DICHLOROETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,1-DICHLOROETHENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,2-DICHLOROETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,2-DICHLOROETHENE (TOTAL)	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
1,2-DICHLOROPROPANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
2-BUTANONE	16.0	U			12.5	U	9.0	B	15.0	U	25.0	U	12.5	U
2-HEXANONE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
4-METHYL-2-PENTANONE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
ACETONE	19.0	B	670	J	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
BENZENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
BROMOFORM	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
BROMOMETHANE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CARBON DISULFIDE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CARBON TETRACHLORIDE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CHLOROBENZENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CHLOROETHANE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CHLOROFORM	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CHLOROMETHANE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
CIS-1,3-DICHLOROPROPENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
DIBROMOCHLOROMETHANE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
ETHYLBENZENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
METHYLENE CHLORIDE	16.0	U	16.0	B	12.5	U	5.0	B	3.0	B	9.0	B	4.0	B
STYRENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
TETRACHLOROETHENE	16.0	U	25.0	U	12.5	U	15.0	UJ	15.0	UJ	25.0	UJ	12.5	UJ
TOLUENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
TRANS-1,3-DICHLOROPROPENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
TRICHLOROETHENE	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
TRICHLOROFLUOROMETHANE			25.0	U										
VINYL ACETATE			50.0	U										
VINYL CHLORIDE	16.0	U	50.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U
XYLENE (TOTAL)	16.0	U	25.0	U	12.5	U	15.0	U	15.0	U	25.0	U	12.5	U

UG/KG

SAMPLE NUMBER:	~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SD		B2-SD	B3-SD	B4/B5-SD
SEMIVOLATILES											
1,2,4-TRICHLOROBENZENE	3600	U	5000	UJ	420	U	450	U			
1,2-DICHLOROBENZENE	3600	U	5000	UJ	420	U	450	U			
1,3-DICHLOROBENZENE	3600	U	25.0	U	420	U	450	U			
1,4-DICHLOROBENZENE	3600	U	5000	UJ	420	U	450	U			
2,2'-OXYBIS(1-CHLOROPROPANE)	3600	U			420	U	450	U			
2,4,5-TRICHLOROPHENOL	8800	U	25000	U	1000	U	1100	U			
2,4,6-TRICHLOROPHENOL	3600	U	5000	U	420	U	450	U			
2,4-DICHLOROPHENOL	3600	U	5000	UJ	420	U	450	U			
2,4-DIMETHYLPHENOL	3600	U	5000	UJ	420	U	450	U			
2,4-DINITROPHENOL	8800	U	25000	U	1000	U	1100	U			
2,4-DINITROTOLUENE	3600	U	5000	U	420	U	450	U			
2,6-DINITROTOLUENE	3600	U	5000	U	420	U	450	U			
2-CHLOROETHYLVINYL ETHER			50.0	U							
2-CHLORONAPHTHALENE	3600	U	5000	U	420	U	450	U			
2-CHLOROPHENOL	3600	U	5000	UJ	420	U	450	U			
2-METHYLPHENOL	3600	U	5000	UJ	420	U	450	U			
2-NITROANILINE	3600	U	25000	U	1000	U	1100	U			
2-NITROPHENOL	3600	U	5000	UJ	420	U	450	U			
3,3'-DICHLOROBENZIDINE	3600	U	5000	U	420	U	450	UJ			
3-NITROANILINE	8800	U	25000	U	1000	U	1100	U			
4,6-DINITRO-2-METHYLPHENOL	8800	U	25000	U	1000	U	1100	U			
4-BROMOPHENYL PHENYL ETHER	3600	U	5000	U	420	U	450	U			
4-CHLORO-3-METHYLPHENOL	3600	U	5000	UJ	420	U	450	U			
4-CHLOROANILINE	3600	U	5000	UJ	420	U	450	U			
4-CHLOROPHENYL PHENYL ETHER	3600	U	5000	U	420	U	450	U			
4-METHYLPHENOL	560	J	5000	UJ	420	U	450	U			
4-NITROANILINE	8800	U	25000	U	1000	U	1100	UJ			
4-NITROPHENOL	8800	U	25000	U	1000	U	1100	U			
ACENAPHTHENE	470	J	110	J	100	J	450	U			
ACENAPHTHYLENE	3600	U	5000	U	420	U	450	U			
ANTHRACENE	1400	J	330	J	253	J	200	J			
BENZ(A)ANTHRACENE	5200		1300	J	580	J	530				
BENZIDINE			40000	U							
BENZO(A)PYRENE	4400		880	J	490	J	450				
BENZO(B)FLUORANTHENE	7100		1300	J	830	J	690				

TABLE 3

07/26/96

NAWC WARMINSTER, WARMINSTER, PENNSYLVANIA

SEMIVOLATILE ORGANIC RESULTS FOR SEDIMENT SITE B

UG/KG

DRAFT

SAMPLE NUMBER:	~~7B~~ B10		~~8A~~ B9		~~9B~~ B11		B1-SD		B2-SD	B3-SD	B4/B5-SD
SEMIVOLATILES											
BENZO(G,H,I)PERYLENE	2000	J	720	J	268	J	390	J			
BENZO(K)FLUORANTHENE	2100	J	1000	J	363		250				
BENZOIC ACID			25000	UJ							
BENZYL ALCOHOL			5000	UJ							
BIS(2-CHLOROETHOXY)METHANE	3600	U	5000	UJ	420	U	450	U			
BIS(2-CHLOROETHYL)ETHER	3600	U	5000	UJ	420	U	450	U			
BIS(2-ETHYLHEXYL)PHTHALATE	18000		1900	J	91.5	J	580				
BUTYLBENZYLPHTHALATE	3600	U	5000	U	420	U	120	J			
CARBAZOLE	1100	J			288	J	120	J			
CHRYSENE	5600		1500	J	588	J	550				
DI-N-BUTYLPHTHALATE	5100		290	B	420	U	450	U			
DI-N-OCTYLPHTHALATE	3600	U	5000	U	420	U	79.0	J			
DIBENZ(A,H)ANTHRACENE	3600	U	5000	U	96.0	J	55.0	J			
DIBENZOFURAN	3600	U	5000	U	98.0	J	450	U			
DIETHYLPHTHALATE	3600	U	5000	U	420	U	450	U			
DIMETHYLPHTHALATE	3600	U	5000	U	420	U	450	U			
FLUORANTHENE	17000	J	3400	J	1630	J	1200				
FLUORENE	600	J	190	J	160	J	65.0	J			
HEXACHLOROBENZENE	3600	U	5000	U	420	U	450	U			
HEXACHLOROBUTADIENE	3600	U	5000	UJ	420	U	450	U			
HEXACHLOROCYCLOPENTADIENE	3600	U	5000	U	420	U	450	U			
HEXACHLOROETHANE	3600	U	5000	UJ	420	U	450	U			
INDENO(1,2,3-CD)PYRENE	2400	J	600	J	313	J	320	J			
ISOPHORONE	3600	U	5000	UJ	420	U	450	U			
N-NITROSO-DI-N-PROPYLAMINE	3600	U	5000	UJ	420	U	450	U			
N-NITROSODIMETHYLAMINE			5000	UJ							
N-NITROSODIPHENYLAMINE	1700	J	5000	U	420	U	450	U			
NAPHTHALENE	3600	U	5000	UJ	420	U	450	U			
NITROBENZENE	3600	U	5000	UJ	420	U	450	U			
PENTACHLOROPHENOL	8800	U	25000	U	1000	U	1100	U			
PHENANTHRENE	8000		2000	J	1300	J	740				
PHENOL	3600	U	5000	UJ	420	U	450	U			
PYRENE	9900	J	2900	J	1380	J	1200				

UG/KG

SAMPLE NUMBER:	~~7B~~ B10		~~8A~~ B9		~~8B~~ B11		B1-SD		B6-SD		B7-SD		B8-SD	
PESTICIDES														
4,4'-DDD	12.0	UL	24.0	UJ	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
4,4'-DDE	24.0	J	24.0	UJ	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	9.0	J
4,4'-DDT	430	J			4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ALDRIN	6.2	UL	12.0	U	2.2	UL	2.3	U	3.6	J	4.0	J	4.7	J
ALPHA-BHC	6.2	UL	12.0	U	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
ALPHA-CHLORDANE	15.0	J			5.9	J	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
AROCLOR-1016	120	UL	120	U	42.5	UL	45.0	U	78.0	UJ	78.0	UJ	58.0	UJ
AROCLOR-1221	240	UL	120	U	86.0	UL	91.0	U	160	UJ	160	UJ	120	UJ
AROCLOR-1232	120	UL	120	U	42.5	UL	45.0	U	78.0	UJ	78.0	UJ	58.0	UJ
AROCLOR-1242	120	UL	120	U	42.5	UL	45.0	U	78.0	UJ	78.0	UJ	58.0	UJ
AROCLOR-1248	120	UL	120	U	42.5	UL	45.0	U	78.0	UJ	78.0	UJ	58.0	UJ
AROCLOR-1254	120	UL	240	U	42.5	UL	45.0	U	78.0	UJ	78.0	UJ	58.0	UJ
AROCLOR-1260	120	UL	240	U	42.5	UL	1900		270	J	380	J	580	J
BETA-BHC	6.2	UL	12.0	U	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
DELTA-BHC	6.2	UL	12.0	UJ	2.2	UL	2.3	U	4.0	J	4.0	UJ	3.0	UJ
DIELDRIN	13.0	J	24.0	U	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ENDOSULFAN I	6.2	UL	12.0	U	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
ENDOSULFAN II	12.0	UL	24.0	U	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ENDOSULFAN SULFATE	12.0	UL	24.0	UJ	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ENDRIN	12.0	UL	24.0	U	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ENDRIN ALDEHYDE	12.0	UL			4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
ENDRIN KETONE	12.0	UL	24.0	U	4.3	UL	4.5	U	7.8	UJ	7.8	UJ	5.8	UJ
GAMMA-BHC (LINDANE)	6.2	UL	12.0	U	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
GAMMA-CHLORDANE	6.2	UL			2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
HEPTACHLOR	6.2	UL	12.0	UJ	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
HEPTACHLOR EPOXIDE	6.2	UL	12.0	UJ	2.2	UL	2.3	U	4.0	UJ	4.0	UJ	3.0	UJ
METHOXYCHLOR	79.0	J	120	UJ	21.5	UL	23.0	U	40.0	UJ	40.0	UJ	30.0	UJ
TOXAPHENE	620	UL	240	U	215	UL	230	U	400	UJ	400	UJ	300	UJ

Appendix A-5

Miscellaneous Parameters

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933
LABORATORY: CEIMIC

BTEX Analyses (ug/Kg)

				SB-05-03		SB-05-14		SB-05-22
Client ID:		W-SB-04		W-SB-05		W-SB-06		W-SB-07
LAB ID:		920317-04		920317-05		920317-06		920317-07
ANALYTE	RL							
Benzene	1	1	U	1	U	1	U	1 U
Ethylbenzene	1	1	U	1	U	1	U	1 U
Toluene	1	1	U	1	U	3		1 U
Xylenes(total)	1	1	U	1	U	1	U	1 U
Dilution Factor:		1.0		1.0		1.0		1.0

SITE: WARMINSTER NAVAL BASE
CASE NO. 3933, SDG 1
LABORATORY: CEIMIC

TPH Analyses (mg/Kg)

		SB-05-03	SB-05-04	SB-05-22		
Client ID:	W-SB-04	W-SB-05	W-SB-06	W-SB-07	W-SB-08	W-SB-09
LAB ID:	920317-04	920317-05	920317-06	920317-07	920317-08	920317-09
ANALYTE						
TPH	63	34 U	430	35 U	63	1800
Dilution Factor:	1.0	1.0	1.0	1.0	1.0	1.0

C[illegible] 9 - NAWC WARMINSTER
SU[illegible] DATA
ARDL, INC.

SAMPLE NUMBER:	W-SD-B06			W-SD-B07			W-SD-B08					
SAMPLE DATE:	05/17/96			05/17/96			05/17/96			/ /		/ /
LABORATORY ID:	300243-01			300243-02			300243-03					
QC_TYPE:	Normal			Normal			Normal					
% SOLIDS:	38.9 %			60.8 %			48.9 %			100.0 %		100.0 %
	RESULT	QUAL	UNITS	RESULT	QUAL	UNITS	RESULT	QUAL	UNITS	RESULT	QUAL	UNITS	RESULT	QUAL	UNITS
GENERAL CHEMISTRY															
SPECIFIC GRAVITY	2.5		G/CC	2.5		G/CC	2.6		G/CC						
TOTAL ORGANIC CARBON	52100		MG/KG	12800		MG/KG	27000		MG/KG						
TOTAL SOLIDS	38.9		%	60.8		%	48.9		%						

CTO 159 - NAWC WARMINSTER
SOIL DATA
ARDL, INC.

SAMPLE NUMBER:	W-SD-A25		W-SD-A26		W-SD-A27					
SAMPLE DATE:	05/08/96		05/08/96		05/08/96		/ /		/ /	
LABORATORY ID:	300228-10		300228-11		300228-12					
QC_TYPE:	Normal		Normal		Normal					
% SOLIDS:	29.8 %		27.6 %		80.5 %		100.0 %		100.0 %	
	RESULT	QUAL UNITS	RESULT	QUAL UNITS	RESULT	QUAL UNITS	RESULT	QUAL UNITS	RESULT	QUAL UNITS
GENERAL CHEMISTRY										
SPECIFIC GRAVITY	2.79	G/CC	2.47	G/CC	2.41	G/CC				
TOTAL ORGANIC CARBON	55500	MG/KG	82600	MG/KG	18700	MG/KG				
TOTAL SOLIDS	29.8	%	27.6	%	80.5	%				

ARDL SAMPLE # 300243-1

GRAIN SIZE ANALYSIS - ASTM METHOD D422

PRELIMINARY SIEVE ANALYSIS

Sample Amount Sieved with a # 10 sieve (g)	119.63
Amt retained on # 10 (g)	2.62
Percent retained on #10	2.19%
Amt passing # 10 sieve (g)	117.01
Percent passing #10	97.81%
Amt Retained on # 4 sieve	0
Percent retained on #4	0.00%

HYGROSCOPIC MOISTURE

Tare Wt. (g)	1
Tare + Wet Wt. (g)	17.1
Tare + Dry Wt. (g)	16.83
Hygroscopic Moisture Correction Factor =	0.983

SPECIFIC GRAVITY

Sample Wt (Mo) (g)	15
Vol. Flask Tare (Mf) (g)	98.0336
Flask + H2O (Ma) (g)	197.8065
temp (C)	22.5
Flask + Sample + H2O (Mb)	206.7308
Temp (Tb) (C)	23.5
G at Tb	2.4669
Correction factor for Tb from D854 Table 1	0.9992
G at 20 C	2.4669

HYDROMETER ANALYSIS

SAMPLE SD-B06

Air Dry Sample Wt. Dispersed (g)	50
Oven Dry Sample Wt Dispersed (g)	49.15
Total Sample Represented by Hydrometer Aliquot (g):	50.25

Factor a ASTM D422 Table 1 = 1.05

Manual Entry of Factor K ASTM D422 Table 3 = 0.01421

Hydrometer Readings at Temp T

Target Elapsed Time	Actual Elapsed Time	Actual Hydrometer Reading	Corrected Hydrometer Reading	Temp (C)	Percentage of Soil in Suspension	Diameter of Particles in Suspension (mm)
2 min	2	27	22.5	22.2	47.0%	0.0347
5 min	5	19.5	15	22.2	31.3%	0.0231
15 min	15	13.5	9	22.2	18.8%	0.0138
30 min	30	12	7.5	22.2	15.7%	0.0098
60 min	60	10	5.5	22.3	11.5%	0.0070
250 min	250	8	3.5	22.3	7.3%	0.0035
1440 min	1440	7	2.5	20.1	5.2%	0.0015

Ave temp (C) = 21.9

SIEVE ANALYSIS

Sieve Mesh #	Wt. (g) Retained
# 4	0.00
# 10	1.10
# 20	1.69
# 40	1.29
# 60	1.54
# 140	5.16
# 200	2.47

Sieve Mesh #	Sieve Diameter (mm)	Percent Passing
4	4.750	100.0%
10	2.000	97.8%
20	0.850	94.4%
40	0.425	91.9%
60	0.250	88.8%
140	0.106	78.5%
200	0.075	73.6%

A-25-24

[ ] = Requires manual entry of data.

Revision Date: 5 June, 1996

ARDL SAMPLE # 300243-1DUP

GRAIN SIZE ANALYSIS - ASTM METHOD D422

PRELIMINARY SIEVE ANALYSIS

Sample Amount Sieved with a # 10 sieve (g)	100.14
Amt retained on # 10 (g)	1.23
Percent retained on #10	1.23%
Amt passing # 10 sieve (g)	98.91
Percent passing #10	98.77%
Amt Retained on # 4 sieve	0
Percent retained on #4	0.00%

HYGROSCOPIC MOISTURE

Tare Wt. (g)	1.01
Tare + Wet Wt. (g)	17.05
Tare + Dry Wt. (g)	16.75
Hygroscopic Moisture Correction Factor =	0.981

SPECIFIC GRAVITY

Sample Wt (Mo) (g)	15
Vol. Flask Tare (Mf) (g)	63.061
Flask + H2O (Ma) (g)	162.6563
temp (C)	22.4
Flask + Sample + H2O (Mb)	171.552
Temp (Tb) (C)	23.5
G at Tb	2.4573
Correction factor for Tb from D854 Table 1	0.9992
G at 20 C	2.4553

HYDROMETER ANALYSIS

SAMPLE SD - B06 (DUP)

Air Dry Sample Wt. Dispersed (g)	50
Oven Dry Sample Wt Dispersed (g)	49.05
Total Sample Represented by Hydrometer Aliquot (g):	49.66

Factor a ASTM D422 Table 1 = 1.05

Manual Entry of Factor K ASTM D422 Table 3 = 0.01421

Hydrometer Readings at Temp T

Target Elapsed Time	Actual Elapsed Time	Actual Hydrometer Reading	Corrected Hydrometer Reading	Temp (C)	Percentage of Soil in Suspension	Diameter of Particles in Suspension (mm)
2 min	2	27.5	23	22.2	48.6%	0.0347
5 min	5	19.5	15	22.2	31.7%	0.0231
15 min	15	13.5	9	22.3	19.0%	0.0138
30 min	30	12	7.5	22.3	15.9%	0.0098
60 min	60	9.5	5	22.3	10.6%	0.0071
250 min	250	8	3.5	22.3	7.4%	0.0035
1440 min	1440	7	2.5	20.1	5.3%	0.0015
			Ave temp (C) =	22.0		

SIEVE ANALYSIS

Sieve Mesh #	Wt. (g) Retained
# 4	0.00
# 10	0.61
# 20	2.15
# 40	1.65
# 60	1.8
# 140	4.39
# 200	1.72

Sieve Mesh #	Sieve Diameter (mm)	Percent Passing
4	4.750	100.0%
10	2.000	98.8%
20	0.850	94.4%
40	0.425	91.1%
60	0.250	87.5%
140	0.106	78.7%
200	0.075	75.2%

A-25-25

[ ] = Requires manual entry of data.

Revision Date: 5 June, 1996

ARDL SAMPLE # 300243-2

GRAIN SIZE ANALYSIS - ASTM METHOD D422

PRELIMINARY SIEVE ANALYSIS

Sample Amount Sieved with a # 10 sieve (g)	159.05
Amt retained on # 10 (g)	18.35
Percent retained on #10	11.54%
Amt passing # 10 sieve (g)	140.73
Percent passing #10	88.46%
Amt Retained on # 4 sieve	4.93
Percent retained on #4	3.10%

HYGROSCOPIC MOISTURE

Tare Wt. (g)	1
Tare + Wet Wt. (g)	17.04
Tare + Dry Wt. (g)	16.77
Hygroscopic Moisture Correction Factor =	0.983

SPECIFIC GRAVITY

Sample Wt (Mo) (g)	15
Vol. Flask Tare (Mf) (g)	60.7009
Flask + H2O (Ma) (g)	160.3509
temp (C)	22.4
Flask + Sample + H2O (Mb)	169.4534
Temp (Tb) (C)	23.4
G at Tb	2.5435
Correction factor for Tb from D854 Table 1	0.9992
G at 20 C	2.5414

HYDROMETER ANALYSIS

SAMPLE SD-B07

Air Dry Sample Wt. Dispersed (g)	50
Oven Dry Sample Wt Dispersed (g)	49.15
Total Sample Represented by Hydrometer Aliquot (g):	55.55

Factor a ASTM D422 Table 1 = 1.03

Manual Entry of Factor K ASTM D422 Table 3 = 0.01374

Hydrometer Readings at Temp T

Target Elapsed Time	Actual Elapsed Time	Actual Hydrometer Reading	Corrected Hydrometer Reading	Temp (C)	Percentage of Soil in Suspension	Diameter of Particles in Suspension (mm)
2 min	2	32	27.5	22.5	51.0%	0.0324
5 min	5	23	18.5	22.5	34.3%	0.0217
15 min	15	18	13.5	22.5	25.0%	0.0129
30 min	30	14.5	10	22.5	18.5%	0.0094
60 min	60	12.5	8	22.6	14.8%	0.0067
250 min	250	11	6.5	22.6	12.1%	0.0033
1440 min	1440	9	4.5	20.2	8.3%	0.0014
			Ave temp (C) =	22.2		

SIEVE ANALYSIS

Sieve Mesh #	Wt. (g) Retained
# 4	1.72
# 10	6.41
# 20	0.84
# 40	1.49
# 60	2.16
# 140	3.34
# 200	0.94

Sieve Mesh #	Sieve Diameter (mm)	Percent Passing
4	4.750	96.9%
10	2.000	88.5%
20	0.850	87.0%
40	0.425	84.3%
60	0.250	80.4%
140	0.106	74.4%
200	0.075	72.7%

A-25-26

[ ] = Requires manual entry of data.

Revision Date: 5 June, 1996

ARDL SAMPLE # 300243-3

GRAIN SIZE ANALYSIS - ASTM METHOD D422

PRELIMINARY SIEVE ANALYSIS

Sample Amount Sieved with a # 10 sieve (g)	185.72
Amt retained on # 10 (g)	45.26
Percent retained on #10	24.37%
Amt passing # 10 sieve (g)	140.46
Percent passing #10	75.63%
Amt Retained on # 4 sieve	18.4
Percent retained on #4	9.91%

HYGROSCOPIC MOISTURE

Tare Wt. (g)	1.01
Tare + Wet Wt. (g)	17.05
Tare + Dry Wt. (g)	16.9
Hygroscopic Moisture Correction Factor =	0.991

SPECIFIC GRAVITY

Sample Wt (Mo) (g)	15
Vol. Flask Tare (Mf) (g)	68.6847
Flask + H2O (Ma) (g)	168.3734
temp (C)	22.4
Flask + Sample + H2O (Mb)	177.5431
Temp (Tb) (C)	23.5
G at Tb	2.5728
Correction factor for Tb from D854 Table 1	0.9992
G at 20 C	2.5707

HYDROMETER ANALYSIS

SAMPLE SD-B08

Air Dry Sample Wt. Dispersed (g)	100
Oven Dry Sample Wt Dispersed (g)	99.10
Total Sample Represented by Hydrometer Aliquot (g):	131.03

Factor a ASTM D422 Table 1 = 1.02

Manual Entry of Factor K ASTM D422 Table 3 = 0.01374

Hydrometer Readings at Temp T

Target Elapsed Time	Actual Elapsed Time	Actual Hydrometer Reading	Corrected Hydrometer Reading	Temp (C)	Percentage of Soil in Suspension	Diameter of Particles in Suspension (mm)
2 min	2	26	21.5	22.4	16.7%	0.0337
5 min	5	21	16.5	22.4	12.8%	0.0221
15 min	15	15	10.5	22.4	8.2%	0.0132
30 min	30	13	8.5	22.4	6.6%	0.0095
60 min	60	12	7.5	22.4	5.8%	0.0067
250 min	250	10.5	6	22.4	4.7%	0.0033
1440 min	1440	10	5.5	20.4	4.3%	0.0014
			Ave temp (C) =	22.1		

SIEVE ANALYSIS

Sieve Mesh #	Wt. (g) Retained
# 4	12.98
# 10	31.93
# 20	24.57
# 40	22.64
# 60	10.8
# 140	10.47
# 200	3.2

Sieve Mesh #	Sieve Diameter (mm)	Percent Passing
4	4.750	90.1%
10	2.000	75.6%
20	0.850	56.9%
40	0.425	39.6%
60	0.250	31.4%
140	0.106	23.4%
200	0.075	20.9%

= Requires manual entry of data.

Revision Date: 5 June, 1996

APPENDIX B

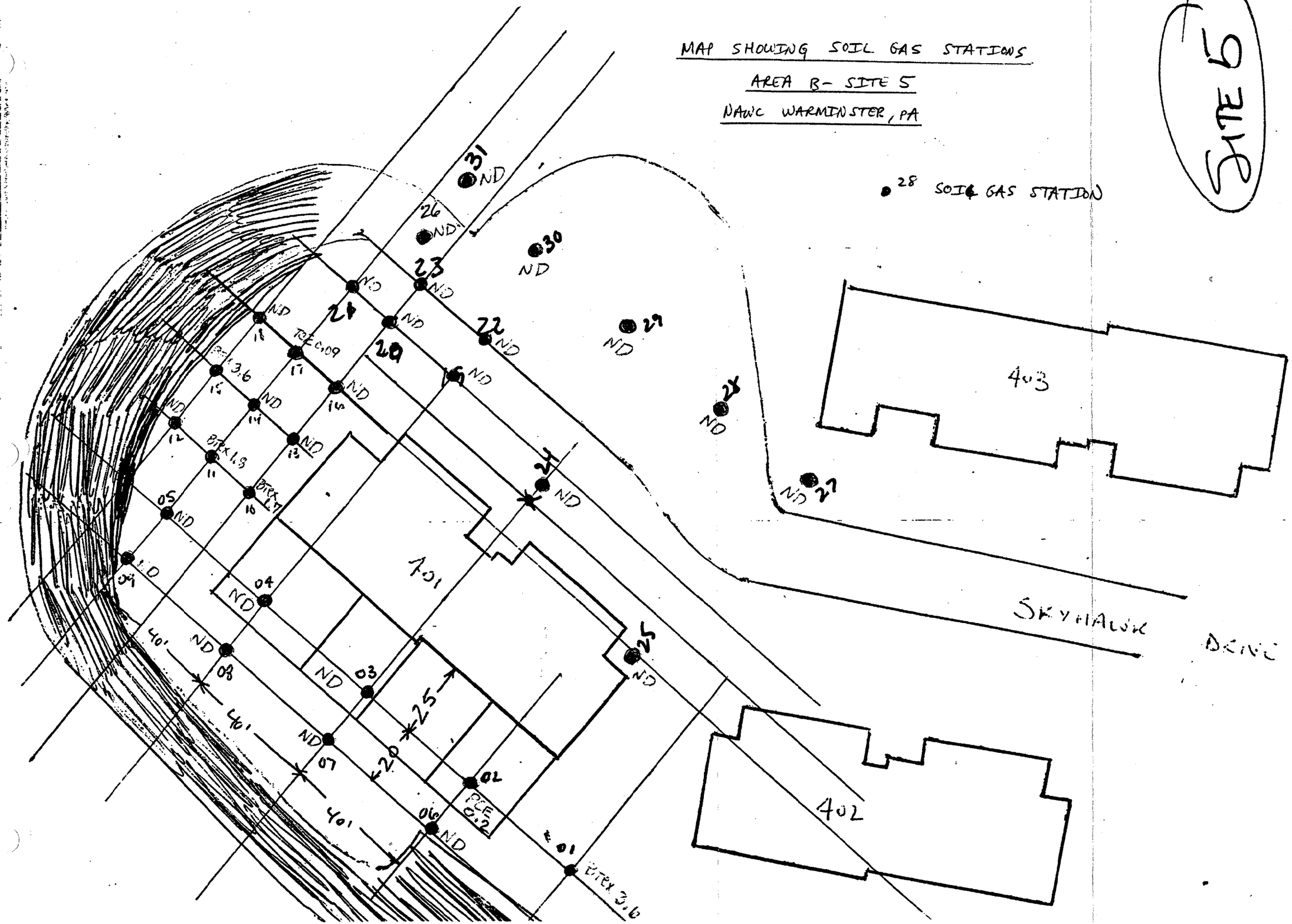
SOIL GAS SURVEY RESULTS

MAP SHOWING SOIL GAS STATIONS

AREA B- SITE 5

NAWC WARMINSTER, PA

SITE 5



C-2 Area B Soil Gas Survey Results - Phase III RI

WARMINSTER SOIL GAS AREA B -- SITE 5

	SAMPLE ID:	5-01-05		5-01-05-DUP		5-02-05		5-03-04		5-03-04-DUP		5-04-05		5-05-05		5-06-05		5-07-04		5-08-05		5-09-04		5-09-04-DUP	
	PID Data File ID:	C609H011		C609H012		C609H013		C609H017		C609H016		C609H014		C609H023		C609H020		C609H015		C609H021		C609H022		C609H031	
	ECD Data File ID:	D609H011		D609H012		D609H013		D609H017		D609H016		D609H014		D609H023		D609H020		D609H015		D609H021		D609H022		D609H031	
	Factor to Multiply PQL by:	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0	
		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.	
PQL	COMPOUND	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
50	acetone	51	B	59	B		U	54	B	46	B	39	B	34	B	46	B	55	B	38	B		U	63	B
2.0	1,1-dichloroethene		U		U		U		U		U		U		U		U		U		U		U		U
5.0	trans-1,2-dichloroethene		U		U		U		U		U		U		U		U		U		U		U		U
15	1,1-dichloroethane		U		U		U		U		U		U		U		U		U		U		U		U
50	2-butanone		U		U		U		U		U		U		U		U	30	B		U		U		U
5.0	cis-1,2-dichloroethene		U		U		U		U		U		U		U		U		U		U		U		U
0.30	chloroform		U		U		U		U		U		U		U		U		U		U		U		U
0.30	1,1,1-trichloroethane		U		U		U		U		U		U		U		U		U		U		U		U
0.030	carbon tetrachloride		U		U		U		U		U		U		U		U		U		U		U		U
3.0	benzene		U		U		U		U		U		U		U		U		U		U		U		U
15	1,2-dichloroethane		U		U		U		U		U		U		U		U		U		U		U		U
0.30	trichloroethene		U		U		U		U		U		U		U		U		U		U		U		U
3.0	toluene		U		U		U		U		U		U		U		U		U		U		U		U
0.30	tetrachloroethene		U		U	0.26	J		U		U		U		U		U		U		U		U		U
3.0	ethyl benzene	3.6			U		U		U		U		U		U		U		U		U		U		U
6.0	m-xylene/p-xylene		U		U		U		U		U		U		U		U		U		U		U		U
6.0	o-xylene/styrene		U		U		U		U		U		U		U		U		U		U		U		U
	Date Sampled:	06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95		06/09/95	
	Injected by:	DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK	
	Reviewed by:	RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS	

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA B -- SITE 5

	SAMPLE ID	5-10-05	5-11-04	5-12-02	5-13-05	5-14-05	5-14-05-DUP	5-15-04	5-16-05	5-17-04	5-18-05	5-18-05-DUP	5-19-05
	PID Data File ID	C609H025	C609H024	C609H029	C609H026	C609H027	C609H028	C612H013	C612H014	C612H006	C612H015	C612H016	C612H007
	ECD Data File ID	D609H025	D609H024	D609H029	D609H026	D609H027	D609H028	D612H013	D612H014	D612H006	D612H015	D612H016	D612H007
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
50	acetone	U	50 B	45 B	U	U	U	28 B	U	200 B	U	U	U
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	U	U	U	U	U
5.0	cis-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	3.6	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	0.09 J	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	1.7 J	1.8 J	U	U	U	U	U	U	U	U	U	U
	Date Sampled	06/09/95	06/09/95	06/09/95	06/09/95	06/09/95	06/09/95	06/12/95	06/12/95	06/12/95	06/12/95	06/12/95	06/12/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA B -- SITE 5

	SAMPLE ID	5-20-05		5-21-03		5-22-05		5-23-05		5-24-03		5-25-03		5-25-03-DUP		5-26-03		5-27-03		5-28-03		5-29-03		5-29-03-DUP	
	PID Data File ID	C612H008		C612H009		C612H010		C612H011		C612H012		C612H024		C612H028		C612H025		C612H023		C612H017		C612H018		C612H019	
	ECD Data File ID	D612H008		D612H009		D612H010		D612H011		D612H012		D612H024		D612H028		D612H025		D612H023		D612H017		D612H018		D612H019	
	Factor to Multiply PQL by	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0	
		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.		Aq. Headsp.	
PQL	COMPOUND	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
50	acetone	35	B	59	B	310	B	28	B	29	B	U		U		U		29	B	32	B	U		U	
2.0	1,1-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
5.0	trans-1,2-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
15	1,1-dichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
50	2-butanone	U		U		U		U		U		U		U		U		U		U		U		U	
5.0	cis-1,2-dichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	chloroform	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	1,1,1-trichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
0.030	carbon tetrachloride	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	benzene	U		U		U		U		U		U		U		U		U		U		U		U	
15	1,2-dichloroethane	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	trichloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	toluene	U		U		U		U		U		U		U		U		U		U		U		U	
0.30	tetrachloroethene	U		U		U		U		U		U		U		U		U		U		U		U	
3.0	ethyl benzene	U		U		U		U		U		U		U		U		U		U		U		U	
6.0	m-xylene/p-xylene	U		U		U		U		U		U		U		U		U		U		U		U	
6.0	o-xylene/styrene	U		U		U		U		U		U		U		U		U		U		U		U	
	Date Sampled	06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95		06/12/95	
	Injected by	DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK		DEK	
	Reviewed by	RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS		RS	

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA B -- SITE 5

	SAMPLE ID:	5-30-03	5-31-03
	PID Data File ID:	C612H026	C612H027
	ECD Data File ID:	D612H026	D612H027
	Factor to Multiply PQL by:	1.0	1.0
		Aq. Headsp.	Aq. Headsp.
PQL	COMPOUND	ug/L	ug/L
50	acetone	U	U
2.0	1,1-dichloroethene	U	U
5.0	trans-1,2-dichloroethene	U	U
15	1,1-dichloroethane	U	U
50	2-butanone	U	U
5.0	cis-1,2-dichloroethene	U	U
0.30	chloroform	U	U
0.30	1,1,1-trichloroethane	U	U
0.030	carbon tetrachloride	U	U
3.0	benzene	U	U
15	1,2-dichloroethane	U	U
0.30	trichloroethene	U	U
3.0	toluene	U	U
0.30	tetrachloroethene	U	U
3.0	ethyl benzene	U	U
6.0	m-xylene/p-xylene	U	U
6.0	o-xylene/styrene	U	U
	Date Sampled:	06/12/95	06/12/95
	Injected by:	DEK	DEK
	Reviewed by:	RS	RS

COMMENTS:

11:41:40 AM

WARMINSTER SOIL GAS AREA B -- SITE 6

	SAMPLE ID	A-157-03	A-157-08	B-155-03	B-155-08	B-155-08-DUP	B-155-08-DUP	B-200-03	B-200-03-DUP	C-150-03	C-150-08	D-105-03	D-105-10
	PID Data File ID	C516H011	C516H012	C516H005	C516H007	C516H008	C516H010	C516H006	C516H009	C516H014	C516H013	C516H017	C516H018
	ECD Data File ID	D516H011	D516H012	D516H005	D516H007	D516H008	D516H010	D516H006	D516H009	D516H014	D516H013	D516H017	D516H018
	Factor to Multiply PQL by	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PQL	COMPOUND	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L	Aq. Headsp. ug/L
50	acetone	U	U	31 B	U	U	43 B	U	U	U	32 B	U	37 B
2.0	1,1-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
5.0	trans-1,2-dichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,1-dichloroethane	U	63	U	U	U	U	U	U	U	U	U	U
50	2-butanone	U	U	U	U	U	U	U	32 B	U	U	32 B	44 B
5.0	cis-1,2-dichloroethene	U	4.6 J	U	U	U	U	U	U	U	U	U	U
0.30	chloroform	U	U	U	U	U	U	U	U	U	U	U	U
0.30	1,1,1-trichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.030	carbon tetrachloride	U	U	U	U	U	U	U	U	U	U	U	U
3.0	benzene	U	U	U	U	U	U	U	U	U	U	U	U
15	1,2-dichloroethane	U	U	U	U	U	U	U	U	U	U	U	U
0.30	trichloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	toluene	U	U	U	U	U	U	U	U	U	U	U	U
0.30	tetrachloroethene	U	U	U	U	U	U	U	U	U	U	U	U
3.0	ethyl benzene	U	U	U	U	U	U	U	U	U	U	1.3 J	1.3 J
6.0	m-xylene/p-xylene	U	U	U	U	U	U	U	U	U	U	U	U
6.0	o-xylene/styrene	U	U	U	U	U	3.4 B	27.0	U	U	U	U	U
	Date Sampled	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95	05/16/95
	Injected by	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK	DEK
	Reviewed by	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS

COMMENTS:

11:41:49 AM

APPENDIX C

SITE 5 SOIL BORING LOGS

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO - 159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-1
DATE 9-14-95
DRILLER Rick Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 3			Med. Stiff	Orange Brown	Silty clay w/roots and small weath. sandstone and shale frags		0 ppm damp Native soil or clean fill
1121	2.0	4 / 4	21"/24"		"	Gray Brown	Silty clay with shale and sandstone frags.		"
S-2 @		5 / 6			Med. Stiff	Gray Brown	Silty clay		0-ppm Native soil or clean fill
1129	4.0	10 / 10	20"/24"		Stiff	Orange	Silty clay with weath. shale + sandstone		"
S-3 @		7 / 9				Orange Brown	Silty clay with weath. shale + sandstone		0 ppm damp
1140	6.0	11 / 15	22"/24"		Stiff	Red Brown	Saprolite		Saprolite
							Augered to 4 ft.		

REMARKS 3½" ID HSA - 24" x 2" Diameter split Barrel Sample spoons
Tele-con Model 15B Drill Rig
170 lb. Hammer

BORING NO. SB-05-01
PAGE 1 OF ____

S-3 For Sample # SB-05-01

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-02 and SB-05-02D
DATE 9-19-95
DRILLER Rick Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	– / –	–	–	–	–	Not		Auger TO
–	2.0	– / –	–	–	–	–	collected		2 Ft. deep
S-2 @		7 / 8			Med Stiff	Brown	Silty clay with weath. Shale + Sandstone frags		Native soil or clean fill 0 ppm
1240	4.0	11 / 12	20"/24"		Stiff	Red Brown	Silty clay with weath Sandstone frags		"
S-3 @		6 / 7			Med Stiff	Red Brown	Silty clay with weath Shale + Sandstone		0 ppm Native soil or clean fill
1250	6.0	10 / 12	22"/24"		Stiff	Red Brown	"		"
S-4 @		5 / 8			Med Stiff	Red Brown	Silty clay with larger weath. Sandstone frags		0 ppm Native soil or clean fill
	8.0	11 / 14	23"/24"		Stiff	Dark Red Brown	Saprolite		Saprolite
							Augered to 6 Ft.		

REMARKS 3½" ID HSA → 24"x 2" Dia. Split Barrel Sample Spoons
Tele-Con Model 15B Drill Rig
170 lb. Hammer

BORING NO. SB-05-02, SB-05-02
PAGE 2 OF ____

S-4 for sample SB-05-02 and SB-05-02D (Duplicate)

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-03
DATE 9-19-95
DRILLER Rick Raab
FIELD GEOLOGIST V. Shickas

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0								
NA	—	—	—	—	—	—	Asphalt → ~6" Crushed stone → ~1 Ft. Not collected		Auger to 2 feet
S-2 @	2.0	3 / 5			Med Stiff	Red Brown	Silty clay with small weath. shale frags		0 ppm Native soil or clean fill
1351	4.0	8 / 11	20"/24		Stiff	"	"		"
S-3 @		5 / 8			Med Stiff	"	"		"
1400	6.0	11 / 15	24"/24"		Stiff	Red TAN	Silty clay with weath. sandstone frags		"
S-4 @		4 / 8			Med Stiff		"		
	8.0	25			Hard	Dark Red Brown	Saprolite at 7.0 Ft.		Refusal at 7.0'
							Augered to 6 Ft.		

REMARKS 3½" ID HSA → 24" X 2" Split Spoon Sampler
Telecon Model 15D Drill Rig
170 lb. Hammer

BORING NO. SB-05-03
PAGE 3 OF ____

S-4 for sample # SB-05-03

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-04
DATE 9-19-95
DRILLER Rick Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	—	— / —	—	—	—	—	No sample collected Auger through ~6" asphalt and 1.5 ft crushed stone		Auger to 2.0 feet
S-2 @	2.0	6 / 5			Med Stiff	Light Brown	Silty clay Fill material with glass Fragments and shale + sandstone		Fill - 0 ppm Material
1442	4.0	4 / 5	24"/24"		Med Stiff	Brown Black	Silty clay Fill material with wood tree limb/roots fragments		0 ppm Fill material
S-3 @		4 / 4			Med Stiff	Brown Black	"		"
1450	6.0	9 / 25	18"/24"		Hard		Saprolite refusal at 5.5 ft.		0 ppm Saprolite
							Augered to 4 ft		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tele-con Model 15B drill rig
170 lb Hammer

BORING NO. SB-05-04
PAGE 4 OF ____

S-2 for Sample # SB-05-04

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE. TIME & CONDITIONS)

BORING NO. SB-05-05
DATE 4-19-95
DRILLER Rick Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	—	— / —	—	—	—	—	No sample collected Auger through ~6" Asphalt and 1.5 ft crushed stone		Auger To 2 feet.
S-2 @	2.0	5 / 6			Med Stiff	Red Brown	Silty clay Fill material		0 ppm Fill
1540	4.0	4 / 4	18"/24"		Med Stiff	Black Brown	Silty clay Fill with Ashes, wood and glass Frags.		0 ppm Fill material
S-3 @		3 / 3			Soft	Gray Brown	Silt-clay with Black paper/cardboard (Fill)		0 ppm Fill material
1551	6.0	3 / 3	14"/24"		Soft	"	"		"
S-4 @		4 / 9			Med Stiff	Red Brown	Silty clay with weath Sandstone + shale Frags		0 ppm Native material
1604	8.0	13 / 14	22"/24"		Stiff	Red Brown	Saprolite at 8.0		0 ppm Native Material
							Augered to 6 ft.		

REMARKS 3.5"ID HSA → 24"x2" split spoon sampler
Telecon Model 15 B drill rig
170 lb. Hammer

BORING NO. SB-05-05
PAGE 5 OF ____

* See Legend on Back

S-3 for sample # SB-05-05

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-06
DATE 9-19-95
DRILLER Rick Reab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 4			Soft		—		0ppm Native soil or clean fill
1645	2.0	4 / 4	12" / 24"		Med Stiff	Brown Red	Silt clay with roots and small weath. Shale and sandstone		"
S-2 @		4 / 4			Med Stiff	Red Brown	Silty clay with weath. sandstone & Shale frags		0ppm Native Soil
1653	4.0	6 / 7	22" / 24"		Med Stiff	"	"		"
S-3 @		5 / 12			Stiff	"	"		"
1659	6.0	11 / 15	24" / 24"		Stiff	"	"		"
S-4 @		5 / 7			Med Stiff	"	"		"
1705	8.0	9 / 12			Stiff	"	Some Saprolite at 7.5 to 8.0 feet		"
S-5 @		25			Hard		Saprolite refusal at 8.1 feet		"
—	10.0		0" / 24"						
							Augered to 8 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tele-con model 15 B drill Rig
170 lb. Hammer

BORING NO. SB-05-06
PAGE 6 OF ____

* See Legend on Back

S-4 for Sample # SB-05-06

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-07
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	3 / 4			Soft	Brown	Silty clay with roots and small weath		0 ppm Native soil
0916	2.0	4 / 4	14"/24"		Med Stiff	"	Sandstone + shale Frags.		"
S-2 @		10 / 17			Stiff	Red Brown	Silty clay with some sandstone frags.		0 ppm Native soil
0922	4.0	10 / 15	08/24"		Stiff	"			"
S-3 @		6 / 10			Med Stiff	Red Brown	Silty clay with small weath. sandstone frags		0 ppm Native soil
0929	6.0	12 / 15	17"/24"		Stiff	"	"		"
S-4 @		25 / -		—	Hard		Saprolite refusal at 6.5 feet		0 ppm Native soil
0938	8.0	- / -							
							Augered to 6 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tele-con Model 150 drill Rig
160 lb Hammer

BORING NO. SB-05-07
PAGE 7 OF ____

* See Legend on Back

S-3 for sample # SB-05-07

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-08
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	4 / 4			Med Stiff	Brown	Silty clay with grass/roots and weath shale frags		0 ppm clean fill or Native Soil
1012	2.0	14 / 15	8"/24"		Stiff	-	—		—
S-2 @		9 / 7			Med Stiff	Red Brown	Silt-clay with weath sandstone & shale frags		0 ppm clean fill or native soil
1020	4.0	6 / 6	16"/24"		Med Stiff	"	"		
S-3 @		7 / 14			Stiff	"	"		0 ppm clean fill or Native Soil
	6.0	17 / 16			Hard		Saprolite at 5.5 ft.		"
							Augered to 4ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15 B drill rig
160 lb hammer

BORING NO. SB-05-08
PAGE 8 OF ____

* See Legend on Back

S-3 for Sample # SB-05-08

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-09
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 4			Soft	Brown	Silty clay with grass-roots and sandstone & shale Frags		0 ppm clean fill or Native material
1054	2.0	12 / 13	20"/24"		Stiff	Gray Brown	Silty clay with weath. Sandstone & shale Frags		"
S-2 @		5 / 9			Stiff	Red Brown	Silty clay with weath. Sandstone Frags		0 ppm Native soil or clean fill
1105	4.0	10 / 13	20"/24"		Stiff	"	"		"
S-3 @		5 / 10			Stiff	"	"		0 ppm Native soil or clean fill
	6.0	11 / 14	19"/24"	—	Stiff		Saprolite at 5.5 Ft.		0 ppm Native soil
							Augered to 4 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill Rig
160 pound hammer

BORING NO. SB-05-09
PAGE 9 OF ____

* See Legend on Back

S-3 for sample # SB-05-09

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-10
DATE 9-20-95
DRILLER R. Reab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	7 / 6			Med Stiff	Brown	Silty clay with grass/roots and sandstone Frags		0 ppm Native soil or clean fill
1142	2.0	9 / 16	20"/24"		Stiff	Tan Brown	Silt-clay with weath. sandstone + shale Frags		"
S-2 @		10 / 13			Stiff	Tan Brown	Silt clay with weath sandstone Frags		0 ppm Native soil
	4.0	23 / 35	18"/24"		Very Stiff		Saprolite at 3.5 Ft.		"
S-3 @	—		—	—	—	—	Not collected	-	—
—	6.0		—	—	—	—	—	—	—
							Augered to 2 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15 B drill rig
160 lb Hammer

BORING NO. SB-05-10
PAGE 10 OF ____

* See Legend on Back

S-2 for sample # SB-05-10

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-11
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	4 / 4			Med Stiff	Brown	Silt-clay with roots and weath sandstone frags		0 ppm Native soil or clean fill
1221	2.0	9 / 12	17"/24"		Stiff	Tan Brown	silty clay with weath sandstone + shale frags		"
S-2 @		5 / 11			Stiff	Brown	Silt clay with pieces of Brick and sandstone frags		0 ppm Fill Material
	4.0	18 / 17		—	Very Stiff		Saprolite at 3.5 Ft		"
							Augered to 2 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb Hammer

BORING NO. SB-05-11
PAGE 11 OF ____

* See Legend on Back

S-2 for Sample # SB-05-11

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-12, SB-05-12D (duplicate)
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	– / –	–	–	–	–	Not collected - Auger through ~6" Asphalt and 1.5 Ft crushed stone		Auger to 2 Ft.
–	2.0	– / –	–	–	–	–	"		"
S-2 @		8 / 8			Stiff	Red Brown	Silty clay with small sandstone + shale Frags		0 ppm Native soil or clean fill
1350	4.0	14 / 23	24" / 24"		Very Stiff	Red Brown	Silty clay with larger sandstone + shale Frags		"
S-3 @		10 / 26			Very Stiff	"	Saprolite / bedrock refusal at 5.0 Ft.		0 ppm Native material
	6.0	– / –	8" / 12"	–	–	–	–	–	–
							Augered to 4 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill Rig
160 lb Hammer.

BORING NO.
PAGE 12 OF ____

* See Legend on Back

S-2 for sample # SB-05-12 and # SB-05-12D (duplicate)

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-12D Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 4.8 feet			
Sample Date & Time: 9-20-95 1400			
Sampled By: Vincent Shickora			
Signature(s): [signature]			
Type of Sample			
☑ Low Concentration			
☐ High Concentration			
☑ Grab			
☐ Composite			
☐ Grab - Composite			

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - PCB/Pest/BNA (1)

Observations / Notes

Duplicate of Sample SB-05-12

(see logsheet page 13)

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-13
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	— —	—	—	—	—	Not collected Auger through ~ 6 inchs Asphalt and 1.5 ft crushed stone		Auger to 2 ft.
—	2.0		—	—	—	—			
S-2 @		3 4			Soft	Red Brown	Silty clay with weath. Sandstone & Shale frags		0 ppm Native soil or clean fill
1426	4.0	8 15	22"/24"		Stiff	"	"		"
S-3 @		9 14			Stiff	Tan Brown	Silty clay with large weath. sandstone frags		0 ppm Native soil or clean fill
1437	6.0	19 20	18"/24"		Very Stiff	"	"		"
S-4 @		20 29	6"/12"		Hard	Tan Brown	Saprolite/Bedrock refusal at 7.0 ft		0 ppm Native Material
1448	8.0		—	—	—	—	—		—
							Augered to 6 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb. Hammer

BORING NO. SB-05-13
PAGE 13 OF ____

5-3 for Sample # SB-05-13

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-14
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 7	*		Med Stiff	Brown	Silty clay with grass/roots and shale Frags		0 ppm Native soil or clean fill
1515	2.0	10 / 18	19"/24"		Stiff	Brown	Silty clay with weath. sandstone + shale Frags		"
S-2 @		10 / 11			Stiff	Brown	"		0 ppm Native soil or clean fill
1522	4.0	10 / 12	20"/24"		Stiff	Red Brown	"		"
S-3 @		6 / 7			Stiff	Red Brown	"		0 ppm Native or clean fill
1531	6.0	11 / 15	17"/24"		Stiff	"	"		"
S-4 @		25 / —		—	Hard		refusal at 6.5 ft.		
1540	8.0	— / —	—	—	—	—	—		—
							Augered to 6 ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15B drill rig
160 lb. Hammer

S-4 For Sample # SB-05-14

BORING NO. SB-05-14
PAGE 14 OF ____

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-15
DATE 9-20-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 5			Med Stiff	Brown	Silty clay with grass/roots and sandstone frags		0 ppm clean fill or Native soil
1613	2.0	6 / 12	17"/24"		Stiff	orange Brown	Silty clay with weath. sandstone & shale frags		"
S-2 @		8 / 10			Stiff	Tan Brown	"		0 ppm clean fill or Native soil
1622	4.0	11 / 14	19"/24"		Stiff	Red Brown	"		"
S-3 @		10 / 9			Stiff	Red Brown	"		0 ppm clean fill or Native soil.
1637	6.0	10 / 19			Very Stiff	Dark Red Brown	"		"
S-4 @		9 / 8			Stiff	Red Brown	Saprolite		0 ppm Native soil
1646	8.0	18 / 25			Very Stiff	"	Saprolite/Fractured Bedrock refusal at 7.8 Ft.		"
							Augered to 6 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill rig
160 lb. Hammer

BORING NO. SB-05-15
PAGE 15 OF ____

* See Legend on Back

S-3 for sample # SB-05-15

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-16
DATE 9-21-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 3			Soft	Brown	Silty clay with grass/roots and sandstone Frags		0 ppm Native soil or clean fill
1448	2.0	3 / 4	16"/24"		Soft	Red Brown	Silty clay with weath. Sandstone + shale Frags		"
S-2 @		4 / 7			Med Stiff	"	"		"
1455	4.0	10 / 11	22"/24"		Stiff	"	"		"
S-3 @		4 / 6			Med Stiff	"	"		"
1523	6.0	10 / 10	17"/18"		Stiff	"	"		"
S-4 @		8 / 9			Stiff		"		"
1531	8.0	10 / 12	10"/24"		Stiff		"		"
S-5 @		9 / 12			Stiff	Dark Red Brown	Silty clay with weath. sandstone frags (moist)		"
1546	10.0	13 / 12	24"/24"		Stiff	"	"		"
S-6 @		13 / 15			Stiff		"		"
1558	12.0	16 / 18	20"/24"		Very Stiff		Saprolite at 12.0 Ft.		"
							Auger to 8 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon Sampler
Tel-Econ Model 15B drill rig
160 lb hammer

BORING NO.
PAGE ____ OF ____

* Augered only to 4 Ft. (used new rods From 4' to) S-5 for sample * SB-05-16

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-17
DATE 9-21-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
—	—	— / —	—	—	—	—	Not collected Auger to 4 feet deep		Auger to 4 Ft.
S-1 @	4.0	4 / 5			Med Stiff	Red Brown	Silty clay with weath. Sandstone + Shale Frags.		0 ppm Clean fill or Native Soil
1630	6.0	6 / 9	21"/24"		Med Stiff	"	"		"
S-2 @		8 / 11			Stiff	"	"		"
1638	8.0	14 / 15			Stiff	"	"		"
S-3 @		26		—	Very Hard		Saprolite		"
1642	10.0	— / —	—	—	—	—	refusal at 8.5 Ft		—
							Auger to 4 Ft.		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ Model 15 B drill rig
160 lb. hammer

BORING NO. SB-05-17
PAGE ____ OF ____

S-2 for Sample # SB-05-17

* See Legend on Back

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-18
DATE 9-28-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shickora

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 4			Soft	Brown	Silty clay with grass/roots and shale frags (moist)		0 ppm native soil or clean fill
1031	2.0	5 / 10	16"/24"		Med Stiff	Red Brown	Silty clay with weath Sandstone frags		"
S-2 @		6 / 6			Med Stiff	"	"		"
1039	4.0	6 / 3	14"/24"		Soft	Black Gray	Silty sand + gravel Fill material with some pieces of burned wood (charcoal)		0 ppm Fill Material
S-3 @		2 / 2			Soft	"	"		"
1044	6.0	3 / 3	12"/24"		Soft.	"	"		HNU - 15ppm Fill material
S-4 @		15 / 25				"	Silty sand + gravel with wood - Saprolite at 6.5 ft. refusal at 7.0 feet		HNU - 20ppm Fill material (saturated)
1050	8.0								
							No Augering done at this location		

REMARKS 3.5" I.D. HSA → 24"x2" split spoon sampler
Tel-etor Model 15B drill Rig
160 lb. Hammer

BORING NO. SB-05-18
PAGE ____ OF ____

* See Legend on Back

S-3 for sample # SB-05-18

BORING LOG

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT NAWC Warminster
PROJECT NO. 1412 (CTO-159)
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. SB-05-19
DATE 9-28-95
DRILLER R. Raab
FIELD GEOLOGIST V. Shackford

SAMPLE NO.	DEPTH (FT.)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
S-1 @	0.0	2 / 4			Soft	Brown	Silty clay with grass/roots and shale Frags.		0 ppm Native soil or clean Fill
1114	2.0	6 / 8	18"/24"		Med. Stiff	"	Silty clay with weak Sandstone and shale Frags.		"
S-2 @		7 / 8			Med Stiff	"	"		"
1120	4.0	8 / 8	14"/24"		Med. Stiff	Black Gray	Silty sand + gravel Fill with pieces of glass and burned wood (charcoal)		0 ppm Fill material
S-3 @		6 / 6			Med Stiff		No recovery		—
1127	6.0	7 / 8	0"/24"		Med Stiff		—		—
S-4 @		2 / 6			Soft	Black Gray	Silty sand + gravel fill with pieces of glass (saturated)		0 ppm Fill material
1132	8.0	4 / 15	4"/24"		Stiff	"	"		"
S-5 @		10 / 12			Stiff	"	"		"
	10.0	14 / 17	7"/24"		Stiff		Saprolite at 10.0 feet		"
							No Augering done at this location		

REMARKS 3.5" ID HSA → 24" x 2" split spoon sampler
Tel-econ model 15B drill Rig
160 lb. hammer

BORING NO. SB-05-19
PAGE ____ OF ____

S-5 + S-4 for sample SB-05-19

* See Legend on Back

BORING LOG **HALLIBURTON NL**

PROJECT: NAWC WARMINSTER BORING NO.: SB-05-20
PROJECT NO.: 3933 (CTO-0022) DATE: 6-17-92 DRILLER: DON McMASTER
ELEVATION: FIELD GEOLOGIST: R. GOOD
WATER LEVEL DATA: PHASE III RI
(Date, Time & Conditions)

SAMPLE NO. & TYPE	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth Ft.)	MATERIAL DESCRIPTION* SOIL DENSITY: CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BR. OR USCS	REMARKS
S-1 (a)	0.0	4 / 4				ORANGE	SILTY CLAY w/ ROOTS & SMALL		0 ppm, DAMP
0826	2.0	4 / 4	18"/24"		STIFF	BRN.	WEATH SANDSTONE & SHALE FRAGS.	ML	NATIVE SOIL OR CLEA. FILL
S-2 (a)		3 / 2				REDDISH	SANDY SILTY CLAY w/ SMALL		0 ppm, DAMP
0830	4.0	6 / 6	17"/24"		STIFF	BRN.	SANDSTONE & SHALE FRAGS	ML	NATIVE SOIL OR CLE. FILL
S-3 (a)		4 / 8				REDDISH	WEATHERED FGR. SANDSTONE		0 ppm, SATURATED
0833	6.0	8 / 8	18"/24"		STIFF	GRAY		Sm	SAPROLITE.

REMARKS 4¼" I.D. HSA; 24" x 3" DIA. SPLIT BARREL SAMPLE SPOONS.
FAILING F-10 DRILL RIG
W-SB-05 FOR ANALYSIS FR/ S-2

BORING SB-0

PAGE 1 OF

* See Legend on back

BORING LOG **HALLIBURTON NUS**

PROJECT: NAWC WARMINSTER BORING NO.: SB-05-21
PROJECT NO.: 3933 (CTO-0022) DATE: 6-17-92 DRILLER: DON McMASTER
ELEVATION: FIELD GEOLOGIST: R. GOOD
WATER LEVEL DATA: PHASE III RI
(Date, Time & Conditions)

SAMPLE NO. & TYPE	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.)	MATERIAL DESCRIPTION* SOIL DENSITY: CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BR. OR USCS	REMARKS
S-1 ⑥	0.0	3 / 3				REDDISH BRN.	SILTY CLAY W/ ROOTS & SMALL RK FRAGS OVERLYING ASHY OR		0 PPM, DAMP
0916	2.0	6 / 8	18"/24"		STIFF	BLK & LT. GRAY	CINDER MAT'L W/ GLASS FRAGS & SMALL SOFT WHITE FRAGS	ML	FILL/WASTE
S-2 ④		2 / 4				BRN	2" SILTY CLAY		0 PPM, DAMP TO WET
0919	4.0	6 / 5	5"/24"		STIFF	BLK	ASH & MISC. DEBRIS (METAL, GLASS, PLASTIC, ETC.)	ML	FILL/WASTE
S-3 ⑥		2 / 3				GRAY	4" ASHY MAT'L AS ABOVE		0 PPM, WET TO MOIST
0923	6.0	5 / 5	18"/24"		STIFF	ORANGE	SILTY CLAY & CLAY W/ SMALL SANDSTONE & SHALE FRAGS	ML	WASTE/SAPROLITE

REMARKS 4¼" I.D. HSA ; 24" x 3" DIA SPLIT BARREL SAMPLE SPOONS ;
FAILING F-10 DRILL RIG
W-SB-06 FOR ANALYSIS FR/ S-2 & S-3

BORING S13

PAGE 1 OF

* See Legend on back.

BORING LOG

PROJECT: NAWC WARMINSTER
BORING NO.: SB-05-22
PROJECT NO.: 3933 (CTO-0022)
DATE: 6-17-92
DRILLER: DON MC MASTER
ELEVATION:
FIELD GEOLOGIST: R. GOOD
WATER LEVEL DATA: PHASE III RI
(Date, Time & Conditions)

SAMPLE NO. & TYPE	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.)	MATERIAL DESCRIPTION* SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ROCK BR. OR USCS	REMARKS
S-1 @	0.0	3 / 4				REDDISH BRN &	SILTY CLAY & CLAY w/ ROOTS & SMALL SANDSTONE &		0 PPM, DRY TO DAMP
1002	2.0	5 / 6	19"/24"		STIFF	ORANGE BRN	SHALE FRAGMENTS	ML	FILL?
S-2 @		3 / 4				REDDISH BRN &	SILTY CLAY & CLAY w/ SOME SMALL RK FRAGS		0 PPM, DAMP
1006	4.0	6 / 9	20"/24"		STIFF	ORANGE BRN		ML	FILL?
S-3 @		3 / 6				RED &	SILTY CLAY, CLAY & SANDY SILTY CLAY w/ SMALL SHALE		0 PPM, DAMP
1010	6.0	9 / 12	19"/24"		MED. STIFF	REDDISH BRN	SILTSTONE & SANDSTONE FRAGS	ML Sm	POSS. SAPROLITE
S-4 @		4 / 10			TO HARD	RED &	CLAY, SILTY CLAY & WEATH.	ML	0 PPM, DAMP
1017	8.0	25 / 50+	14"/18"			REDDISH BRN.	SHALE		SAPROLITE
									REF. @ 7.5 FT

REMARKS 4¼" I.D. HSA ; 24" x 3" DIA. SPLIT BARREL SAMPLE SPOONS ;
FAILING F-10 DRILL RIG
W-SB-07 FOR ANALYSIS FR/ S-2

BORING SB-07

PAGE 1 OF 1

* See Legend on back

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-24
DATE: 12-08-99
GEOLOGIST: S. Pekpke
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0946	0	3/3	24/24		soft		red-brn to brn clayey silt		damp	0.0	0.0	0.0	0.0
	2	5/6			med. stiff		3" brn silt loam - roots near top						
0948	2	6/6	22/24		med stiff		red-brn clayey silt + sm. dk brn + yellow-		damp	0.0	0.0	0.0	0.0
	4	9/11			stiff		brn mottling tr. weathered micaceous s.s. fragments (friable)						
0953	4	14/15	24/24		stiff		9" red-brn silty clay/		damp	0.0	0.0	0.0	0.0
	6	18/21			v stiff		clayey silt 15" brn silty sand w/ wth. s.s. fragments weathered Fe-stained s.s. near bottom of spoon						
0958	6	50/5" over	6/24		hard		red-brn silty clay lag →		dump	0.0	0.0	0.0	0.0
	8			T.D.-6.5'			brn-gray f.g. weathered s.s. →		dry				
									2000- rel'nq sample SB-05-24 from 2' to 4'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: S.S. = sandstone

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekton Auger Rig

BORING NUMBER: SB-05-25
DATE: 12-08-99
GEOLOGIST: S. Pekpko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1016	0	1/3	24/24		soft		brn silt bum + roots red-brn to brn		damp	0.0	0.0	0.0	0.0
	2	5/6			med. stiff		clayey silt tr. brn-gray sand						
							lenses + wth. s.s. fragments		metal wire located in shoe				
							orange-brn mottling near bottom		(poss fill ?)				
1020	2	7/8	19.5/24		med. stiff		9" red-brn to brn clayey silt, s.m.		damp	0.0	0.0	0.0	0.0
	4	17/17			v. stiff		orange-brn mottling 10.5" mostly red-brn						
							clayey silt w/ lt. brn to brn, orange-brn						
							weathered s.s. fragments (micaceous)						
1023	4	16/17	22.5/24		v. stiff		9" brn silty sand		damp	0.0	0.0	0.0	0.0
	6	24/27			↓		w/ brn-gray wth. s.s. fragments						
							13.5" brn-gray wth. s.s. w/ s.m. brn						
							silty sand lenses						
1027	6	33/50	14/24		hard		brn to brn-gray wth. micaceous s.s. w/		damp to wet	0.0	0.0	0.0	0.0
	8	over 5"		T.D. = 7'			trace silty sand Fe-staining						
									1035 - collect sample SB-05-25 from 2' to 5'. (MS/MSD)				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: s.s. = sandstone; wth. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekran Auger Rig

BORING NUMBER: SB-05-26
DATE: 12-08-99
GEOLOGIST: S. Pokpko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1105	0	2/5	22.5/24		soft		4" brn silt loam + roots 19.5" brn, red-brn,		dump	0.0	0.0	0.0	0.0
	2	7/9			med. stiff		orange-brn clayey silt mottled appearance →						
							poss. fill? sm. black fragments →		waste				
							ash / cinders, + metal wire						
1117	2	10/14	14/24		stiff		9" red-brn, brn, orange-		→ dump	0.0	0.0	0.0	0.0
	4	12/8			↓		brn clayey silt w/ sm. wth. slt.s. + s.s. frags.						
							6" brn, gray clayey		→ wet, perched water zone				
							silt w/ black ashes + metal fragment		(waste/fill?)				
							gray clayey silt layer near bottom						
1122	4	7/9	21/24		stiff		3" gray, reddish		wet	0.0	0.0	0.0	0.0
	6	8/14			↓		clayey silt 9" tan to gray						
							silty clay, tr. reddish mottling		poss. fill?				
							10" red-brn clayey silt + wth. slt. st.		dump				
							fragments						
1128	6	35/50	10/24		hard		red-brn clayey silt		dump	0.0	0.0	0.0	0.0
	8	over 5"		T.D.=7'			to wth. micaceous siltstone						
									1110 - collect sample SS-05-17				
									from 6" to 24"				
									1120 - collect sample SB-05-26				
									from 3' to 5'				
									1140 - collect sample SB-05-27				
									from 5' to 7'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: slt. st. = siltstone ; s.s. = sandstone ; wth = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Teleron Auger Rig

BORING NUMBER: SB-05-27
DATE: 12-08-99
GEOLOGIST: S. Ashoke
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1238	0	3/3	22/24		soft		4" brn silt loam + roots 18" brn, gray, red-brn		dump	0.0	0.0	0.0	0.0
	2	5/5			med. stiff		silty clay (mottled → fill?)						
							glass fragment						
1240	2	5/6	22/24		med. stiff		2" lay as above 20" red-brn silty		dump	0.0	0.0	0.0	0.0
	4	11/12			stiff		clay to clayey silt (orange-brn + gray						
							mottling) tr. with. s.s. frags.,						
							black mottling						
1244	4	15/15	24/24		stiff		21" red-brn clayey silt		dump	0.0	0.0	0.0	0.0
	6	16/30			v. stiff		3" wth. brn s.s. frags + clayey to sandy						
							silt						
1250	6	16/17	24/24		v. stiff		24" red-brn clayey silt + wth. micaceous		dump	0.0	0.0	0.0	0.0
	8	24/32			↓		sh. stone. Sm. gray, orange-brn,						
							black mottling		1240 - collect sample SS-05-13				
									from 6" - 24"				
									1315 - collect sample SB-05-28				
1310	8	50/3" over	0/24		hard		no returns		+ SB-05-100 from 2'-6'				
	10			T.D. = 8'									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: sh. s. = siltstone ; s.s. = sandstone ; wth. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekron Auger Rig

BORING NUMBER: SB-05-29
DATE: 12-08-99
GEOLOGIST: S. Arkoke
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1326	0	2 / 5	21.5/24		Soft		brn silt loam + roots 10" brn, orange-brn		dump	0.0	0.0	0.0	0.0
	2	14 / 20			v. stiff		silty clay 11.5" red-brn, brn,		poss fill?				
							orange-brn clayey silt w/ sm. brn-gray s.s.						
							frags.						
1330	2	14 / 11	7.5/24		stiff					0.0	0.0	0.0	0.0
	4	16 / 25			v. stiff		brn, orange-brn, reddish clayey silt w/		dump to wet,				
							abundant black ashes/cinders		perched water				
									zone				
									(waste/fill?)				
1333	4	13 / 21	17.5/24		v. stiff		2" lag		dump	0.0	0.0	0.0	0.0
	6	24 / 28			↓		15.5" red-brn clayey silt/silty clay w/						
							with. siltstone						
1350	6	50 over 3"	0/24		hard		with. red-brn micaceous slt. s. (trace) +		dry	—	—	—	—
	8			T.D.=6'			metal wire						
									1405-Collect Sample SB-05-29				
									from 2'-4'				
									1410-Collect Sample SB-05-30				
									from 4'-6'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: slt. s. = siltstone; s.s. = sandstone; with = weathered
Supplemental boring drilled 4" to 6" S. of first boring to acquire additional sample volume (T.D. = 4' BGS). Note metal + plastic frags + paper in supplemental boring (2'-4'

Converted to Well: Yes ____ No X Well I.D. #: —N/A—

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekron Auger Rig

BORING NUMBER: SB-05-29
DATE: 12-08-99
GEOLOGIST: S. Rokopko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1420	0	2/4	15.5/24		soft		brn silt loam 6" red-brn clayey		→ damp	0.0	0.0	0.0	0.0
	2	10/8			stiff		silt 9.5" glass, cinders,						
							ash (black), metal wires + brn, orange-		→ wet; perched water zone				
							brn clayey silt		(waste)				
1422	2	4/9	9/24		med. stiff		lt. gray fibrous		wet / oily	1.0	0.0	0.0	0.0
	4	10/8			stiff		material → poss. asbestos + abundant black		slight petroleum				
							ash / cinders, Fe-staining, sm. clayey silt		or fuel odor noted				
									(waste)				
1425	4	2/1	0/24		v. soft		no returns						
	6	4/5		T.D.=6	med. stiff								
									1435 - Collect sample SS-05-19				
									from 1'-4'				
									1455 - Collect sample SB-05-31				
									from 6'-7.5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: Supplemental boring drilled approx 1' SW of first boring to acquire additional sample volume. See page 2

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekran Auger Rig

BORING NUMBER: SB-05-29
DATE: 12-08-99
GEOLOGIST: S. Pokpko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1430	0	3/2	12.5/24		soft		6" red-brn clayey silt, brn silt kum near top.		→ damp	0.0	0.0	0.0	0.0
	2	2/4			↓		6.5" black ash / cinders + clayey silt		→ oily, slight petroleum/fuel odor (waste)				
1432	2	3/2	7/24		soft		transit pipe fragments		damp to wet	6.7*	0.0	0.0	0.0
	4	7/5			med. stiff		(gray, fibrous) + black ash / cinders + black / v. dk brn oil, glass frags. + orange brn clayey silt.		oily; perched water zone petroleum/fuel odor (waste) * PID headspace off bag full of sample material.				
1440	4	3/2	11/24		soft		5" lay		→ wet; petroleum/fuel odor (fill)	0.0	0.0	0.0	0.0
	6	4/2			↓		6" gray silty clay + roots / leaf		→ wet to damp				
							red-brn clayey silt near bottom						
1450	6	4/9	18/24		med. stiff		5" gray silty clay lay		→ wet	0.0	0.0	0.0	0.0
	8	39/50 over 1"		T.D.=7.5'	hard		13" red-brn clayey silt to wth. sht.s. + trace lt. gray mottling		→ damp to dry				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: sh.s. = siltstone; wth = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekran Auger Rig
BORING NUMBER: SB-05-30
DATE: 12-08-99
GEOLOGIST: S. Arkoko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1515	0	2/3	22.5/24		Soft		3" brn silt loam + roots 2" black/d'k brn gravel		damp	0.0	0.0	0.0	0.0
	2	5/8			med. stiff		fill 16.5" brn, orange-brn						
							red-brn, gray mottled silty clay/clayey		fill				
							silt + black ashes, glass, granular M.		↓ waste				
							blue material → poss. chemical?						
1520	2	6/7	3/24		med. stiff		3" black ash/cinders		damp	0.0	0.0	0.0	0.0
	4	7/8			med. stiff		+ gray silty clay		waste/fill				
1524	4	4/4	13/24		soft		black ash/spongy cinders, copper wire, plastic		saturated to wet	0.0	0.0	0.0	0.0
	6	16/22			v. stiff		frags. + glass frags.		waste perched water zone				
							red-brn silty clay/ clayey silt						
1530	6	35/45	24/24		hard		12" saturated waste						
	8	50	over 1"	T.D.=7'	↓		lag 12" red-brn clayey silt to with. sh. s. metal wire at bottom of spoon		→ damp/dry	0.0	0.0	0.0	0.0
									1525-collect sample SS-05-20 from 1'-5'				
									1535-collect sample SB-05-32 from 6'-7'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: sh. s. = siltstone; with = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-31
DATE: 12-09-99
GEOLOGIST: S. Pelepko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
0840	0	2/6	22/2		Soft		3" brn silt loam + roots 19" red-brn to brn		dump	0.0	0.0	0.0	0.0
	2	7/6			med. stiff		clayey silt w/ sm. glass + black cinder near top of interval, s.m. gray mottling		poss fill?				
0842	2	8/10	15.5/24		Stiff		brn to red-brn clayey silt to silty clay near bottom, tr. s.s. frags		dump	0.0	0.0	0.0	0.0
	4	10/11			↓								
0844	4	8/13	22/24		Stiff		red-brn silty clay near top to clayey		dump	0.0	0.0	0.0	0.0
	6	16/16			v. stiff		silt, tr. slt. st. frags. + orange-brn mottling						
0848	6	23/26	19.5/24		v. stiff		red-brn clayey silt to wth. slt. st., sm. gray,		wet/muddy, ok brn at top of	0.0	0.0	0.0	0.0
	8	38/50	over 2"	T.D.=7.5'	hard		brn, orange-brn mottling		interval to dump				
									0840- Collect Sample SS-05-23 from 6"-18"				
									0855- Collect Sample SB-05-33 from 3'-5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: S.S. = sandstone; slt. st. = siltstone; wth = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-32
DATE: 12-09-99
GEOLOGIST: S. Petrpko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0912	0	2 / 6	21/24		soft		4" brn silt loam + roots 17" lt. brn to brn		damp	0.0	0.0	0.0	0.0
	2	8 / 12			stiff		clayey silt, tr. glass + brick + wth. rock						
							frags (poss. fill)						
0914	2	16 / 19	16.5/24		v. stiff		6" to 8" lt brn to brn (clayey silt w/ roots)		damp	0.0	0.0	0.0	0.0
	4	17 / 19			v. stiff		(poss. fill) 8.5" to 10.5" brn						
							clayey silt → harder at bottom w/ wth.						
							slt. st. frags.						
0918	4	15 / 16	15.5/24		v. stiff		red-brn to brn clayey silt, sm. orange-brn		damp	0.0	0.0	0.0	0.0
	6	18 / 22			↓		mottling; brn sandy silt near bottom						
0922	6	22 / 23	15/25		v. stiff		red-brn clayey silt to wth. slt. st., tr.		damp	0.0	0.0	0.0	0.0
	8	50 /		T.D. = 7'	hard		brn + gray mottling						
									0915 - Collect sample SS-05-24				
									from 6" - 18"				
									0930 - Collect sample SB-05-34				
									from 3' - 5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: slt. st. = siltstone ; wth = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekron Auger Rig

BORING NUMBER: SB-05-33
DATE: 12-09-99
GEOLOGIST: S. Pelepko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0952	0	4/4	14.5/24		soft		thin brn silt loam layer H. brn to brn, red-brn		dump	0.0	0.0	0.0	0.0
	2	3/2			soft		clayey silt/silty clay, piece of coal + roots		poss. fill				
0954	2	2/6	16/24		soft		red-brn, brn, brn-gray, brn-orange clayey		dump/wet	0.0	0.0	0.0	0.0
	4	9/7			stiff		silt/silty clay w/ black asbes, corroded		perched water				
							metal, processed wood, blue coloration		zone				
							poss. paint						
0956	4	5/4	18/24		med stiff		6" waste/fill → lay		dump	0.0	0.0	0.0	0.0
	6	5/6			↓		12" red-brn clayey silt + wth. sh. st. frags;						
							tr. gray mottling						
0958	6	10/10	22/24		stiff		red-brn clayey silt		dump/dry	0.0	0.0	0.0	0.0
	8	26/50		T.D.=7.5	hard		w/ wth. sh.st. frags to wth. sh. st.						
									0955- collect sample SS-05-25				
									from 6"-18"				
									1000- collect sample SB-05-35				
									from 2'-5'				
									1010- collect sample SB-05-36				
									from 5'-7'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: sh. st. = siltstone; wth. = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Iteron Auger Rig

BORING NUMBER: SB-05-34
DATE: 12-09-99
GEOLOGIST: S. Pekarko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
1035	0	N/A / 24	12/24		med. dense		6" black, broken asphalt 6" dk brn/gray/black gravel base		dry/damp	—	—	—	—
	2	24 / 17			↓								
1040	2	20 / 17	0/24		med dense		tr. black / v. dk brn gravel lay		damp	—	—	—	—
	4	19 / 19			↓								
1045	4	19 / 22	12/24		med. dense		black gravel lay reddish silty clay to		dry/damp	0.2	—	—	—
	6	42 / 50		T.D.=5.5	hard		red-brn, clayey silt to wth. sh. st.						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borenole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: sh. st. = siltstone; wth = weathered
Insufficient sample volume in first boring → drill supplemental boring (see p. 2)

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-34
DATE: 12-04-99
GEOLOGIST: S. Pelepko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
1055	0	N/A / 14	19/24		med. dense		5" broken asphalt + gravel base		dry	0.0	0.0	0.0	0.0
	2	5 / 7			med. stiff		8" brn silty sand + gravel		damp/wet; perched water				
							6" reddish silty clay to clayey silt		damp				
1100	2	4 / 11	19/24		Stiff		reddish silty clay		damp	0.0	0.0	0.0	0.0
	4	13 / 13			↓		clayey silt, tr. orange-brn mottling						
1105	4	11 / 27	18/24		Stiff		2" reddish silty clay + brown gravel lag		damp	0.0	0.0	0.0	0.0
	6	36 / 50		T.D = 6'	hard		16" red-brn clayey silt to wth. slt. st.						
							tr. brn mottling near top of interval						
									1110 - Collect Sample SB-05-37				
									from 2'-4'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: SH. St. = siltstone; wth = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-35
DATE: 12-09-99
GEOLOGIST: S. Petapko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
1112	0	N/A / 12	14/24		med dense		3" broken asphalt + gravel 5" brn sandy silt + gravel		dry / damp	0.0	0.0	0.0	0.0
	2	24 / 16			v. stiff		2" reddish silty clay / clayey silt						
1125	2	14 / 13	16/24		stiff		reddish to red-brn silty clay		wet → poss.	—	—	—	—
	4	22 / —		T.D.: 4	v. stiff		(spoon bott full)		perched water from above (gravel base zone)				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Insufficient sample volume in first boring → drill supplemental boring (see p. 2)

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well-I.D.#: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-35
DATE: 12-09-99
GEOLOGIST: S. Pokopke
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
1255	0						auger down to 1.5 FT BGS						
	1.5												
1308	1.5	4/6	16/24		med. stiff		0.5" dk brn gravel base 15.5" reddish silty		damp	0.0	0.0	0.0	0.0
	3.5	6/8			↓		clay to clayey silt						
1312	3.5	11/11	24/24		stiff		4" lag as previous 20" reddish clayey		damp	0.0	0.0	0.0	0.0
	5.5	20/20			v. stiff		silt / silty clay						
1315	5.5	16/21	24/24		v. stiff		2" lag 22" clayey silt / silty		damp	0.0	0.0	0.0	0.0
	7.5	27/25			↓		clay						
1320	7.5	18/19	6/24		v. stiff		6" reddish clayey silt to with silt/clay		damp / dry	0.0	0.0	0.0	0.0
	9.5	50		T.D = 8.5'	hard		tr. gray mottling						
									1330 - Collect sample SB-05-38				
									from 3.5' to 5.5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: with = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-36
DATE: 12-09-99
GEOLOGIST: S. Pokoke
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
1355	0						auger down 1 FT BGS						
	1												
1345	1	9/10	17/24		Stiff		2" dk brn gravel + sand		wet/muddy — perched water?	0.0	0.0	0.0	0.0
	3	9/9			↓		15" red-brn to reddish clayey silt, tr. lt. brn s.s. trays.		damp				
1348	3	14/17	19.5/24		v. stiff		1" lay 19.5" red-brn clayey		damp	0.0	0.0	0.0	0.0
	5	22/29			↓		silt; tr. brn + gray mottling						
1355	5	36/44	18.5/24		hard		red-brn clayey silt to wth. sh. st.		damp	0.0	0.0	0.0	0.0
	7	42/50	over 2"	T.D.=6.5'	↓								
									1350 - Collect sample SS-05-27				
									from 1'-3'				
									1400 - Collect sample SB-05-39				
									from 3'-5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: slt. st. = siltstone; wth = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: N/A

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-37
DATE: 12-09-99
GEOLOGIST: S. Pelopke
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1' BGS						
	1												
1421	1	7/5	18.5/24		Med. stiff		2" gravel + sand		wet/muddy → perched water	0.0	0.0	0.0	0.0
	3	4/5			↓		16.5" dk brn clayey silt, tr. brown mottling w/ leaves, twigs, + roots		→ small pockets organic; poss. original topsoil or fill				
1424	3	4/4	14/24		Soft		dk brn silty clay/clayey silt		wet / damp	0.0	0.0	0.0	0.0
	5	4/5			med. stiff		w/ poss. black ashes, burnt piece of wood		poss. perched water (waste fill)				
							brn-gray silty clay near bottom of interval		red-brn S.S. frag lodged in shoe				
1427	5	50 6/3"	3/24		hard		3" black/dark brown muddy clay w/		wet	0.0	0.0	0.0	0.0
	7			T.D. = 5'			red-brn S.S. frags (hard)						
									1425 - Collect sample SS-05-25 from 1'-3'				
									1435 - Collect sample SB-05-40 from 3'-5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: S.S. = sandstone

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekran Auger Rig

BORING NUMBER: SB-05-38
DATE: 10-09-99
GEOLOGIST: S. Pekeke
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
–	0						Auger down 1 FT BGS						
	1												
1435	1	6/8	15/24		med. stiff		11" dk brn/black gravel 3" dk brn/brn		damp	0.0	0.0	0.0	0.0
	3	9/12			stiff		clayey silt, sm. gravel						
							11" reddish to red-brn clayey silt						
1440	3	16/22	18/24		v. stiff		2" reddish silty clay + brn/dk brn		damp	0.0	0.0	0.0	0.0
	5	24/38			↓		gravel + silt lay 16" red-brn clayey silt						
1445	5	38/42	16/24		hard		2" brn sand + black gravel lay		damp/dry	0.0	0.0	0.0	0.0
	7	50		T.D.: 6.5'	↓		14" red-brn clayey silt to with. sh.						
							st.		1445 - Collect sample SS-05-29				
									from 1'-3'				
									1455 - Collect sample SB-05-41				
									from 3'-5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: sh. st. = siltstone; with = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekwin Auger Rig

BORING NUMBER: SB-05-39
DATE: 12-10-99
GEOLOGIST: S. Pelapko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1 FT BGS						
	1												
0844	1	6/7	18.5/24		med. stiff		4" brn silty clay, tr. lt. brn s.s. frags.		dump	0.0	0.0	0.0	0.0
	3	11/6			stiff		8" brn to red-brn clayey silt / silty clay w/ s.s. frags						
							3" brn silty clay + black gravel to red-brn silty clay / clayey silt		→ black mottling → prev. dragging organic debris				
0846	3	7/11	16.5/24		stiff		red-brn clayey silt, tr. gray mottling + sh. st frags.		dump	0.0	0.0	0.0	0.0
	5	11/13			↓								
0849	5	11/20	21/24		v. stiff		red-brn silty clay to clayey silt to		wet / saturated →	0.0	0.0	0.0	0.0
	7	26/35		T.D.=7'	hard		with sh. st.) tr. gray mottling		perched water zone?				
									OBSS - Collect sample SB-05-42 from 3'-5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: S.S. = Sandstone; sh. st. = siltstone; wth. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekron Auger Rig

BORING NUMBER: SB-05-40
DATE: 12-10-99
GEOLOGIST: S. Pekopko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1FT BGS						
	1												
0909	1	5/7	18/24		med. stiff		1" black / dk brn gravel + sand		wet / muddy; perched water	0.0	0.0	0.0	0.0
	3	12/14			Stiff		17" red-brn silty clay to clayey silt		damp				
0912	3	14/22	19/24		v. stiff		6" brn / dk brn / black gravel + sand / lay		wet / muddy	0.3	0.0	0.0	0.0
	5	26/28			↓		13" red-brn silty clay to clayey silt → becoming harder near bottom, sm. gray mottling		damp				
0916	5	21/31	12/24		v. stiff		4" lay as previous (wet)			0.0	0.0	0.0	0.0
	7			T.D = 6'			8" red-brn clayey silt to wth. slt. st., sm. gray, orange-brn mottling		damp; hard slt st. bedded in shale				
									0925 - collect sample SB-05-43 from 2'-4'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0-2

Remarks: slt. st. = siltstone; high humidity conditions causing elevated PID readings
wth. = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tetra Auger Rig

BORING NUMBER: SB-05-41
DATE: 12-10-99
GEOLOGIST: S. Pelepko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1FT BGS						
	1												
0938	1	7/6	21/24		med. Stiff		3" black/brn/dk brn gravel + sand		wet/muddy (moist) water	0.0	0.0	0.0	0.0
	3	8/10			Stiff		18" red brn silty clay to clayey silt, gray with. S.S. frag.		damp				
0942	3	10/12	10/24		Stiff		lay at top 10" red-brn clayey		damp	0.0	0.0	0.0	0.0
	5	13/16			↓		silt						
0945	5	12/13	17/24		Stiff		3" lay 17" red-brn clayey		damp	0.0	0.0	0.0	0.0
	7	14/26			v. Stiff		silt with sh. st. frags.						
0951	7	20/26	14.5/24		v Stiff		red-brn clayey silt to wtr. slt. st.		damp	0.0	0.0	0.0	0.0
	9	30		T.D.=8.5'	hard				wtr. slt. st. lodged in				
									shoe				
									0940 - Collect sample SS-05-30 from 1'-2'				
									0955 - Collect Sample SB-05-44				
									from 3.5'-6'				

* When rock conng. enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: slt. st. = siltstone ; s.s. = sandstone . Drive additional split-spoon adjacent to first boring to acquire additional sample volume. wtr. = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telaron Auger Rig

BORING NUMBER: SB-05-42
DATE: 12-10-99
GEOLOGIST: S. Pokpku
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1 FT BGS						
	1												
1021	1	13/12	14/24		stiff		5" brn clayey silt 3" lt. brn s.s. frags		damp	0.0	0.0	0.0	0.0
	3	21/23			v. stiff		6" red-brn, clayey brn silt,		dry s.s. frag.				
							some silty clay + s.s. frags.		locked in shoe				
1024	3	42/50	7/24		hard		2" brn clayey silt lay		damp lay	0.0	0.0	0.0	0.0
	5	over 3"		T.D.=3.5'			5" gray-brn, Fe-stained, with s.s.						
									1025 - collect sample SS 05-31 from 1'-2'.				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: S.S. = sandstone. Additional spoon driven adjacent to first boring to acquire necessary sample volume
wth = weathered

Converted to Well: Yes ____ No X Well I.D. #: —N/A—

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-43
DATE: 12-10-99
GEOLOGIST: S. Pelepka
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Asphalt						
—	0						Auger down 1 FT BGS						
	1												
1038	1	4/6	19/24		med. stiff		10" brn/blk brn silt, sm. clay to silty		dump	2.2	0.0	0.0	0.0
	3	6/10			↓		clay, with. S.S. frags 9" red-brn silty clay		top 10" → poss. fill				
1040	3	8/12	19.5/24		stiff		4" lag 5" red-brn silty clay		damp	0.0	0.0	0.0	0.0
	5	16/16			v. stiff		14.5" red-brn clayey silt						
1045	5	8/14	15.5/24		stiff		2" lag 15.5" red-brn clayey		damp	0.0	0.0	0.0	0.0
	7	16/17			v. stiff		silt, tr. gray mottling						
1055	7	19/32	10/24		v. stiff		red-brn clayey silt		dump	0.0	0.0	0.0	0.0
	9			T.D.=8'			to wth. siltstone		hard, gray clay lodged in spoon				
									1100-collect sample SB-05-45 from 3.5'-5.5'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0-0.2

Remarks: High humidity conditions causing elevated PID readings.
wth. = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-44
DATE: 12-10-99
GEOLOGIST: S. Pelepko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1112	0	3/3	22/24		Soft		4" brn silt loam + roots		pipe at glass cut top	0.0	0.0	0.0	0.0
	2	5/7			med. stiff		brn, red-brn silty clay + yel.-brn		damp				
							with S.S. frags.						
							black gravel + dk brn clayey silt at bottom of interval		fill?				
1116	2	7/8	10/24		med. stiff		dk brn clayey silt		fill?	0.0	0.0	0.0	0.0
	4	8/17			stiff		to silty clay w/ abundant wood		damp				
							frags. → roots, twigs, or processed wood?						
							black staining →						
							decomposing organic debris						
1119	4	17/13	20/24		v. stiff		red-brn clayey silt		damp	0.0	0.0	0.0	0.0
	6	13/11			stiff		gray mottling						
1124	6	21/24	6/24		v. stiff		6" brn to gray S.S.		wet /sat./	0.0	0.0	0.0	0.0
	8	50/over 2"		T.D.: 7'	hard		frags.		muddy → perched water?				
									1120 - collect sample SS-05-32				
									from 6" - 24"				
									1125 - collect sample SB-05-46.				
									from 2' - 5'				
									1130 - collect sample SB-05-				
									47 from 5' - 6'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: S.S. = Sandstone; wth = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Tekron Auger Rig

BORING NUMBER: SB-05-45
DATE: 12-10-99
GEOLOGIST: S. Pelepko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1150	0	2/2	13/24		v soft		brn silt loam roots brn to red-brn		wet	–	–	–	–
	2	3/4			soft		silty clay / clayey silt, sm. orange-brn						
							mottling, tr. wth. S.S. frags.		piece of tarp at bottom				
									of shoe fill?				
1152	2	5/6	22/24		med stiff		red-brn clayey silt, sm. brn. gray.		damp	–	–	–	–
	4	12/19			v. stiff		orange-brn mottling						
1154	4	35/42	13/24		hard		red-brn clayey silt to wth. sh. st.		damp	–	–	–	–
	6	50/3" wr		T.D. = 5'	hard								
									1155 - Collect sample SS-05-33				
									from 6" - 24"				
									1200 - Collect sample SB-05-46				
									from 2' - 4'				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: S.S. = sandstone; SH. St. = siltstone. PID malfunctioning due to moderate to heavy precipitation with = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-46
DATE: 12-21-99
GEOLOGIST: S. Pekoko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0950	0	3/3	20.5/24		soft		brn silt loam w/ roots to brn clayey silt,		damp	0.0	0.0	0.0	0.0
	2	7/7			med. stiff		sm. sand tr. glass, Fe staining,		fill				
							+ rock frags.						
0954	2	5/6	18.5/24		med stiff		brn clayey silt/ silty clay to		damp	0.0	0.0	0.0	0.0
	4	7/6			↓		gray-brn clayey silt		fill				
0957	4	5/5	8/24		med. stiff		brn-gray clayey silt tr. black mottling		wet/sat → perched H_2O	0.0	0.0	0.0	0.0
	6	11/17			stiff				fill poss. waste?				
1003	6	9/12	11/24		stiff		brn, brn-gray silty sand to wth.		wet/sat	0.0	0.0	0.0	0.0
	8	14/22			↓		s.s.		piece of twisted				
									metal in				
									shoe → from				
									above?				
1015	8	28/50	14/24		hard		wth. brn-gray s.s.		wet/sat →	12.8	0.0	0.0	0.0
	10	over 3"		T.D. = 9					oily petroleum/fuel				
									odor noted				
									1025 - collect				
									sample SB-05-49				
									from 3'-5' BGS				
									(MS/MSD collected)				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: S.S. = Sandstone, wth. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-47
DATE: 12-21-99
GEOLOGIST: S. Pelepko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1040	0	3/3	13.5/24		soft		brn silt loam + roots to brn clayey silt		damp	0.0	0.0	0.0	0.0
	2	4/5			↓								
1042	2	4/10	24/24		med. stiff		tan/brn, clayey silt red-brn		damp	0.0	0.0	0.0	0.0
	4	13/12			stiff		brn silty sand + wth. s.s. frags						
1046	4	10/13	24/24		stiff		brn, brn-gray silty sand + microcrys		damp	0.0	0.0	0.0	0.0
	6	13/16			↓		wth. s.s. near bottom of spoon → v. dk brn mottling						
1052	6	11/13	24/24		stiff		brn silty (muddy) sand tg to brn-gray wth. microcrys s.s.		wet/sat → perched H2O	0.0	0.0	0.0	0.0
	8	16/50		T.D.=8'	hard								
									no sample collected → encountered only clean native formational material				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: S.S. = Sandstone ; wth. = weathered

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-48
DATE: 12-21-99
GEOLOGIST: S. Pelpko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1125	0	2/2	21.5/24		v. soft		9" brn silt loam + roots		damp	0.0	0.0	0.0	0.0
	2	6/10			med. stiff		9" brn, lt. brn clayey silt		poss. fill				
							4" red-brn, lt brn, brn mottled clayey silt						
							+ wth. s.s. frags.						
1128	2	7/6	16/24		med. stiff		16" red-brn, brn, lt		damp	0.0	0.0	0.0	0.0
	4	10/9			stiff		brn clayey silt + wth. s.s. + slt st.		poss. fill				
							frags (micaceous)						
							2" red-brn clayey silt		damp native soil				
1133	4	8/10	21/24		stiff		red-brn clayey silt		damp	0.0	0.0	0.0	0.0
	6	11/11			↓		brn mottling						
1140	8	12/14	21/24		stiff		red-brn clayey silt		wet to damp	0.0	0.0	0.0	0.0
	8	18/46		T.D.=8'	hard		to wth. siltstone, lt. gray mottling		perched water				
									1145 - Collect sample SB-05-50				
									from 2'-6' BGS. Field duplicate				
									SB-05-102 collected at location.				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: s.s. = sandstone; slt.st. = siltstone; wth. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-49
DATE: 12-21-99
GEOLOGIST: S. Pelepko
DRILLER: J. Di Pasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample Breathing Zone	Borehole**	Driller BZ**
1200	0	2/2	22/24		v soft		brn silt loam + roots to brn clayey silt /		damp	0.0	0.0	0.0	0.0
	2	3/5			soft		silty clay, piece of root + glass frag.		till				
							near bottom of interval						
1204	2	3/6	19/24		med. stiff		11.5" brn, red-brn clayey silt		damp	0.0	0.0	0.0	0.0
	4	6/7			↓		6.5" brn, orange-brn, white, black cinders		till → waste				
							corroded metal, glass, ceramic metal + sand						
							silt, clay						
1208	4	4/2	7/24		soft		black, orange-brn, red brn sand silt		damp	0.0	0.0	0.0	0.0
	6	2/5			↓		clay, + corroded metal, cinders, green glass		till / waste				
1212	6	6/8	20/24		med. stiff		12" red-brn clayey silt		damp	0.0	0.0	0.0	0.0
	8	11/14			stiff		6" brn sandy silt 2" red-brn clayey silt, gray mottling						
1215	8	10/19	21/24		stiff		red-brn clayey silt,		damp	0.0	0.0	0.0	0.0
	10	19/23			v. stiff		getting harder near bottom, tr. gray, orange-brn mottling						
1220	10	18/50	12/24		hard		red-brn clayey silt to with sh. st., tr.		wet / sat. to wet	0.0	0.0	0.0	0.0
	12			T.D. = 11'			gray mottling						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0.0

Remarks: sh. st. = siltstone ; wth. = weathered
Collect sample SB-05-51 from 3'-6' BGS (1215)
1225 - collect sample SB-05-53 from 6'-9' BGS

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NAWC Warminster-Site 5
PROJECT NUMBER: 7606
DRILLING COMPANY: Raab Well Drilling, Inc.
DRILLING RIG: Telecon Auger Rig

BORING NUMBER: SB-05-50
DATE: 12-21-99
GEOLOGIST: S. Pelepko
DRILLER: J. DiPasquale

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
1254	0	3/8	22/24		med. stiff		brn silt loam + roots brn clayey silt, tr.		damp	0.0	0.0	0.0	0.0
	2	11/12			stiff		red-brn mottling, sm. black slate frags.		fill				
1305	2	11/14	24/24		stiff		brn clayey silt/silty clay, tr. gravel.		damp	0.0	0.0	0.0	0.0
	4	14/13			↓		pos cinder becoming brn-gray near bottom of interval		fill				
1308	4	8/8	24/24		med. stiff		15" dk brn-gray clayey silt to silty clay, sm.		damp	0.0	0.0	0.0	0.0
	6	10/17			stiff		orange-brn, red-brn mottling near top inch		fill				
							5" lt brn-gray clayey silt						
							4" brn clayey silt, tr. gravel + s.s. frag.						
1313	6	15/25	22/24		v. stiff		3" tan/brn clayey silt (fill)		damp	0.0	0.0	0.0	0.0
	8	25/50		T.D.=8'	hard		11" red-brn clayey to sandy silt + with s.s. frags						
							6" red-brn clayey silt, becoming harder near bottom of interval						
									1320 - Collect Sample SB-05-52 from 3-5' BGS				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: S.S. = sandstone; with. = weathered

Drilling Area Background (ppm): 0.0

Converted to Well: Yes ____ No X Well I.D. #: -N/A-

APPENDIX D

PHASE I CONFIRMATION BORING LOGS

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-1 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. 6' 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stendt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See site map

NOTES Start 10:10
Finish 10:30

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	HNU ~~SAMPLE NUMBER~~	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
	OL		ND		0'-4" Brown organic silt (OL)
1	ML		ND		4"-1' Red-Brown silt (ML)
2	ML		ND		1'-3' Dark brown silt (ML)
3			ND		3'-6' Olive-brown silty clay (CL)
4	CL		1		Contains metal debris
5			5-10		Hit water & metal debris at 6'
6					
7					
8					
9					
10					

Auger refusal → 6'

Material appears to be fill

Waste found:
Much metal debris.

Metal cylinders and wires

PAGE ___ OF ___

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-2 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. None 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See Site map

NOTES Start 10:35 10:45 Finish

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	~~SAMPLE NUMBER~~ HNU	~~BLOW COUNT/ RQD/% REC.~~ OVA	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1	OL		ND	ND	0-1' Brown organic silt (OL)
2			ND	ND	1'-4' Red-brown m-grained silt (ML)
3	ML		ND	ND	4' - Bedrock
4			ND	ND	
5	Bedrock				
6					
7					
8					
9					
10					
					Material appeared to be native red silt. (Stockton)
					No Waste

PAGE OF

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER NAVY

LOCATION SS-3 W.O. NUMBER 9522-20005

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. None 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Barber & Ni DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/2/90

SKETCH MAP

Site 5

See Site Map

NOTES Start 11:20
Finish 11:40

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	~~SAMPLE NUMBER~~ HNU	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1	OL				0-1' Brown organic silt (OL)
2	ML				1'-4' Brown-gray Sandy silt (ML)
					4'-5' Orange-brown clayey silt (ML)
	ML				5'-10' Mar-Red-brown medium g silt
5					
6					
7					
8	ML				Boring Depth → 10'
9					
10					
					Top 4' appeared to be fill
					From 4-6' " " " native Stockton
					No Waste Found

PAGE OF

SMC ENVIRONMENTAL SERVICES GROUP

PROJECT NADC OWNER

LOCATION S5-4 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. None 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See site map

NOTES Start 10:45
Finish 11:00

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	HNU SAMPLE NUMBER	OVA ~~BLOW COUNT~~ / ~~RQD/% REC.~~	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1	OL		ND	ND	0-4' Brown organic silt (OL)
2			ND	ND	with a little glass
3	ML		ND	ND	1-4.5' Orange-red silt (ML)
4			ND	ND	with small wood fragments
5			ND	ND	& glass
6	ML		ND	ND	4.5-7' Native maroon-red silt (ML)
7			ND	ND	7' Bedrock
8	Bedrock				
9					
10					

Top 4.5' was fill
4.5 and down was native

Waste Found:
Small amts. of glass and wi
One chunk of metal.

PAGE ___ OF ___

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION S5-5 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

see Site Map

NOTES Start 11:05 Finish 11:25

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE NUMBER	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1			ND	ND	0-3' - Brown organic silt (OL)
			ND	ND	3'-4.5' Lt. Brown fine silt (ML)
			ND	ND	4.5'-6' Red-brown fine silt (ML)
4			ND	ND	6'-8' Maroon-red silt (ML)
5			ND	ND	8'-10' Orange-olive silt (ML)
6			ND	ND	
7			5-15	ND	
8			↓	1	
9				1	
10			↓	8-10	
					Material appeared to be fill. Had hits from HNU and OVA
					NO Waste found

PAGE OF

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-6 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stovall LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See Site map

NOTES Start 1:40 Finish 2:00

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	~~SAMPLE NUMBER~~ HNU	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1			ND		0 – 2' Brown organic silt (OL)
2			ND		2' – 4' Orange-brown silty clay (CL)
3			ND		4' – 7' Red m-grained silt (ML)
4			ND		7' – 10' Maroon-Brown silty clay (CL)
5			ND		
6			ND		
7			ND		
8			ND		
9			ND		
10			ND		
					Material is probably native
					Waste Found: Nail
					beer can tab
					Screw
					Candy Wrapper

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-7 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. None 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber Sons DRILLING METHOD Auger

DRILLER B. Stovall LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See Site Map

NOTES Started 1:00 Finished 1:15

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	HNU ~~SAMPLE NUMBER~~	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
1	OL		ND		0-2' Brown- organic silt (OL)
2			ND		2'-5' Orange-brown silty clay (CL)
3			ND		found metal screw
4	CL		ND		5'-6.5' Red-brown silty clay (CL)
5			ND		6.5'-8' Maroon-red Silt (ML)
6	CL		ND		8'-10' Weathered bedrock
7			ND		
8	ML		ND		
9			ND		
10	WB		ND		
					Material looks native
					Waste Found:
					Several glass fragments
					One metal screw

PAGE ___ OF ___

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-8 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber/Sonn DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See Site Map

NOTES Started 1:20
Finished 1:40

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	~~SAMPLE NUMBER~~ HNU	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
	OL				0 - 6" Brown organic silt (OL)
1					
2	ML + CL				6" - 5' Yellow-brown silt (ML) with clay.
3					
4					5' - 6' Red-brown silt (ML)
5					6' - 8' Brown silt with tr pebbles (ML)
6	ML				8' - 9' Red silt and clay (ML + CL)
7	ML				9' - Bedrock
8					
9	ML+CL				
10	Bed				

Material appeared to be mostly fill

NO WAste Found

PAGE ____ OF

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT _____ OWNER _____

LOCATION SS-9 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. _____ 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5

See Site Map

NOTES Start 3:10
Finish 3:30

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	~~SAMPLE NUMBER~~ HNU	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
			ND		0-6" Brown organic silt (OL)
			ND		6"-2' Red m-grained silt (ML)
			ND		2'-6 Gray-black clay (CL)
			ND		Hit water at 4.5'
			ND		6'-8' Red-brown clay (CL)
			ND		8' - Refusal and gushing groundwater
			ND		
			ND		
					Boring depth → 8'
					Material looks like fill metal pieces were noticed while backfilling the borehole pieces in 2'-6' Interval?
					Waste Found: 1 piece of wood 1 " " metal

PAGE ____ OF ____

SMC ENVIRONMENTAL SERVICES GROUP

DRILLING LOG

PROJECT NADC OWNER

LOCATION SS-10 W.O. NUMBER N/A

WELL NUMBER N/A TOTAL DEPTH N/A DIAMETER 8"

SURFACE ELEV. N/A WAT. LEV.: INIT. None 24-HRS N/A

SCREEN: DIA. N/A LENGTH N/A SLOT SIZE N/A

CASING: DIA. N/A LENGTH N/A TYPE N/A

DRILLING COMPANY Garber & Sons DRILLING METHOD Auger

DRILLER B. Stoudt LOG BY PDB DATE DRILLED 5/1/90

SKETCH MAP

Site 5
See Site Map

NOTES Start 2:30
Finish 3:00

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	HNU SAMPLE NUMBER	BLOW COUNT/ RQD/% REC.	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES, MOISTURE, OVA READING)
	Fill		ND		0-6" Soil & gravel fill
1	ML		ND		6" - 2' Olive silt (ML)
2			ND		2' - 4.5' Lt. brown m-grained silt (ML)
3	ML		ND		4.5 - 6' Red-maroon silty clay (CL)
4			ND		6' - 7' Lt. Brown coarse silt (ML)
5	CL		ND		7' - 10' Maroon-red medium silt (ML)
6	ML		ND		
7			ND		
8	ML		ND		
9			ND		
10					
					Material appears to be all fill with the exception of 7-10' which looks native.
					NO Waste Found

PAGE OF

APPENDIX E

TABULATED SURVEY DATA

FEATURE COORDINATES			
following coordinates were obtained using April 4, 1965, aerial photographs.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
Trench 5B- End Point	2751859.772	326273.099	339
Trench 5B- Center Point	2751924.295	326222.877	332
Trench 5B- End Point	2751999.010	326167.960	No value due to sun glint
Pennsylvania State plane coordinate system, south zone. 1927 North American Datum. National Geodetic Vertical Datum of 1929.			

FEATURE COORDINATES			
following coordinates were obtained using October 20, 1967, aerial tographs.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
Trench 5C- End Point	2751865.759	326297.872	341
Trench 5C- Center Point	2751907.101	326268.605	338
Trench 5C- End Point	2751949.314	326235.543	337
Pennsylvania State plane coordinate system, south zone. 1927 North American Datum. National Geodetic Vertical Datum of 1929.			

FEATURE COORDINATES			
The following coordinates were obtained using September 23, 1958 aerial photographs. Refer to EPIC Report 93053, Figure 6 for descriptions of features listed.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
TR 3 - End point	2751775.767	326187.206	333.856
TR 3 - Center point	2751859.799	326125.968	333.281
TR 3 - End point	2751933.332	326068.594	334.243
POSS TR 4 - End point	2751691.373	326333.390	347.654
POSS TR 4 - Center point	2751604.662	326219.400	343.275
POSS TR 4 - End point	2751534.216	326124.054	342.909
EX 3/MM 2 - Corner point	2751621.622	326642.124	361.055
EX 3/MM 2 - Corner point	2751873.999	326420.590	349.917
EX 3/MM 2 - Corner point	2751612.864	326027.861	338.460
EX 3/MM 2 - Corner point	2751299.313	326373.087	357.402
EX 3/MM 2 - Center point	2751620.714	326317.235	344.844
Pennsylvania coordinate system, south zone. 1927 North American Datum, National Geodetic Vertical Datum of 1929.			

FEATURE COORDINATES			
The following coordinates were obtained using March 31, 1965 aerial photographs. Refer to EPIC Report 93053, Figure 9 for descriptions of features listed.			
Feature	Easting (ft)	Northing (ft)	Elevation (ft)
TR 5 - End point	2751829.687	326244.017	335.830
TR 5 - Center point	2751877.945	326209.132	335.335
TR 5 - End point	2751933.945	326170.435	335.459
POSS TR 6 - North End point	2751995.956	325747.998	323.080
POSS TR 6 - North Center point	2752064.898	325694.757	321.842
POSS TR 6 - North End point	2752146.007	325625.333	320.848
POSS TR 6 - South End point	2751846.377	325770.127	327.492
POSS TR 6 - South Center point	2751980.578	325682.025	322.784
POSS TR 6 - South End point	2752096.409	325600.964	322.351
Pennsylvania coordinate system, south zone. 1927 North American Datum. National Geodetic Vertical Datum of 1929.			

SITES 5 + 7

APPENDIX F

SAMPLE LOG SHEETS

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon / Pond
- [ ] Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. W-SS-05-06 Source Location Site #5

	Composite Sample Data		
	Sample	Time	Color / Description
Sample Method: Hand Auger			
Depth Sampled: 12-24"			
Sample Date & Time: 04/13/95 1252			
Sampled By: C. Meyer			
Signature(s):			

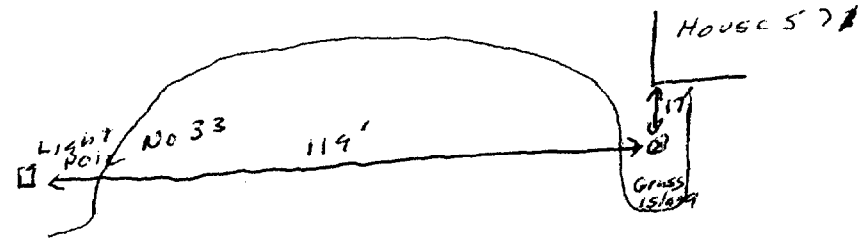
Type of Sample
- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Reddish Brown	Dry Silty Clay

Analysis:
- TCL VOL
- BNA Pest / PCB
- TAL Metals, Cyanide

Observations / Notes

* Field Duplicate W-SS-05-11 1307



	Organic	Inorganic
Traffic Report #		
Tag #		
AB #		
Date Shipped		
Time Shipped		
Lab		
Volume		

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon / Pond
- [ ] Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. W-55-05-07 Source Location Site 5

Sample Method: Hand Auger	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 14 - 20"			
Sample Date & Time: 4/13/95 1116			
Sampled By: Andy Spaugh			
Signature(s): [signature]			

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

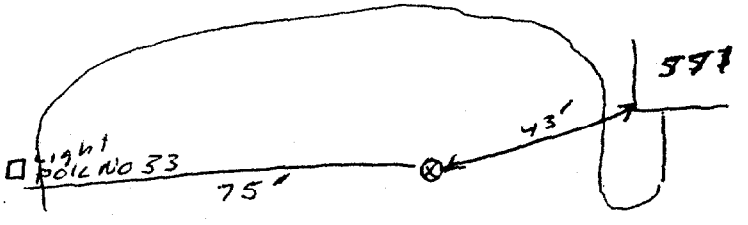
Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Drk Brown	Sandy Silt with pebbles

Analysis:

BNA Pest PCB
TAL Metals Cyanide
TCL VOC

Observations / Notes



	Organic	Inorganic
Traffic Report #		
Tag #		
AB #		
Date Shipped		
Time Shipped		
Lab		
Volume		

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon / Pond
- [ ] Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. W-SS-05-08 Source Location Site 5

Sample Method: SS Hand Auger	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 14-20"			
Sample Date & Time: 4/13/95 1147			
Sampled By: A. Spaugh			
Signature(s): [signature]			

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

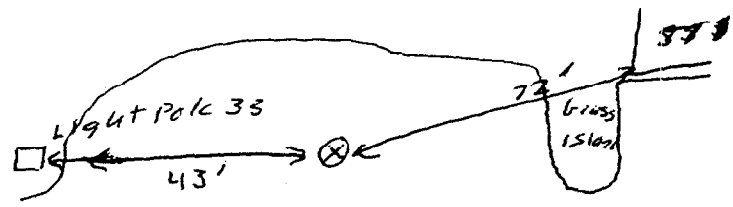
Sample Data

Color	Description: (Sand, Clay, Dry; Moist, Wet, etc.)
Dk Brown	Clay Sand with fill. styrofoam, fabric, wood

Analysis:

BNA, Pest / PCB
TAL Metals / Cyanide
TCL VOC

Observations / Notes



	Organic	Inorganic
Traffic Report #		
Tag #		
AB #		
Date Shipped		
Time Shipped		
Lab		
Volume		

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon / Pond
- [ ] Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. W-SS-05-09 Source Location Site #5

	Composite Sample Data		
	Sample	Time	Color / Description
Sample Method: Hand Auger			
Depth Sampled: 6-12"			
Sample Date & Time: 04/13/95 1221			
Sampled By: A. SPAUGH			
Signature(s): [signature]			

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

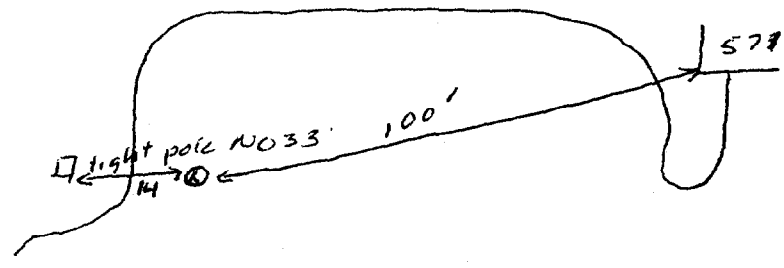
Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Dk Brown/Black	Fine Dry Sandy with pebbles.

Analysis:

BNA, Pest/PCB
TAL Metals / Cyanide

Observations / Notes



	Organic	Inorganic
Traffic Report #		
Tag #		
AB #		
Date Shipped		
Time Shipped		
Lab		
Volume		

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon / Pond
- [ ] Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. W-55-05-10 Source Location Site #5

	Composite Sample Data		
	Sample	Time	Color / Description
Sample Method: Hand Auger			
Depth Sampled: 8-16"			
Sample Date & Time: 04/13/95 1235			
Sampled By: A. Spaust			
Signature(s): [signature]			

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Sample Data

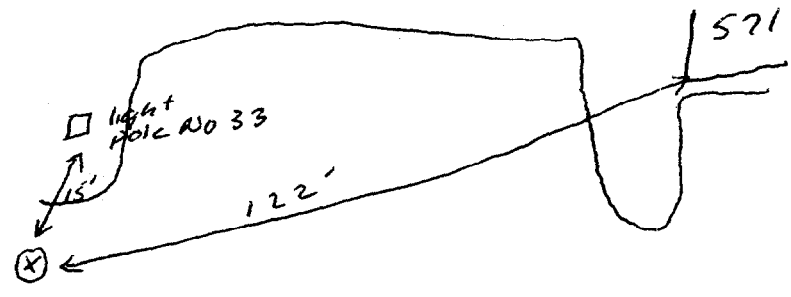
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Lt Brown	Dry Sandy Clay

Analysis:

BNA, Pest/PCB

TAL Metals / Cyanide

Observations / Notes



	Organic	Inorganic
Traffic Report #		
Tag #		
AB #		
Date Shipped		
Time Shipped		
Lab		
Volume		

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-17
Sample Location: SB-05-03
Sampled By: V. Shirkora, S. Pekoko
C.O.C. No.: 02282/02283

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 12-08-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1110 Method: Encore / SS. Trowel Monitor Reading (ppm): 0.0	6" - 24"	brn, red-brn, orange-brn, black	clayey silt (poss. fill) with ash/cinders + metal wire damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

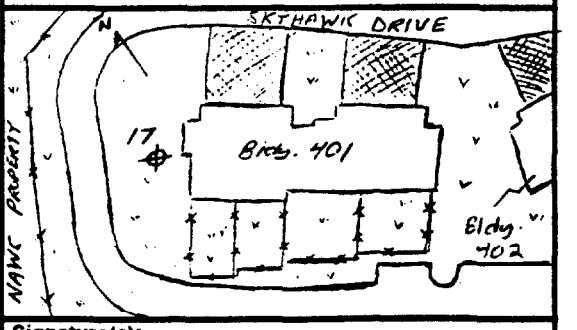
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-18
Sample Location: SB-05-04
Sampled By: V. Shirkova, S. Pokpale
C.O.C. No.: 02282/02283

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1240 Method: Encore / SS. Trowel Monitor Reading (ppm): 0.0	6"-24"	brn, gray, red-brn	silty clay, glass fragment (poss. fill) damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

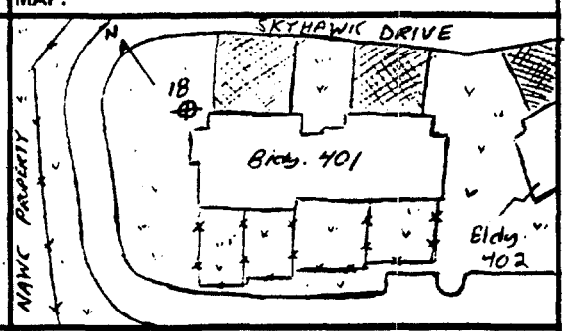
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-19
Sample Location: SS-05-05
Sampled By: V. Shickora, S. Pekpko
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [x] QA Sample Type: MS/MSD

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 11-13-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1045	10" - 18"	brn, black	silt loam to silty clay, roots, sm. gravel, + ashes/cinders, wire, wood, glass, + plastic; damp
Method: Encore/SS. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

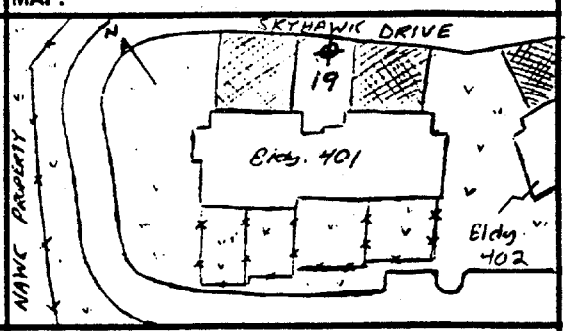
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs. TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals. Cr(VI), pH. Fe(II), ORP, sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD SS-05-37-MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-20
Sample Location: SS-05-06
Sampled By: V. Shirkota, S. Pekoke
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 10-13-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1100	10"-18"	brn	SiH loam to silty clay w/ sm. gravel + roots. Tr. glass + cinder block frags. damp
Method: Encore / SS. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

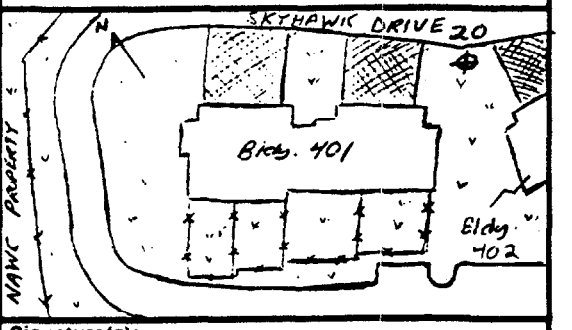
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-21
Sample Location: SB-05-07
Sampled By: S. Pelepko, V. Shickora
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0745 Method: S/S Trowel/Encore Monitor Reading (ppm): 0.0	0" - 6"	brown	silt loam with roots, damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

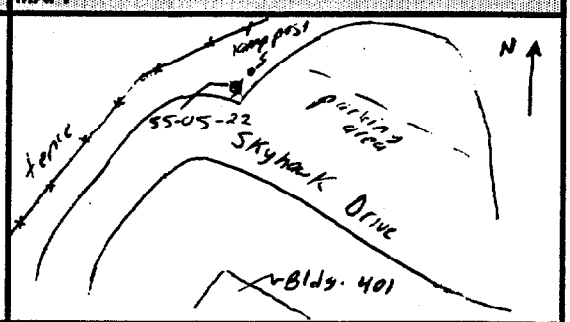
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	8 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl with S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-22
Sample Location: SB-05-06
Sampled By: S. Pelepko, V. Shickner
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0755 Method: S/S Trowel/Encore Monitor Reading (ppm): 0.0	3"-6"	brown	silt loam with roots, damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

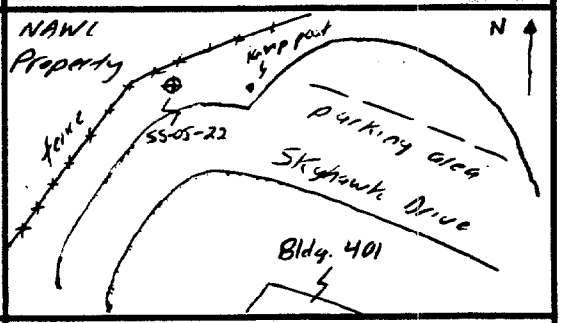
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	8 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl with S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-23
Sample Location: SB-05-08
Sampled By: V. Shickora, S. Pelepko
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0840 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	6"-18"	red-brn, brn, gray	clayey silt w/ black cinder + sm. glass (fill?) dump

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

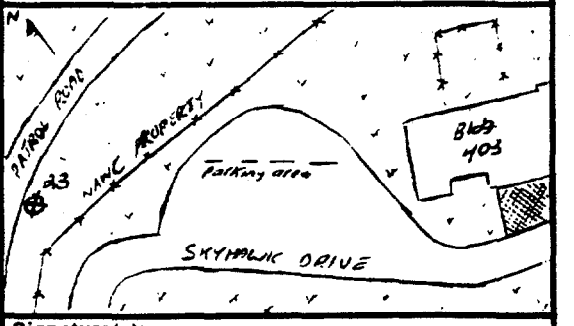
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-24
Sample Location: SB-05-09
Sampled By: V. Shickora, S. Pokko
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0915 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	6" - 18"	lt. brn - brn	clayey silt, tr. glass, brick + rock trays (fill) damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

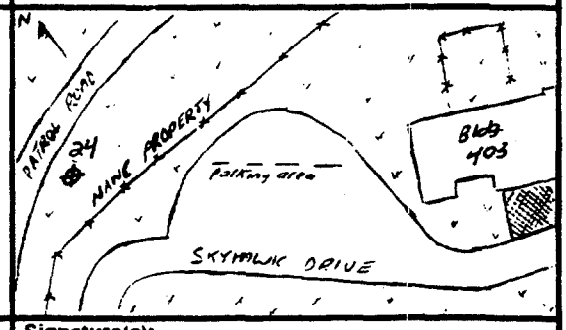
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-25
Sample Location: SB-05-10
Sampled By: V. Shickora, S. Polyako
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 12-09-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0955	6" - 18"	lt. brn - brn, red-brn	clayey silt / silty clay, piece of coal + roots (poss. fill) damp
Method: Encore / S.S. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

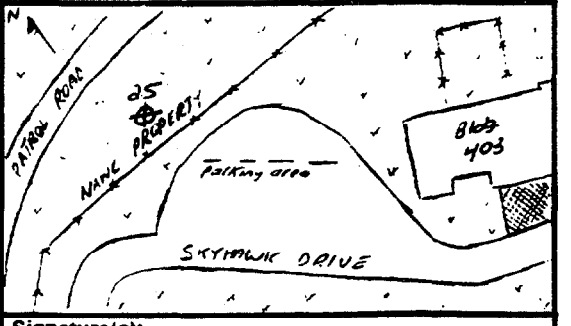
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-26
Sample Location: SS-05-01
Sampled By: V. Shirkora, S. Pokpke
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1215 Method: Encore / SS. Trowel Monitor Reading (ppm): 0.0	0.5'-1.25'	brn	Silt loam w/ roots to clayey silt, tr. with S.S. + asphalt + piece of glass (fill) damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

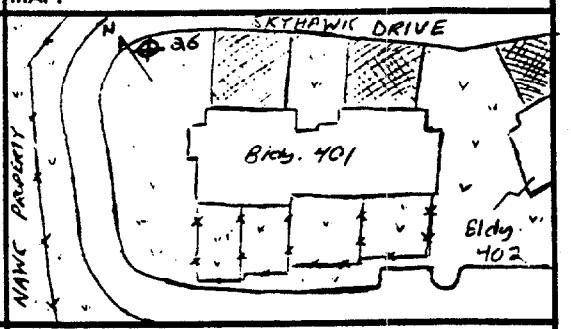
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-27
Sample Location: SB-05-13
Sampled By: V. Shickora, S. Pelpko
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1350 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	1' - 3'	lt. gray, red-brn	clayey silt + S.S. frags. wet / muddy to damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

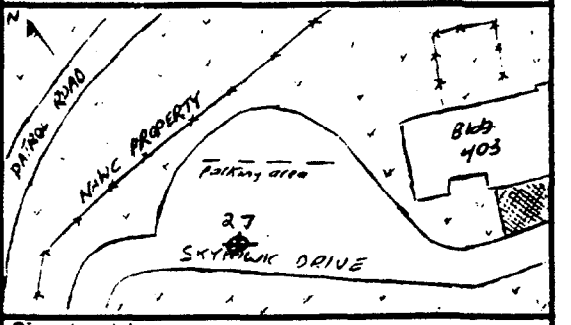
Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

TCL VOCs collected from 1'-2' interval.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-28
Sample Location: SB-05-14
Sampled By: V. Shickora, S. Rapko
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1425 Method: Encore / S.S. Trowel Monitor Reading (ppm):	1'-3'	dk brn, brn	(fill?) clayey silt w/ leaves, twigs, + roots (organic debris) wet / moist earthy odor

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

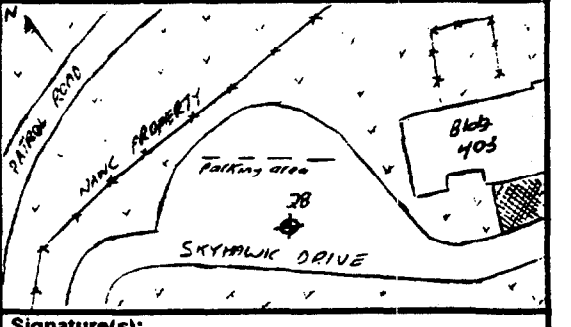
Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

TCL VOCs collected from 1'-2' interval.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-29
Sample Location: SB-05-15
Sampled By: V. Shickora, S. Pelko
C.O.C. No.: 02281

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1445 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	1'-3'	reddish, red-brn	clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

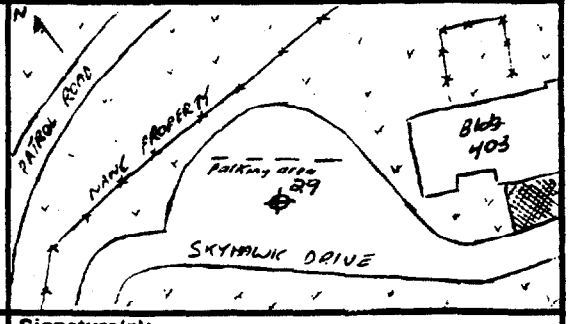
Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

TCL VOCs collected from 1'-2' interval

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-30
Sample Location: SB-05-18
Sampled By: V. Shickora, S. Pekoko
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 0940 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	1'-2'	red-brn, gray	silty clay / clayey silt + S.S. fragment dump

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

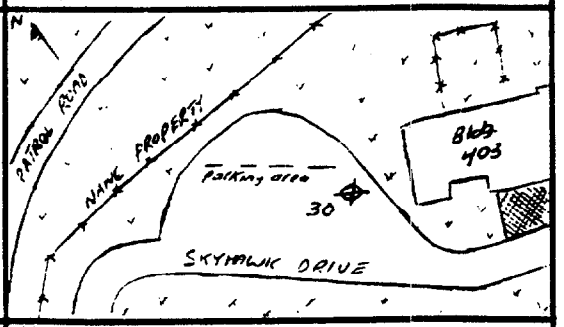
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-31
Sample Location: SB-05-19
Sampled By: V. Shickora, S. Pelepko
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1025 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	1'-2'	red-brn, H. brn-brn	clayey silt / silty clay + S.S. frags. damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

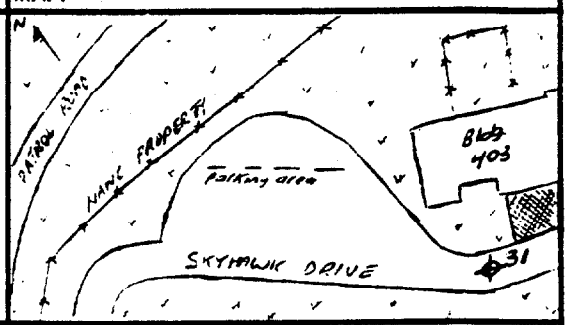
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-32
Sample Location: SB-05-21
Sampled By: V. Shickora, S. Polyako
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1120 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	6" - 24"	brn, red-brn, yel.-brn, black	silty clay / clayey silt, gravel, + S.S. frags. damp (fill?)

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

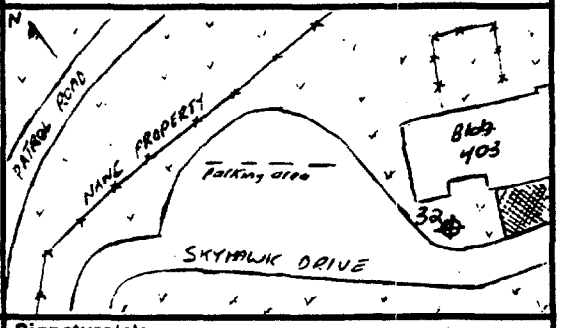
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from manually disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-33
Sample Location: SB-05-22
Sampled By: V. Shickora, S. Polako
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1155 Method: Encore / S.S. Trowel Monitor Reading (ppm): *	6"-24"	brn, red-brn, orange-brn	silty clay / clayey silt + S.S. trays. + piece of felt (fill?) wet

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

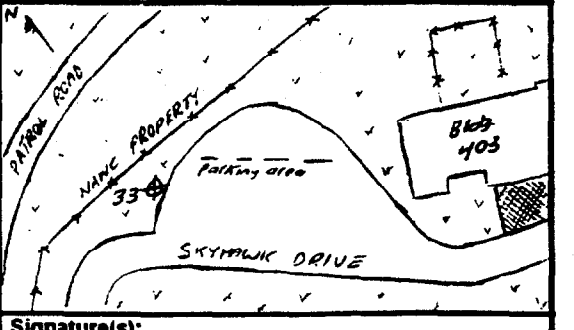
Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

* moderate to heavy rain falling → PID malfunctioning

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-34
Sample Location: SS-05-02
Sampled By: V. Shickora, S. [illegible]
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-13-99 Time: 1000 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	12" - 18"	brn	silt loam + roots damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

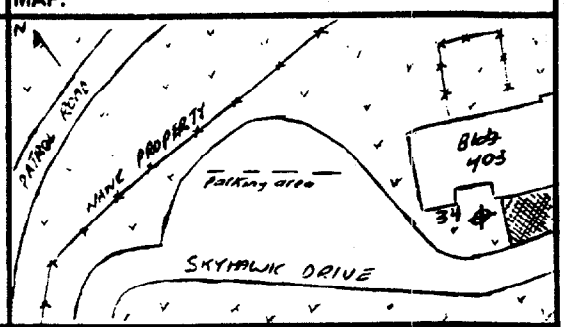
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-35
Sample Location: SS-05-03
Sampled By: V. Shickora, S. Pelpko
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-13-99 Time: 1015 Method: Encore / S.S. Trowel Monitor Reading (ppm): 0.0	12" - 18"	brn	silt loam to silty clay, sm. gravel damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

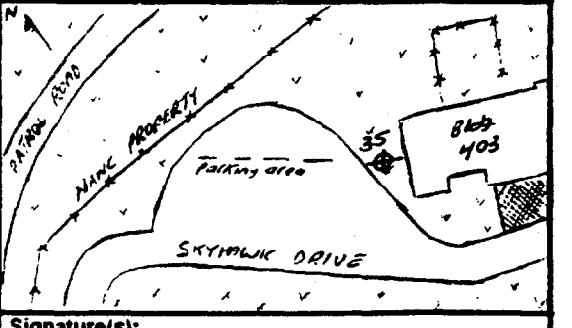
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SS-05-36
Sample Location: SS-05-04
Sampled By: V. Shickora, S. Pelpako
C.O.C. No.: -n.a.-

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [x] QA Sample Type: Blind Field Duplicate

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 12-13-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1025	10" - 18"	brn, white, black	silt loam to silty clay w/ ashes, glass frags + metal wire, sm. gravel; damp
Method: Encore / S.S. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

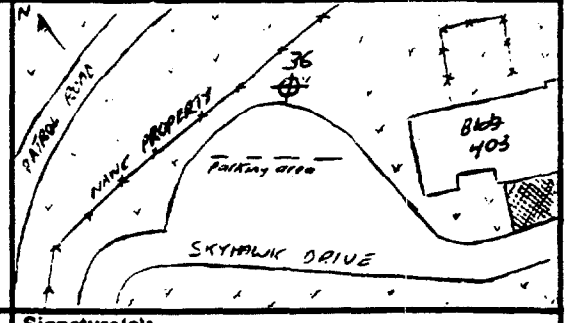
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in S.S. bowl using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	SS-05-101

Signature(s):

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 1 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. 513-05-01 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 5.5 Feet			
Sample Date & Time: 9-19-95 1143			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Orange/Brown	Silty clay with weathered sandstone Flags (damp)

Analysis:

4 ounce Jar - VOA

8 ounce Jar - TAL Metals

Observations / Notes

- Collected 58 feet southeast of southeast corner building 401 and 52 feet from southeast corner of fence of 401.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	2505135032	
Date Shipped	9-19-95	
Time Shipped	1830	
Lab	CEIMIC	
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-02 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.5 feet			
Sample Date & Time: 9-19-95 1305			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry; Moist, Wet, etc.)

Analysis:

- 4 ounce Jar - VOA (2)
- 8 ounce Jar - TAL Metals (2)

Observations / Notes

- collected 13 feet north of southeast fence corner of building 401 and 27.5 feet west of southeast corner of building 401
- This is Matrix spike / Matrix spike duplicate sample
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5032
Date Shipped	9-19-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 3 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-02D Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.5 feet			
Sample Date & Time: 9-19-95 1305			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			
Type of Sample			
☑ Low Concentration			
☐ High Concentration			
☑ Grab			
☐ Composite			
☐ Grab - Composite			

Sample Data	
Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)

Analysis:

4 ounce Jar - VOA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

Duplicate of Sample SB-05-02

(see log sheet page 2)

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5032
Date Shipped	9-19	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-03 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.0 feet			
Sample Date & Time: 9-19-95 1410			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☐ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with weathered sandstone Frags (damp)

Analysis:

4 ounce Jar - VOA (1)

8 ounce Jar - TAL metals (1)

Observations / Notes

- collected 67 feet from Northeast corner building 401 and 31.5 feet from southwest corner of building 403.

- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AS #	250513	5032
Date Shipped	9-19-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 5 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-04 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel

Depth Sampled: 4.0 Feet

Sample Date & Time: 9-19-95 1454

Sampled By: Vincent Shickora

Signature(s): [illegible]

Type of Sample
- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry: Moist, Wet, etc.)
Brown/Black	Silty clay fill with tree roots (damp)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)

Observations / Notes
- Collected 51 feet from southwest corner of building 403 and 86 feet from northeast corner building 401.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5032
Date Shipped	9-19-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 6 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. _____ Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled:			
Sample Date & Time: 6.0 Feet			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Black/Brown	Silty clay fill with pieces of paper + cardboard (moist)

Analysis:

4 ounce Jar - VOA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 20 feet northeast of WH-SB-05 and 20 feet north of WH-SB-04
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5032
Date Shipped	9-19	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-06 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 8.0 feet			
Sample Date & Time: 9-19-95 1715			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			
Type of Sample: ☑ Low Concentration ☐ High Concentration ☑ Grab ☐ Composite ☐ Grab - Composite			

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with weathered sandstone frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 19 feet from the northwest corner of building 403 and 29.5 feet from southwest corner 403.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5032
Date Shipped	9-19	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 8 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-07 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 9-20-95 0940			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with weathered Sandstone Frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 27 feet from northwest corner building 403 and 33.5 feet from southwest corner 403.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 9 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-08 Source Location Site 5

Sample Method: 24"x2" split spoon Sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 5.0 Feet			
Sample Date & Time: 9-20-95 1530			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample
- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone + shale Frags (damp)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)

Observations / Notes
- Collected 31.5 feet from southwest corner building 401 and 22 feet from southwest fence corner building 401
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20-95	
Time Shipped	1830	
Lab	CEIMIC	
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-09 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel

Depth Sampled: 5.0 feet

Sample Date & Time: 9-20-95 1116

Sampled By: Vincent Shickora

Signature(s): [illegible]

Type of Sample
- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone + shale frags (damp)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)

Observations / Notes
- collected 20.5 feet from southwest fence corner and 34 feet from southwest corner of building 401
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 11 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-10 Source Location Site 5

Sample Method: 24"x2" split spoon Sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 3.0 feet			
Sample Date & Time: 9-20-95 : 1157			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry; Moist, Wet, etc.)
Tan Brown	Silt clay with sandstone + shale frags (dry to damp)

Analysis:

4 ounce Jar - VOA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

- collected inside yard 16 feet from southwest fence corner and 17.5 feet from southeast fence corner.

- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-11 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 3.0 feet			
Sample Date & Time: 9-20-95 1233			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.) (dry to damp)
Brown	Silty clay with pieces of brick + sandstone fragments

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)

Observations / Notes

- collected 22 feet from southwest fence corner and 16 feet from southeast fence corner.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	41600
Date Shipped	9-20-95	
Time Shipped	1830	
Lab	CFI	MIC
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 13 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. 513-05-12 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel

Depth Sampled: 4.8 feet

Sample Date & Time: 9-20-95 1400

Sampled By: Vincent Shickora

Signature(s): [illegible]

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone frags (damp

Analysis:

4 ounce Jar - VOA	(2)
8 ounce Jar - TAL Metals	(2)
8 ounce Jar - Pest/PCB/BNA	(2)

Observations / Notes

- Collected 16.5 feet from northwest corner of western garage at building 401 and 16.5 feet from northeastern garage corner.
- No HNU readings above background.
- This is matrix spike / Matrix spike duplicate Sample

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-13 Source Location Site 5

	Composite Sample Data		
Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Sample	Time	Color / Description
Depth Sampled: 5.5 feet			
Sample Date & Time: 9-20-95 1450			
Sampled By: Vincent Shickora			
Signature(s):			

Type of Sample

- ☐ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Tan Brown	Silty clay with sandstone frags (dry to damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - Pest/PCB/BNA (1)

Observations / Notes

- collected 17 feet from northwest corner of eastern garage building 401 and 17 feet from northeast corner of garage.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-14 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel

Depth Sampled: 6.0 feet

Sample Date & Time: 9-20-95 1540

Sampled By: Vincent Shickora

Signature(s): [signature]

Type of Sample
- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Composite Sample Data

Sample	Time	Color / Description

Sample Data

Color	Description: (Sand, Clay, Dry; Moist, Wet, etc.)
Brown Red	silty clay with sandstone shale frags (damp)

Analysis:
- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - Pest/PCB/BNA (1)

Observations / Notes

- Collected 21 feet from western garage corner building 401 and 20 feet from eastern garage corner.
- No HNU readings above background.

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 17 of 52

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-15 Source Location [illegible]

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 5.5 feet			
Sample Date & Time: 9-20-95 1650			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)
- 8 ounce Jar - Pest/PCB/BNA (1)

Observations / Notes

- Collected 38 feet west of WH-SB-13 and 20 feet from northwest corner building 401.

- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4100
Date Shipped	9-20	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Case # _____

By _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-16 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 10 feet			
Sample Date & Time: 9-21-95 1600			
Sampled By: Vincent Shickora			
Signature(s):			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone frags (moist)

Analysis:

4 ounce Jar - VOA (1)

8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 30 feet west of well # DG-19 and 1.5 feet from security fence

- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4111
Date Shipped	9-21	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-17 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 7.5 feet			
Sample Date & Time: 9-21-95 1645			
Sampled By: Vincent Shickora			
Signature(s): [illegible]			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red Brown	Silty clay with sandstone + shale frags (damp)

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL Metals (1)

Observations / Notes

- Collected 72 feet northeast of well #DG-18 and 1.5 feet from security fence.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4111
Date Shipped	9-21-95	
Time Shipped	1830	
Lab	CEI	MIC
Volume	See Analysis	

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-18 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet.			
Sample Date & Time: 9-28-95 1052			
Sampled By: Vincent Shickora			
Signature(s): [signature]			

Type of Sample

- ☐ Low Concentration
- ☐ High Concentration
- ☐ Grab
- ☑ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.) (moist to wet)
Black/Gray	Silty sand and gravel with burned wood + charcoal

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - Pest/PCB/BNA (1)

Observations / Notes

- Collected 17 feet northwest of southwest corner building 401 and 35 feet west of northwest corner 401.
- HNU reading 15 ppm off sample material

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4122
Date Shipped	9-28	-95
Time Shipped	18	30
Lab	CEIMIC	
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

Case # _____

By _____

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Project Site Name NAWC Warminster CTO-159 Project Site Number 1412-2304

NUS Source No. SB-05-19 Source Location Site 5

Sample Method: 24"x2" split spoon sampler and stainless steel Trowel	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 8.0 feet			
Sample Date & Time: 9-28-95 1145			
Sampled By: Vincent Shickora			
Signature(s):			

Type of Sample

- ☑ Low Concentration
- ☐ High Concentration
- ☑ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.) (Saturated)
Black/Gray	Silty sand & gravel fill with wood, glass, wire.

Analysis:

- 4 ounce Jar - VOA (1)
- 8 ounce Jar - TAL metals (1)
- 8 ounce Jar - Pest/PCB/BNA (1)

Observations / Notes

- Collected 33 feet northwest of northwest corner building 401 and 24 feet west of WH-SB-17.
- No HNU readings above background

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	4122
Date Shipped	9-28	-95
Time Shipped	18	30
Lab	CEI	MIC
Volume	See	Analysis

HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Surface Soil
- ☒ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page 26 of 52

Case # _____

By _____

Project Site Name NAWC Warminster Project Site Number CTO-159

NUS Source No. SB-05-23 Source Location Site 5 -

Sample Method: Hand Auger and stainless steel Trowel.	Composite Sample Data		
	Sample	Time	Color / Description
Depth Sampled: 6.0 feet			
Sample Date & Time: 10-31-95 1205			
Sampled By: Chuck Meyer			
Signature(s):			

Type of Sample

- ☒ Low Concentration
- ☐ High Concentration
- ☒ Grab
- ☐ Composite
- ☐ Grab - Composite

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Sandy clay (dry to damp)

Analysis:

4 ounce Jar - VOA

8 ounce Jar - TAL Metals

Observations / Notes

- Collected 8 feet southeast of south corner building 401 and 8 feet south of gas line pipe on wall of building 401.
- No HNU readings above background
- Boring log was not completed

	Organic	Inorganic
Traffic Report #	—	—
Tag #	—	—
AB #	250513	5426
Date Shipped	10-31-95	
Time Shipped	1700	
Lab	CEI	MIC
Volume	See	Analysis

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-24
Sample Location: SB-05-01
Sampled By: V. Shickora, S. Pokoke
C.O.C. No.: 02282/02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1000 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-4'	red-brn, sm. dk. brn, yellow-brn	clayey silt, tr. wth. micaceous S.S. frags. damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

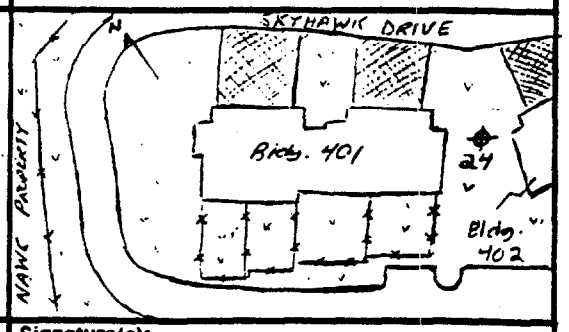
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[■] QA Sample Type: MS/MSD

Sample ID No.: SB-05-25
Sample Location: SB-05-02
Sampled By: V. Shickora, S. Pokoke
C.O.C. No.: 02282/02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1035 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-5'	red-brn, lt. brn, brn, org.-brn	clayey silt to silty sand w/ wtr. S.S. damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

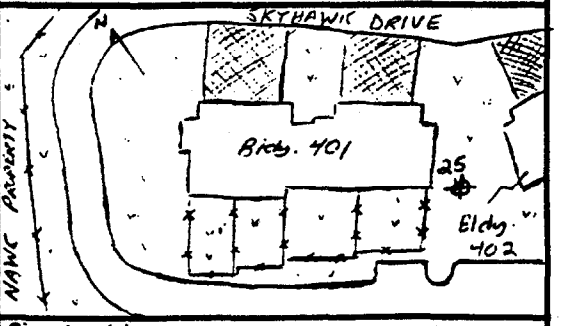
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(6)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(2)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, sulfides	8 oz. Glass	(2)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD SB-05-25-MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-26
Sample Location: SB-05-03
Sampled By: V. Shickora, S. Pekoke
C.O.C. No.: 02282/02283

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1120 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	brn, gray, reddish, tan, black	clayey silt to silty clay w/ S.S. + slt. st. frags + ashes, metal frag., wet (waste fill)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

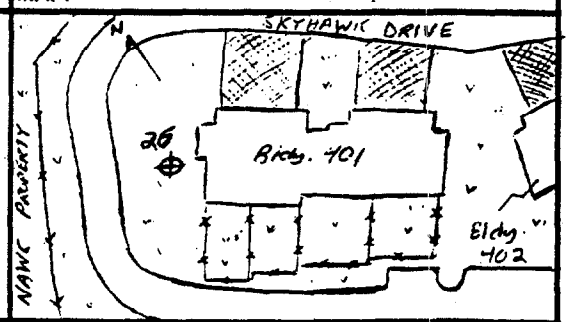
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-27
Sample Location: SB-05-03
Sampled By: V. Shickora, S. Pokoke
C.O.C. No.: 02282/02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 12-08-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1140	5'-7'	red-brn	clayey silt w/ sh. st. frags, damp
Method: Encore/S.S. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

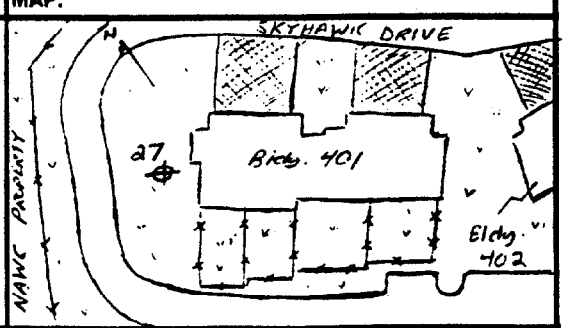
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-28
Sample Location: SB-05-04
Sampled By: V. Shikora, S. Pokoke
C.O.C. No.: 02282/02283

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[■] QA Sample Type: Blind Field Duplicate

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 12-08-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1315	2' – 6'	red-brn, brn, gray, ory.-brn, black	silty clay / clayey silt / sandy silt + wth. S.S. frags damp
Method: Encore / S.S. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

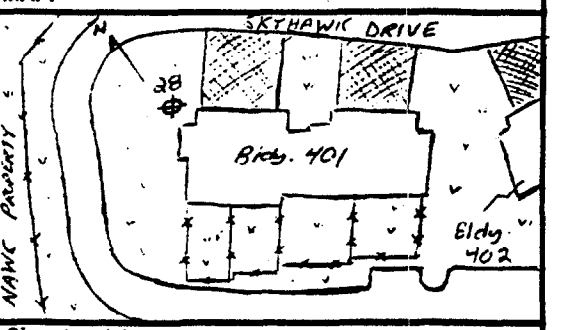
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(6)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(2)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(2)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
	SB-05-100

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-29
Sample Location: SB-05-05
Sampled By: V. Shickora, S. Pokoke
C.O.C. No.: 02282/02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1405 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-4'	brn, org.-brn, reddish, black	clayey silt w/ ashes/cinders damp to wet (waste/fill)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

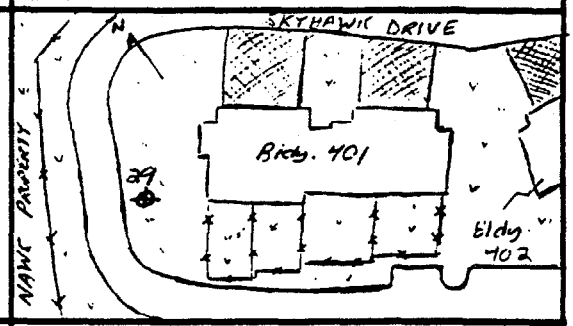
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-30
Sample Location: SB-05-05
Sampled By: V. Shickora, S. Pokpoke
C.O.C. No.: 02282/02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1410 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	4' - 6'	red-brn	clayey silt/silty clay + wth. sh. st. damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

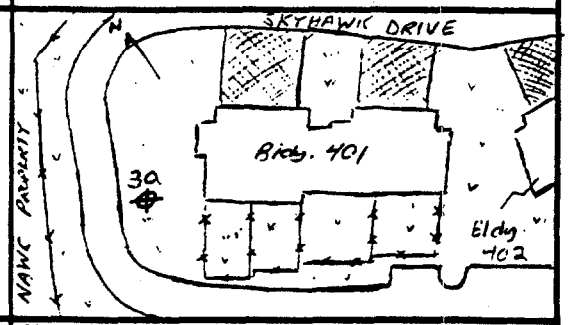
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Comm
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using s.s. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-31
Sample Location: SB-05-06
Sampled By: V. Shickora, S. Palopko
C.O.C. No.: 022821022B3

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-06-99 Time: 1455 Method: Encore/S.S. Trowel Monitor Reading (ppm):	6' - 7.5'	red-brn	clayey silt to wth. slt. sf. damp/dry

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

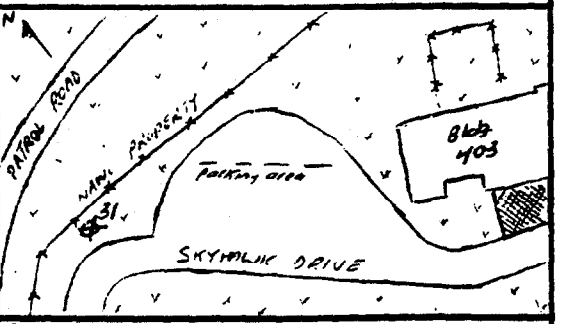
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-32
Sample Location: SB-05-07
Sampled By: V. Shickora, S. Pelgoke
C.O.C. No.: 02282/02283

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1535 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	6'-7'	red-brn	clayey silt to wth. SH. st. damp/dry

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

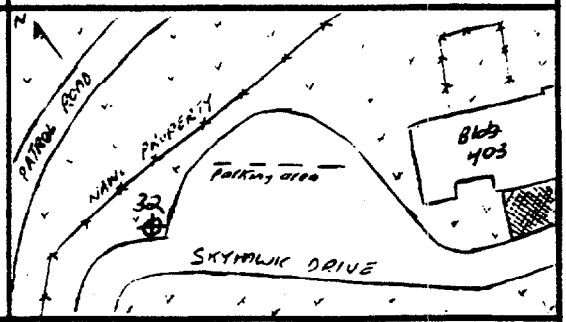
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[ ] Surface Soil
[x] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: SB-05-33
Sample Location: SB-05-08
Sampled By: V. Shickora, S. Polopko
C.O.C. No.: 02281

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0855 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	red-brn, brn, orange-brn	clayey silt / silty clay w/ tr. slt. st. frags. damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

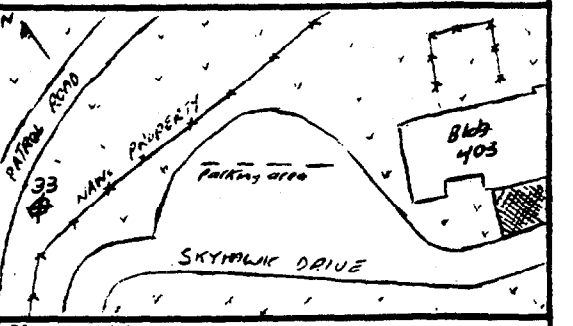
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Seth Polopko

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-34
Sample Location: SB-05-09
Sampled By: V. Shickora, S. Pelapko
C.O.C. No.: 02281

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 0930 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	red-brn, brn, orange-brn	clayey silt + wth. slt. st. frags damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

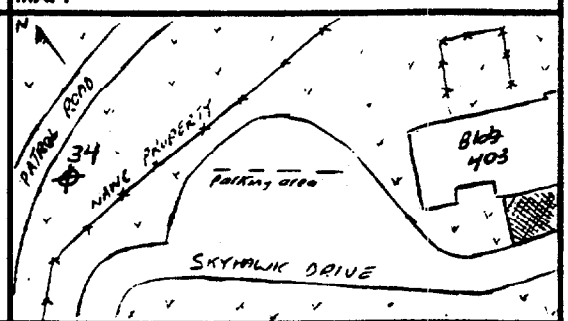
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-35
Sample Location: SB-05-10
Sampled By: V. Shickora, S. Palopko
C.O.C. No.: 02281

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1000 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-5'	red-brn, brn, brn-gray, brn-orange, black	clayey silt/silty clay, ashes, corroded metal, processed wood, poss. paint (blue), damp/wet (waste/fill)

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

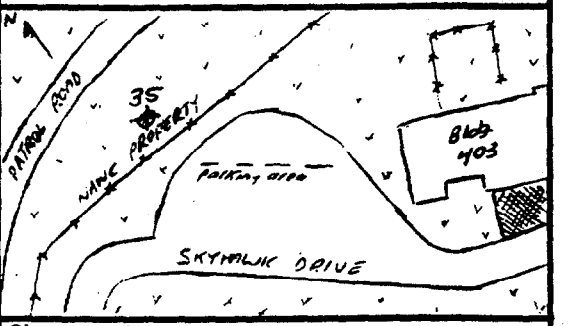
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[ ] Surface Soil
[x] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: SB-05-36
Sample Location: SB-05-10
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: 02281

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1010 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	5'-7'	red-brn, gray	clayey silt + wth. slt. st. fragments damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

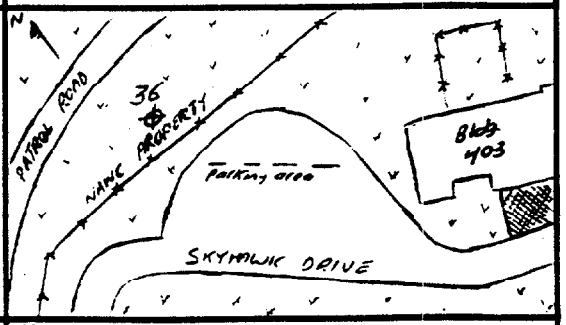
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-37
Sample Location: SB-05-11
Sampled By: V. Shickora, S. Pokoke
C.O.C. No.: 02281

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1110 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-4'	reddish, orange-brn	silty clay/clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

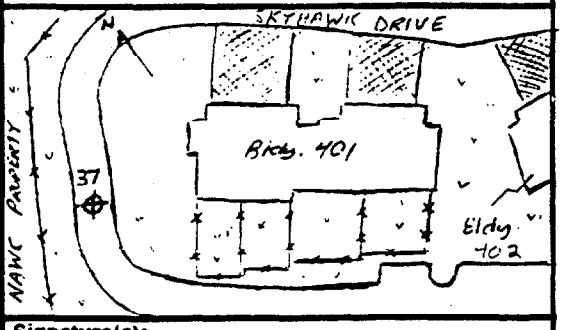
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[ ] Surface Soil
[x] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: SB-05-39
Sample Location: SB-05-12
Sampled By: V. Shickora, S. Arkoke
C.O.C. No.: 02281

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

Date: 12-09-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1330	3.5'-5.5'	reddish	clayey silt / silty clay
Method: Encore / S.S. Trowel			damp
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

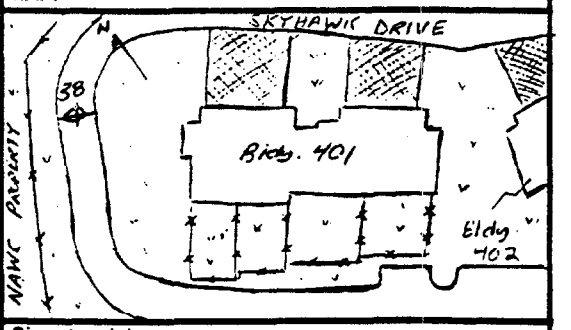
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-39
Sample Location: SB-05-13
Sampled By: V. Shickora, S. Pelopko
C.O.C. No.: 02281

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1400 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	red-brn, brn, gray	clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

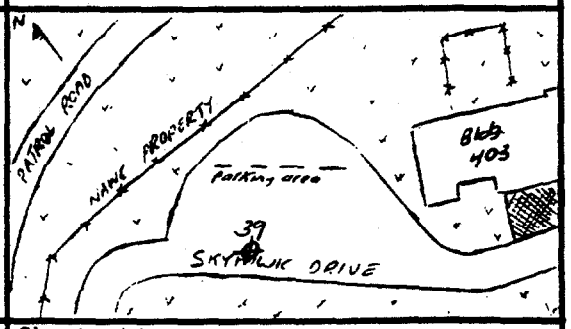
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-40
Sample Location: SB-05-14
Sampled By: V. Shickora, S. Polopko
C.O.C. No.: 02281

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1435 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	dk brn, brn-gray, black	silty clay/clayey silt + ashes, burnt wood (waste/fill) wet/damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

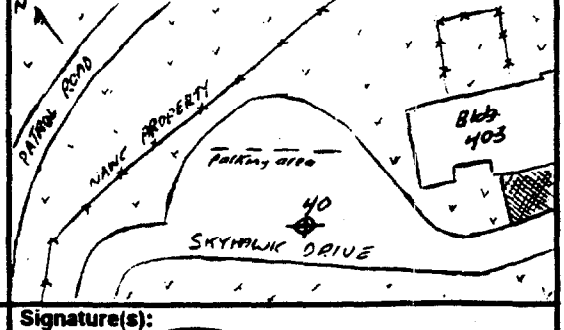
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-41
Sample Location: SB-05-15
Sampled By: V. Shickora, S. Pelopko
C.O.C. No.: 02281

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-09-99 Time: 1455 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	red-brn	clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

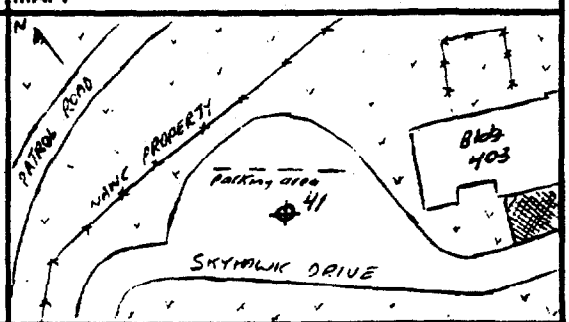
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-42
Sample Location: SB-05-16
Sampled By: V. Shickora, S. Pelpke
C.O.C. No.: -n.a.-

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 0855 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	red-brn, gray	clayey silt + slt. st. frags. damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

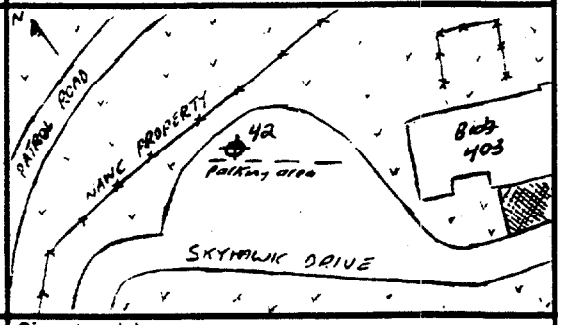
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-43
Sample Location: SB-05-17
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 0925 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.3	2'-4'	red-brn, gray	Silty clay / clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

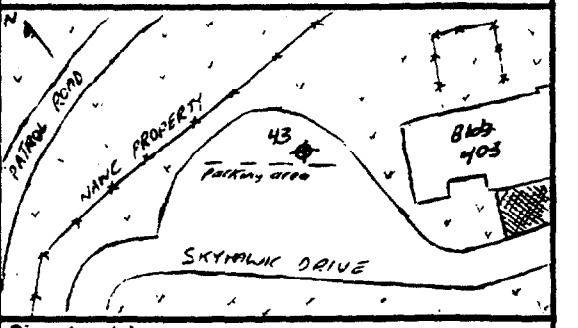
Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

High humidity conditions causing elevated PID readings

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Sample ID No.: SB-05-44
Sample Location: SB-05-18
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 12-10-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 0955	3.5'-6'	red-brn	clayey slt. + slt. st. frags.
Method: Encore/S.S. Trowel			damp
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

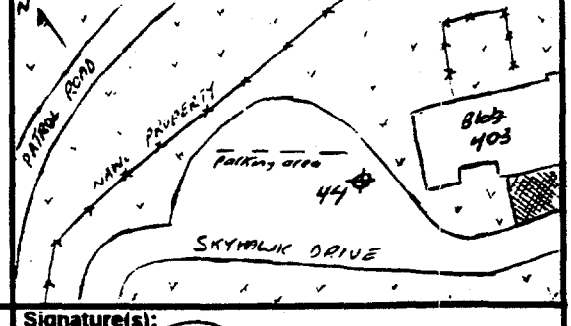
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-45
Sample Location: SB-05-20
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1100 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3.5'-5.5'	red-brn; gray	silty clay / clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

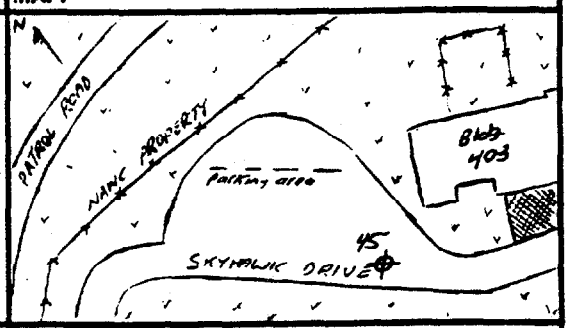
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-46
Sample Location: SB-05-21
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1125 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2'-5'	dk brn, black, red-brn, gray	clayey silt/silty clay + wood frags → roots, twigs. or processed wood? black staining → decomposing organic debris; dump (fill?)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

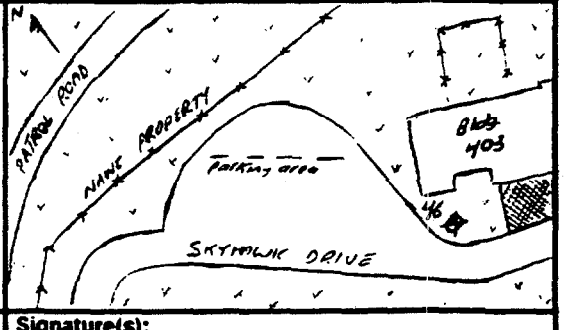
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, SUH/ales	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-47
Sample Location: SB-05-21
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1130 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	5'-6'	red-brn, gray	clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

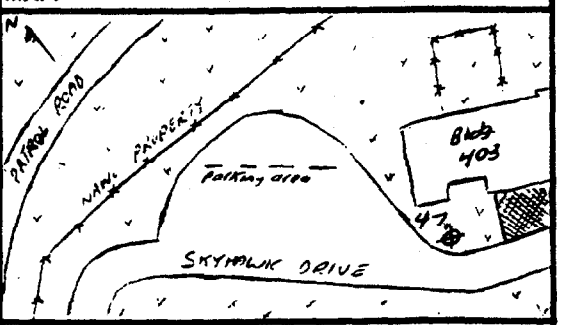
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-48
Sample Location: SB-05-22
Sampled By: V. Shickora, S. Pelopke
C.O.C. No.: -n.a.-

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-10-99 Time: 1200 Method: Encore/S.S. Trowel Monitor Reading (ppm): *	2'-4'	red-brn, brn, gray, orange-brn	clayey silt damp

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

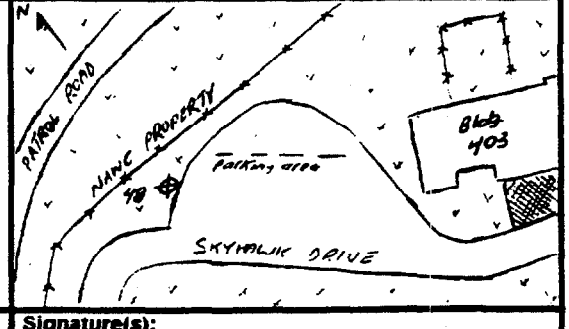
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[ ] Surface Soil
[x] Subsurface Soil
[ ] Sediment
[ ] Other:
[x] QA Sample Type: MS/MSD

Sample ID No.: SB-05-49
Sample Location: SB-05-23
Sampled By: C. Meyer, S. Pokoke
C.O.C. No.: -n.a.-

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-21-99 Time: 1025 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	2' - 5'	brn, gray-brn, brn-gray, black	clayey silt to silty clay, black mottling (fill; poss waste) damp to wet. /sat.

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

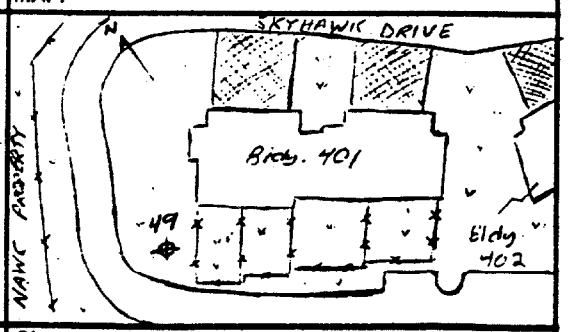
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(6)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(2)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(2)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD
SB-05-49-MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[x] Subsurface Soil
[] Sediment
[] Other:
[x] QA Sample Type: Blind Field Duplicate

Sample ID No.: SB-05-50
Sample Location: SB-05-25
Sampled By: C. Meyer, S. Polopko
C.O.C. No.: -n.a.-

Type of Sample:
[x] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-21-99 Time: 1145 Method: Encore/S.S Trowel Monitor Reading (ppm): 0.0	2'-6'	red-brn, brn, lt. brn	clayey silt, s.s. + sl.st. frags. (wtb., micaceous), damp poss. fill + native soil

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

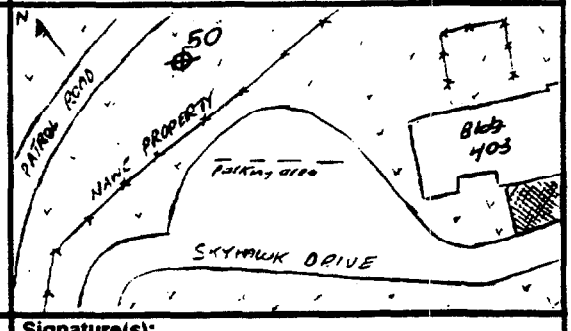
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(6)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(2)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(2)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:
	SB-05-102

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-51
Sample Location: SB-05-26
Sampled By: C. Meyer, S. Pilopko
C.O.C. No.: -n.a.-

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-21-99 Time: 1215 Method: Encore/S.S. Trowel Monitor Reading (ppm):	3'-6'	brn, orange-brn, white, black, red-brn	sand, silt, clay, + corroded metal, glass, ceramic metal, ash/cinders; damp; (fill/waste)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

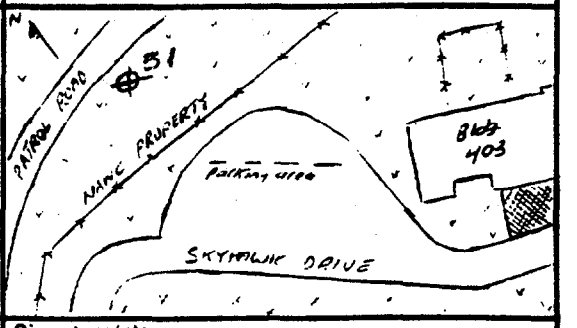
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[ ] Surface Soil
[x] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: SB-05-52
Sample Location: SB-05-27
Sampled By: C. Meyer, S. Pilapko
C.O.C. No.: -n.a.-

Type of Sample:
[x] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-21-99 Time: 1320 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	3'-5'	brn, brn-gray, orange-brn, red-brn	clayey silt to silty clay + poss. cinder, tr. gravel, roots (fill) damp

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

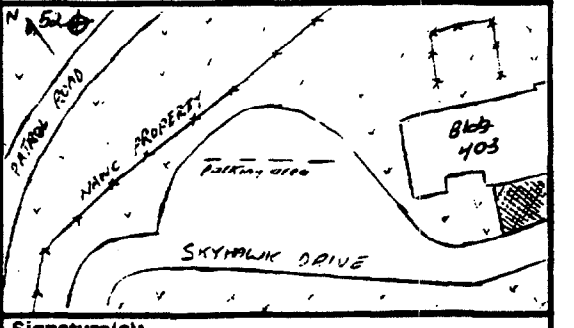
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-53
Sample Location: SB-05-26
Sampled By: C. Meyer, S. Alapko
C.O.C. No.: -n.a.-

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 12-21-99	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1225	6'-9'	red-brn, brn, gray, orange-brn	clayey silt to sandy silt damp
Method: Encore/S.S. Trowel			
Monitor Reading (ppm): 0.0			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

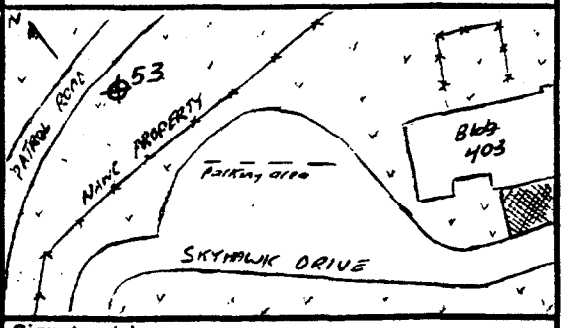
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

1225- Sample material for TCL VOCs and other parameters collected in 8oz glass jar + plastic baggie respectively and held on ice.
1350- TCL VOCs transferred to Encores from minimally disturbed soil mass. Remaining soil composites in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

[] Surface Soil
[■] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: SB-05-54
Sample Location: SB-05-06
Sampled By: V. Shickora, S. Pekoko
C.O.C. No.: 02282 / 02283

Type of Sample:
[■] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1435 Method: Encore / S.S. Trowel Monitor Reading (ppm): 1.0	1' - 4'	red-brn, org.-brn, lt. gray-gray, black, brn-v.dk. brn	clayey silt, ash/cinders, glass, transit pipe frags (asbestos), oil, Fe-staining; damp to wet (wastel)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

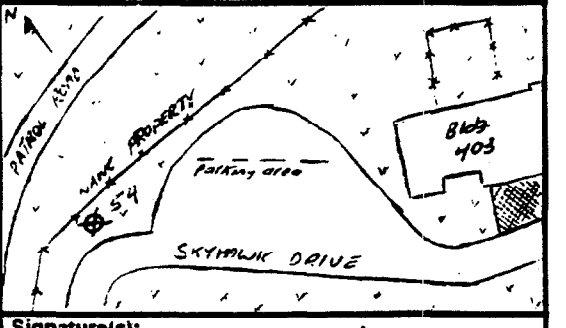
OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

PID headspace off baggie full of sample material = 6.7 ppm

Petroleum/fuel odor evident

MAP:



Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAWC Warminster-Site 5
Project No.: 7606

Sample ID No.: SB-05-55
Sample Location: SB-05-07
Sampled By: V. Shickora, S. Polyako
C.O.C. No.: 02282/02283

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 12-08-99 Time: 1525 Method: Encore/S.S. Trowel Monitor Reading (ppm): 0.0	1'-5'	brn, ory.-brn, red-brn, gray, black	silty clay/clayey silt + ash/cinders, plastic, glass, copper wire, granular H. blue matl (chemical?) dump, wet to saturated (waste fill)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

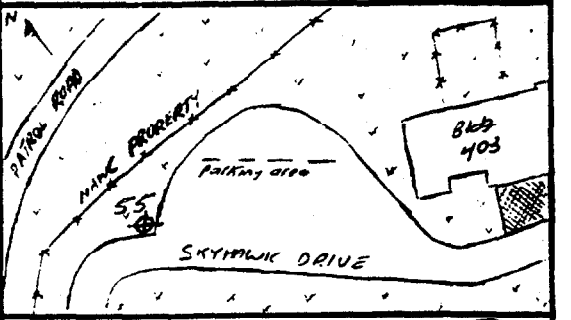
SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
TCL VOCs	5 gram Encore	(3)	-n.a.-
TCL SVOCs, TCL Pesticides/PCBs	16 oz. Glass	(1)	-n.a.-
TAL Metals, Cr(VI), pH, Fe(II), ORP, Sulfides	8 oz. Glass	(1)	-n.a.-

OBSERVATIONS / NOTES:

TCL VOCs collected directly from minimally disturbed soil mass. Remaining soil composited in plastic baggie using S.S. trowel before being transferred to appropriate bottleware.

MAP:



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

APPENDIX G

EXAMPLE CALCULATIONS

Appendix G-1

Blood-Lead Level Modeling

SITE 5 SURFACE SOIL

EAD MODEL Version 0.99d

CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
door AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

IET: DEFAULT

RINKING WATER Conc: 4.00 ug Pb/L DEFAULT
WATER Consumption: DEFAULT

OIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	77.5	77.5
1-2	77.5	77.5
2-3	77.5	77.5
3-4	77.5	77.5
4-5	77.5	77.5
5-6	77.5	77.5
6-7	77.5	77.5

Additional Dust Sources: None DEFAULT

AINT Intake: 0.00 ug Pb/day DEFAULT

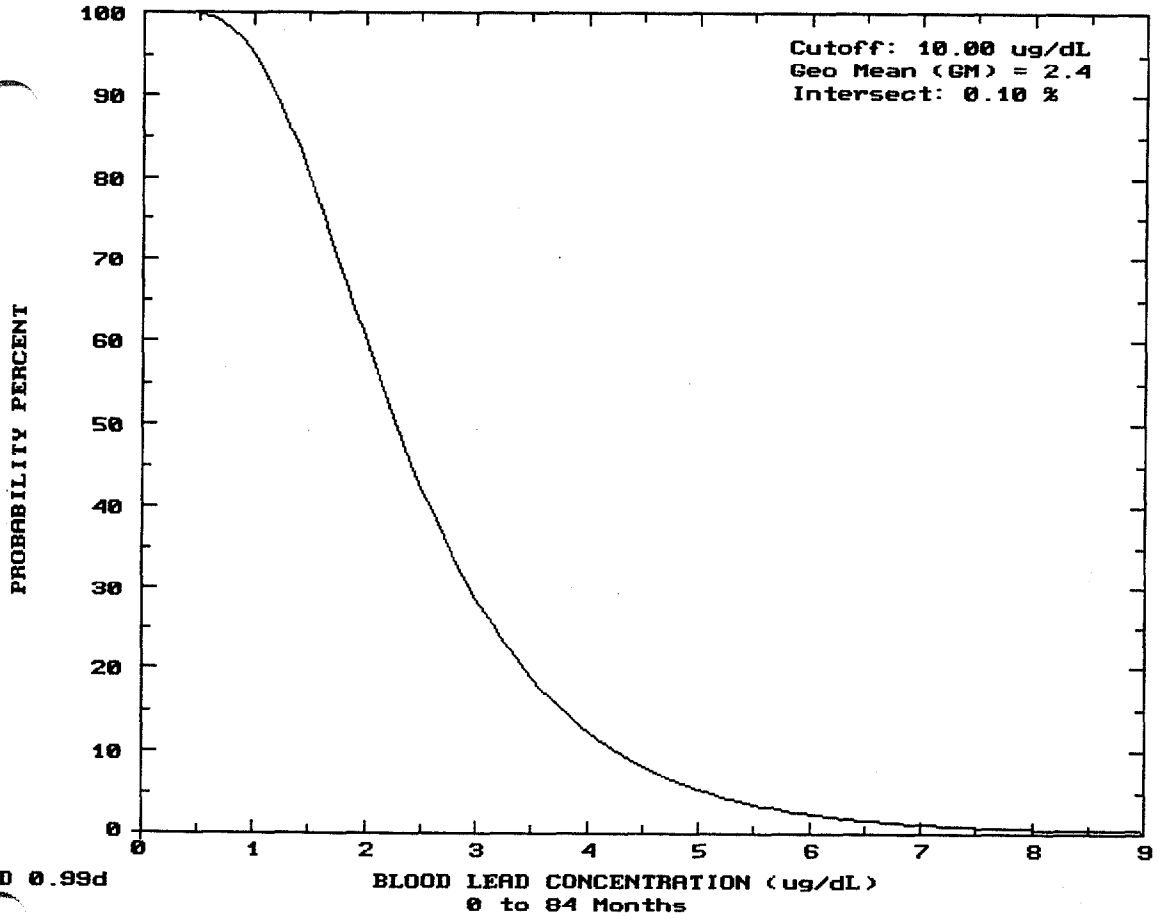
ATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

ALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
.5-1:	2.7	4.89	1.87
1-2:	2.8	6.67	2.96
2-3:	2.6	7.11	2.98
3-4:	2.5	7.07	3.00
4-5:	2.2	6.28	2.25
5-6:	2.0	6.32	2.03
6-7:	1.9	6.56	1.92

R	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
.5-1:	2.62	0.38	0.00	0.02
1-2:	2.73	0.94	0.00	0.03
2-3:	3.08	0.99	0.00	0.06

3-4:	2.98	1.01	0.00	0.07
4-5:	2.90	1.06	0.00	0.07
5-6:	3.08	1.13	0.00	0.09
6-7:	3.40	1.15	0.00	0.09



LEAD 0.99d

G-1-1-3

SITE 5 SUBSURFACE SOIL

EAD MODEL Version 0.99d

IR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

IET: DEFAULT

RINKING WATER Conc: 4.00 ug Pb/L DEFAULT
WATER Consumption: DEFAULT

OIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	72.7	72.7
1-2	72.7	72.7
2-3	72.7	72.7
3-4	72.7	72.7
4-5	72.7	72.7
5-6	72.7	72.7
6-7	72.7	72.7

Additional Dust Sources: None DEFAULT

AINT Intake: 0.00 ug Pb/day DEFAULT

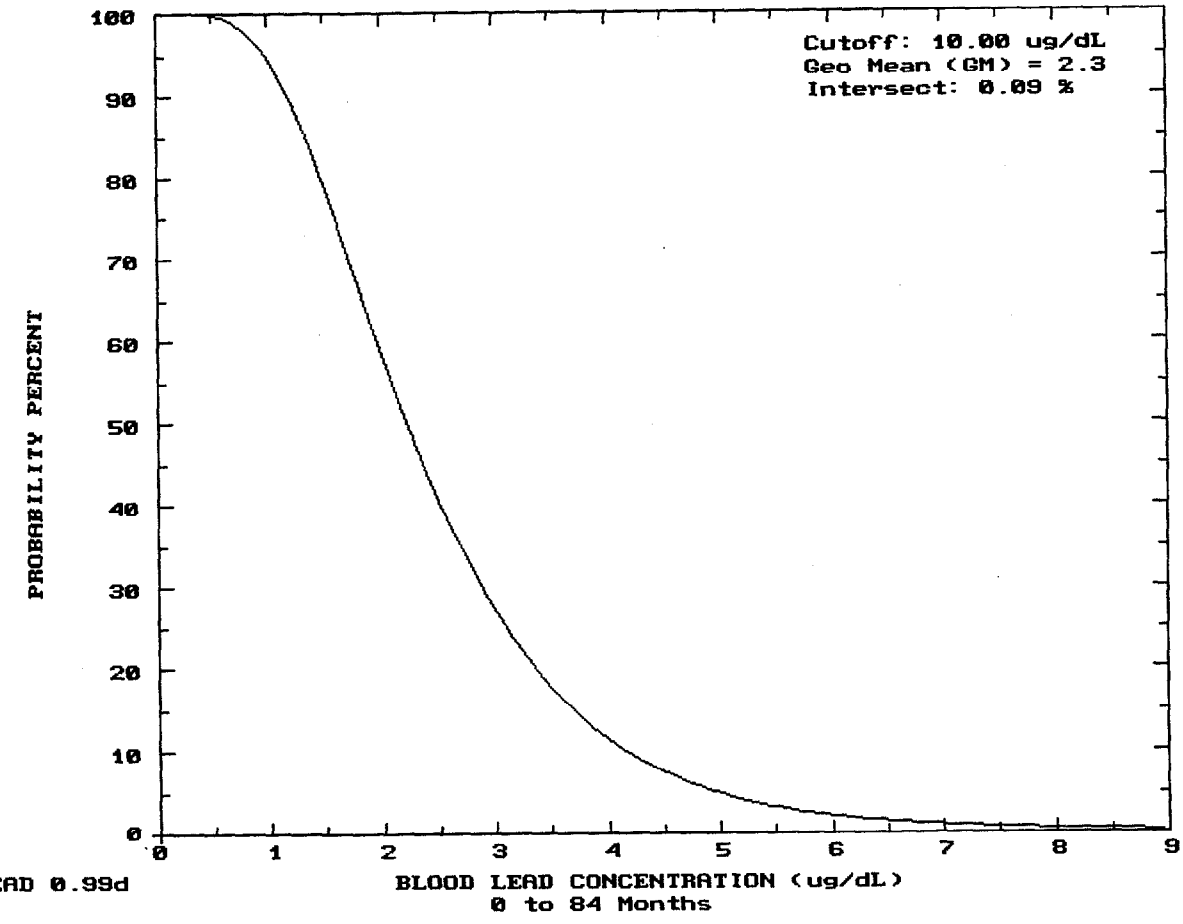
ATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

ALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
.5-1:	2.6	4.78	1.76
1-2:	2.7	6.49	2.78
2-3:	2.6	6.93	2.80
3-4:	2.4	6.89	2.82
4-5:	2.1	6.15	2.11
5-6:	1.9	6.20	1.91
6-7:	1.8	6.45	1.80

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
.5-1:	2.62	0.38	0.00	0.02
1-2:	2.73	0.95	0.00	0.03
2-3:	3.08	0.99	0.00	0.06

3-4:	2.99	1.02	0.00	0.07
4-5:	2.91	1.06	0.00	0.07
5-6:	3.08	1.13	0.00	0.09
7:	3.40	1.15	0.00	0.09



EAD 0.99d

G-1-2-3

Appendix G-2

Background Comparison Tests

BACKGROUND COMPARISON TESTS FOR METALS - SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq. Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:	Site Freq. > Back Freq.?				Site Maximum > UTL for Background Data ?							Majority are site?				Ranks of Site > Back?				Site Mean > Back. Mean ?					Site Standard Deviation <Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/log					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=k				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back.	Site	P	YN	Back.	Std.Dev.	t	L,N	Back.	Site	YN	r	k	P	YN	P	Test	Used	YN	Back.	Site	t	t	YN	Back.	Site	Std.Dev.	Std.Dev.	F	F	YN
Substance	Freq.	Freq.	Value		Mean@	Back.@	Value	Q	UTL	Max.				Value		Value				Mean@	Mean@	Value	Table		Distrib.	Distrib.	Back.@	Site@	Value	Table	
Aluminum Y	29/29	36/36		NA	13200			Q	18000	18500	Y	1	1	0.5538	N	0.9419			N	13200	12500			NA	nonpar.	lognor.					NA
Antimony N	1/29	21/31	<.0001	Y	3.69					8.8	NA				NA	0.3894	Gehan	Test	N	3.69	2.89			NA	nonpar.	nonpar.					NA
Arsenic N	25/29	35/36		NA	3.92			Q	9.65	7.9	N	36	22	0.2166	N	0.2963	Gehan	Test	N	3.92	4.23			NA	nonpar.	normal					NA
Barium Y	25/29	36/36		NA	58.6			Q	170	311	Y	45	32	0.0002	Y	<.0001	Gehan	Test	Y	58.6	103			NA	nonpar.	lognor.					NA
Beryllium Y	25/29	36/36	0.0351	Y	-0.302	0.336	2.2328	L*	1.56	1.6	Y	2	1	0.8048	N	0.0599	Gehan	Test	N	-0.302	-0.105	2.6918	1.6772	Y	lognor.	lognor.	0.336	0.232	4.1873	3.8408	N
Cadmium Y	0/29	18/34		NA						10.5	NA	5	5	0.0396	Y				NA		1.88			NA							NA
Calcium Y	23/29	36/36	0.0058	Y	6.37	0.481	2.2328	L*	1710	35400	Y	31	28	<.0001	Y	<.0001	Gehan	Test	Y	655	2780			NA	lognor.	nonpar.					NA
Chromium Y	29/29	36/36		NA	2.92	0.317	2.2328	L*	37.5	49.2	Y	45	29	0.0265	Y	0.0082			Y	2.92	3.11	2.6675	1.6694	Y	lognor.	lognor.	0.317	0.278	0.5442	3.8408	Y
Cobalt Y	25/29	36/36	0.0351	Y	1.99	0.538	2.2328	L*	24.2	21.3	N	24	17	0.0477	Y	0.0258			Y	1.99	2.24	2.2479	1.6829	Y	lognor.	lognor.	0.538	0.293	11.1780	3.8408	N
Copper Y	27/29	36/36	0.1952	N	2.35	0.482	2.2328	L*	30.8	875	Y	37	29	<.0001	Y	<.0001			Y	11.7	133			NA	lognor.	nonpar.					NA
Cyanide NA	0/20	1/16		NA						0.56	NA				NA				NA		0.459			NA							NA
Iron N	29/29	36/36		NA	33700			Q	225000	48300	N	18	12	0.1973	N	0.2829			N	33700	23100			NA	nonpar.	lognor.					NA
Lead Y	29/29	36/36		NA	12			Q	60	1020	Y	45	34	<.0001	Y	<.0001			Y	12	85.1			NA	nonpar.	lognor.					NA
Magnesium Y	25/29	36/36	0.0351	Y	1960	960	2.2328	N*	4100	16000	Y	7	6	0.0931	N	0.1435	Gehan	Test	N	1960	2770			NA	normal	nonpar.					NA
Manganese Y	29/29	36/36		NA	425			Q	1360	2550	Y	42	29	0.0030	Y	0.0013			Y	425	640			NA	nonpar.	lognor.					NA
Mercury Y	1/29	20/28		NA	0.0413					12	NA	10	10	0.0003	Y	<.0001	Gehan	Test	Y	0.0413	0.688			NA	nonpar.	lognor.					NA
Nickel Y	18/29	36/36		NA	9.34	4.82	2.2328	N*	20.1	83.2	Y	18	16	0.0006	Y	0.0001	Gehan	Test	Y	9.34	18.7			NA	normal	lognor.					NA
Potassium Y	25/29	36/36	0.0351	Y	6.24	0.801	2.2328	L*	3060	4660	Y	31	21	0.0476	Y	0.0017			Y	6.24	6.83	3.3713	1.6694	Y	lognor.	lognor.	0.801	0.618	2.0682	3.8408	Y
Selenium N	0/29	3/13		NA						2.6	NA	2	2	0.0906	N				NA		0.663			NA							NA
Silver Y	0/29	27/29		NA						87.2	NA	24	24	<.0001	Y				NA		12.2			NA							NA
Sodium Y	4/29	14/15		NA	80.9					831	NA				NA	<.0001	Gehan	Test	Y	80.9	184			NA	nonpar.	lognor.					NA
Thallium Y	3/29	7/36		NA	0.374					2	NA				NA	0.0153	Gehan	Test	Y	0.374	0.694			NA	nonpar.	nonpar.					NA
Vanadium Y	29/29	36/36		NA	29.4	8.55	2.2328	N*	48.4	60.9	Y	12	9	0.1157	N	0.1086			N	3.33	3.45	1.5904	1.6694	N	lognor.	lognor.	0.317	0.267	0.8784	3.8408	Y
Zinc Y	25/29	36/36		NA	25.7	13.2	2.2328	N*	55.1	4180	Y	32	29	<.0001	Y	<.0001	Gehan	Test	Y	25.7	273			NA	normal	lognor.					NA

Notes: Units are mg/kg for inorganics, ug/kg for organics.
A statistical significance level (P value) of 0.05 is used for all tests that directly compare site to background. A two-sided significance level of 0.1 is used for Bartlett's test for equal variance.
UTL is the expected value for the upper 95 % quantile of the background population; there is an equal chance of the population's true 95 % quantile being either below or above this estimate.
For each test, a YES or NO decision is presented only if all assumptions are met. The overall decision (is site > background) for each chemical appears at the left and is based on four criteria:
(1) Overall decision is YES if any one of the UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is YES, regardless of other test results.
(2) Overall decision is NO if at least one of UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is NO, and none of the aforementioned tests are YES.
(3) Overall decision is YES/NO if Z/Fisher Test is YES/NO, respectively, and other tests are NA. Z-test is treated as lowest priority since it relies on detection frequency, not magnitude of results.
(4) Overall decision is NA if all tests are NA. (Chemicals assigned NA are still included in human health risk-based screening and/or risk assessment.)

Abbreviations:

# NDs or # Pos.	
# s or # b	Number of non-detected (ND) or positive (Pos.) results in data set, not including rejected data or blank-qualified data.
s = b	Number of site (s) or background (b) samples, not including rejected data or blank-qualified data.
P value	Standard deviation of site results must not be different from the standard deviation of background results.

BACKGROUND COMPARISON TESTS FOR METALS - SITE 5 SURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Name of Test: Question Posed:	Detection Freq. Z or Fisher: Site Freq. > Back.Freq.?				95 % Upper Tolerance Limit (UTL): Site Maximum > UTL for Background Data ?							Upper Ranks: Majority are site?				Mann-Whitney/Gehan: Ranks of Site > Back?				Student's or Satterthwaite T-test: Site Mean > Back. Mean ?					Bartlett's Test for Equal Standard Deviations: Site Standard Deviation > Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/log					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=k				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back.	Site	P	YN	Back.	Std.Dev.	t	L,N	Back.	Site	YN	r	k	P	YN	P	Test	Used	YN	Back.	Site	t	t	YN	Back.	Site	Std.Dev.	Std.Dev.	F	F	YN
Substance	Freq.	Freq.	Value		Mean@	Back.@	Value	Q	UTL	Max.				Value		Value				Mean@	Mean@	Value	Table		Distrib.	Distrib.	Back.@	Site@	Value	Table	

L, N, or Q — Probability or significance level is defined as the chance of a false positive. If P <= 0.05 then test determines site > background with 95 % confidence.

% ND — UTL is based on 95 % upper limit (using t-value) when data are lognormal (L) or normal (N). Otherwise, an upper 95 % quantile (Q) is used if there are > 18 back. points.

@ — Mann-Whitney test used if < 40% of data Non-Detected and detect. limits uniformly below the range of positive values. If not, the Gehan Test is used.

Mean and standard deviations are shown of log-transformed data when distributions are of this type; ie., if an (L) code appears for the UTL test or if site and background distributions both match lognormal, and both T-test and Bartlett's test are applicable. (Arithmetic mean and normal standard deviation are shown only for illustration in the event that these tests are NA.)

r,k — The upper ranks test calculates the probability that k or more samples from the top r ranks of the combined site and background data set are comprised of site data if both populations are in fact equal.

BACKGROUND COMPARISON TESTS FOR METALS - SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq. Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:	Site Freq. > Back Freq.?				Site Maximum > UTL for Background Data ?							Majority are site?				Ranks of Site > Back?				Site Mean > Back. Mean ?					Site Standard Deviation =Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/log					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=k				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back. Freq.	Site Freq.	P Value	YN	Back. Mean@	Std.Dev. Back.@	t Value	L,N Q	Back. UTL	Site Max.	YN	r	k	P Value	YN	P Value	Test	Used	YN	Back. Mean@	Site Mean@	t Value	t Table	YN	Back. Distrib.	Site Distrib.	Std.Dev. Back.@	Std.Dev. Site@	F Value	F Table	YN
Substance																															
Aluminum Y	29/29	55/55		NA	13200			Q	18000	20700	Y	4	4	0.1768	N	0.9223			N	13200	12600			NA	nonpar.	nonpar.					NA
Antimony N	1/29	28/36		NA	3.69					50.4	NA	2	2	0.3029	N	0.1025	Gehan	Test	N	3.69	3.95			NA	nonpar.	nonpar.					NA
Arsenic Y	25/29	46/53		NA	3.92			Q	9.65	12.9	Y	1	1	0.6463	N	0.9971	Gehan	Test	N	3.92	2.22			NA	nonpar.	nonpar.					NA
Barium Y	25/29	54/54		NA	58.6			Q	170	1030	Y	58	45	0.0004	Y	<.0001	Gehan	Test	Y	58.6	182			NA	nonpar.	nonpar.					NA
Beryllium Y	25/29	53/53	0.0136	Y	-0.302	0.336	2.2328	L*	1.56	3.7	Y	27	26	<.0001	Y	<.0001	Gehan	Test	Y	0.78	1.32			NA	lognor.	nonpar.					NA
Cadmium Y	0/29	13/54		NA						137	NA	8	8	0.0264	Y				NA		4.65			NA							NA
Calcium Y	23/29	53/53	0.0014	Y	6.37	0.481	2.2328	L*	1710	22000	Y	47	43	<.0001	Y	<.0001	Gehan	Test	Y	655	2800			NA	lognor.	nonpar.					NA
Chromium Y	29/29	55/55		NA	2.92	0.317	2.2328	L*	37.5	305	Y	29	23	0.0430	Y	0.2597			N	19.3	28.8			NA	lognor.	nonpar.					NA
Cobalt Y	25/29	54/54	0.0129	Y	1.99	0.538	2.2328	L*	24.2	30.1	Y	58	45	0.0004	Y	<.0001			Y	8.27	13.4			NA	lognor.	nonpar.					NA
Copper Y	27/29	42/42	0.1634	N	2.35	0.482	2.2328	L*	30.8	19300	Y	36	28	0.0012	Y	0.0003			Y	11.7	636			NA	lognor.	nonpar.					NA
Cyanide N	0/20	1/3	0.1304	N						1.5	NA				NA				NA		1.15			NA							NA
Iron Y	29/29	55/55		NA	33700			Q	225000	92600	N	32	25	0.0453	Y	0.1198			N	33700	28600			NA	nonpar.	nonpar.					NA
Lead Y	29/29	54/54		NA	12			Q	60	2400	Y	54	41	0.0050	Y	0.0002			Y	12	138			NA	nonpar.	nonpar.					NA
Magnesium Y	25/29	53/53	0.0136	Y	1960	960	2.2328	N*	4100	8660	Y	41	36	<.0001	Y	<.0001			Y	1960	3950			NA	normal	nonpar.					NA
Manganese Y	29/29	55/55		NA	425			Q	1360	9240	Y	44	34	0.0153	Y	0.0581			N	425	740			NA	nonpar.	nonpar.					NA
Mercury Y	1/29	22/50		NA	0.0413					2.6	NA	7	7	0.0345	Y	0.0464	Gehan	Test	Y	0.0413	0.248			NA	nonpar.	nonpar.					NA
Nickel Y	18/29	55/55		NA	9.34	4.82	2.2328	N*	20.1	625	Y	39	36	<.0001	Y	<.0001	Gehan	Test	Y	9.34	39			NA	normal	nonpar.					NA
Potassium Y	25/29	54/54	0.0129	Y	6.24	0.801	2.2328	L*	3060	6950	Y	56	43	0.0016	Y	<.0001			Y	679	2110			NA	lognor.	nonpar.					NA
Selenium N	0/29	4/30		NA						1.3	NA	2	2	0.2542	N				NA		0.375			NA							NA
Silver Y	0/29	33/52		NA						111	NA	33	33	<.0001	Y				NA		13.6			NA							NA
Sodium Y	4/29	38/38		NA	80.9					677	NA				NA	<.0001	Gehan	Test	Y	80.9	190			NA	nonpar.	nonpar.					NA
Thallium Y	3/29	7/52		NA	0.374					1.1	NA				NA	0.0065	Gehan	Test	Y	0.374	0.622			NA	nonpar.	nonpar.					NA
Vanadium Y	29/29	54/54		NA	29.4	8.55	2.2328	N*	48.4	6510	Y	5	5	0.1089	N	0.9247			N	29.4	160			NA	normal	nonpar.					NA
Zinc Y	25/29	52/52		NA	25.7	13.2	2.2328	N*	55.1	4760	Y	44	40	<.0001	Y	<.0001	Gehan	Test	Y	25.7	265			NA	normal	nonpar.					NA

Notes: Units are mg/kg for inorganics, ug/kg for organics.

A statistical significance level (P value) of 0.05 is used for all tests that directly compare site to background. A two-sided significance level of 0.1 is used for Bartlett's test for equal variance.

UTL is the expected value for the upper 95 % quantile of the background population; there is an equal chance of the population's true 95 % quantile being either below or above this estimate.

For each test, a YES or NO decision is presented only if all assumptions are met. The overall decision (is site > background) for each chemical appears at the left and is based on four criteria:

(1) Overall decision is YES if any one of the UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is YES, regardless of other test results.

(2) Overall decision is NO if at least one of UTL, Mann-Whitney/Gehan, Upper Ranks Test, or T-Test is NO, and none of the aforementioned tests are YES.

(3) Overall decision is YES/NO if Z/Fisher Test is YES/NO, respectively, and other tests are NA. Z-test is treated as lowest priority since it relies on detection frequency, not magnitude of results.

(4) Overall decision is NA if all tests are NA. (Chemicals assigned NA are still included in human health risk-based screening and/or risk assessment.)

Abbreviations:

# NDs or # Pos.	
# s or # b	Number of non-detected (ND) or positive (Pos.) results in data set, not including rejected data or blank-qualified data.
s = b	Number of site (s) or background (b) samples, not including rejected data or blank-qualified data.
P value	Standard deviation of site results must not be different from the standard deviation of background results.

BACKGROUND COMPARISON TESTS FOR METALS - SITE 5 SUBSURFACE SOIL
NAWC WARMINSTER, PENNSYLVANIA

Name of Test:	Detection Freq: Z or Fisher				95 % Upper Tolerance Limit (UTL)							Upper Ranks				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:	Site Freq. > Back Freq. ?				Site Maximum > UTL for Background Data ?							Majority are site?				Ranks of Site > Back?				Site Mean > Back. Mean ?					Site Standard Deviation > Background Std.Dev.?						
Assumptions Valid:	#ND & Pos.>=5 or use Fisher				Back. lognorm. or norm. If not, #b>18 for Quantile Test							# Site (s) in Top r				<40% ND or use Gehan				#s>2,#b>2,>=85% Pos; both norm/log					#s>2,#b>2, site & back both normal or both lognorm.						
Test Criterion:	P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=k				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Conclusion: Site > Back? YN	Back.	Site	P	YN	Back.	Std.Dev.	t	L,N	Back.	Site	YN	r	k	P	YN	P	Test	Used	YN	Back.	Site	t	t	YN	Back.	Site	Std.Dev.	Std.Dev.	F	F	YN
Substance	Freq.	Freq.	Value		Mean@	Back.@	Value	Q	UTL	Max.				Value		Value				Mean@	Mean@	Value	Table		Distrib.	Distrib.	Back.@	Site@	Value	Table	

L, N, or Q — Probability or significance level is defined as the chance of a false positive. If P <= 0.05 then test determines site > background with 95 % confidence.

% ND — UTL is based on 95 % upper limit (using t-value) when data are lognormal (L) or normal (N). Otherwise, an upper 95 % quantile (Q) is used if there are > 18 back. points.

@ — Mann-Whitney test used if < 40% of data Non-Detected and detect. limits uniformly below the range of positive values. If not, the Gehan Test is used.

Mean and standard deviations are shown of log-transformed data when distributions are of this type; ie., if an (L) code appears for the UTL test or if site and background distributions both match lognormal, and both T-test and Bartlett's test are applicable. (Arithmetic mean and normal standard deviation are shown only for illustration in the event that these tests are NA.)

r,k — The upper ranks test calculates the probability that k or more samples from the top r ranks of the combined site and background data set are comprised of site data if both populations are in fact equal.

Appendix G-3

Risk Assessment Sample Calculations

Appendix G (Part 3)

RISK ASSESSMENT EXAMPLE CALCULATIONS

The example calculations listed in this appendix are presented in order to verify the approaches taken and calculations used to estimate risk at areas/media of interest at NAWC Warminster Site 5.

The example calculations are all based on RME exposure. Example calculations based on CTE exposure would be estimated following the same pattern as RME exposure examples listed here; however, several input parameter values are different for each exposure equation. For receptor-specific differences, see the BHRA's RAGs D Table 4's.

Additionally, examples are shown for representative receptors for surface water, subsurface soil, total soil, and sediment media exposure. Only one potential receptor per exposure media is shown, other receptors' exposures would be estimated following the same pattern as exposure examples listed below. Additionally, a total soil (a combination of surface and subsurface soils via ingestion, dermal absorption, and inhalation of fugitive dust) exposure example is not shown here, but total soil exposure would also follow the same patterns as surface soil exposure.

6.1 Surface Water Exposure

Two potential exposure routes are associated with direct exposure to surface water at Site 5. These exposure routes include ingestion and dermal absorption.

6.2.1 Ingestion of COPCs in Surface Water:

Ingestion of bis(2-ethylhexyl)phthalate in surface water at Site 5 for a future recreational child (age 6-12) under an RME scenario was evaluated using the following equation (EPA1989a):

$$IngestionDose(mg/kg/day) = \frac{CW * IR_{SW} * CF * EF * ED}{BW * AT}$$

Where:

Carc-Ingestion Dose	= 1.32E-8	= Carcinogenic Ingestion exposure dose (mg/kg/day)
Noncarc-Ingestion Dose	= 1.53E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)
CW	= 1.0 ug/L	= bis(2-ethylhexyl)phthalate concentration in surface water
CF	= 1 mg/10^3 ug	= conversion factor
IR_{SW}	= 0.2 L/day	= Ingestion rate
EF	= 7 days/yr	= Exposure frequency
ED	= 6 yr	= Exposure duration
BW	= 25 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogen (365 d/yr x 70 yrs)
ATN	= 2190 days	= Averaging time for noncarcinogens (365 d/yr x 6 yrs)

The RME carcinogenic risk for a future recreational child (age 6-12) from ingestion of bis(2-ethylhexyl)phthalate in surface water at Site 5 is estimated as follows:

CA = Ingestion Dose * SF

CA	=1.8E-10	= Incremental cancer risk
SF	= 1.4E-2 $(mg/kg/day)^{-1}$	= Oral slope factor

Carc-Ingestion Dose = 1.32E-8 = Carcinogenic Ingestion exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a future recreational child (age 6-12) from ingestion of bis(2-ethylhexyl)phthalate in surface water at Site 5 is estimated as follows:

NC = Ingestion Dose/RfD

NC = 7.7E-6 = Noncarcinogenic risk
RfD = 2.4E-02 (mg/kg/day) = Oral reference dose
Noncarc-Ingestion Dose = 1.53E-7 = Noncarcinogenic Ingestion exposure dose (mg/kg/day)

6.2.2 Dermal Absorption of Surface Water:

Dermal absorption of nickel** in surface water at Site 5 for a future recreational child (age 6-12) under an RME scenario was evaluated using the following equation (EPA 1989a; EPA 1995):

$$DermalDose(mg/kg/day) = \frac{CW * KP * CF_1 * CF_2 * SA * Func(ET) * EF * ED}{BW * AT}$$

Note: Nickel doesn't have an available dermal slope factor, therefore only an example calculation based on noncarcinogenic risk is presented for dermal absorption of nickel by a child resident.

Where:

Noncarc-Dermal Dose = 1.25E-7 = Noncarcinogenic Dermal exposure dose (mg/kg/day)

CW = 17.5 ug/L = Nickel concentration in surface water
KP = 0.001 cm/hr = Permeability coefficient from water
SA = 3580 cm^2 = Skin surface area available for contact
CF_1 = 1 mg/10^3 ug = Conversion Factor
CF_2 = 1 L/10^3 cm^3 = Conversion Factor
FuncET = 2.6 hr/day = For Inorganics: Function(ET) = Exposure Time (2.6hr/day)
EF = 7 days/yr = Exposure frequency
ED = 6 yr = Exposure duration
BW = 25 kg = Body weight
ATN = 2190 days = Averaging time for noncarcinogens (365 d/yr x 6 yrs)

The RME noncarcinogenic risk for a future recreational child (age 6-12) from dermal absorption of nickel in surface water at Site 5 is estimated as follows:

NC = Dermal Dose/RfD

NC = 4.1E-5 = Noncarcinogenic risk
RfD = 3.0E-03 (mg/kg/day) = Dermal reference dose = (RfD_{oral}*GI Factor; [2.0E-2*1.5E-1])
Noncarc- Dermal Dose = 1.25E-7 = Noncarcinogenic Dermal exposure dose (mg/kg/day)

6.3 Subsurface Soil Exposure

Three potential exposure routes are associated with direct exposure to subsurface soil at areas/media of interest at NAWC Warminster Site 5. These exposure routes include ingestion, dermal absorption, and inhalation of fugitive dust.

6.3.1 Ingestion of COPCs in Subsurface Soil:

Ingestion of arsenic in subsurface soil at Site 5 for a current/future adult industrial worker under an RME scenario was evaluated using the following equation (EPA1989a):

$$IngestionDose(mg/kg/day) = \frac{CS * IR_{soil} * FI * CF * EF * ED}{BW * AT}$$

Where:

Carc-Ingestion Dose	= 5.35E-7	= Carcinogenic Ingestion exposure dose (mg/kg/day)
Noncarc-Ingestion Dose	= 1.50E-6	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)
CS	= 3.06 mg/kg	= Arsenic concentration in subsurface soil
IR_{soil}	= 50 mg/day	= Ingestion rate
FI	= 100%	= Fraction Ingested
CF	= 1E-06 kg/mg	= Conversion Factor
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 9125 days	= Averaging time for noncarcinogens (365 d/yr x 25 yrs)

The RME cancer risk for a current/future adult industrial worker from ingestion of arsenic in subsurface soil at Site 5 is estimated as follows:

CA = Ingestion Dose * SF

CA	= 8.02E-7	= Incremental cancer risk
SF	= 1.5 $(mg/kg/day)^{-1}$	= Oral slope factor
Carc-Ingestion Dose	= 5.35E-7	= Carcinogenic Ingestion exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future adult industrial worker from ingestion of arsenic in subsurface soil at Site 5 is estimated as follows:

NC = Ingestion Dose / RfD

NC	= 4.99E-3	= Noncarcinogenic risk
RfD	= 0.0003 mg/kg/day	= Oral reference dose
Noncarc-Ingestion Dose	= 1.50E-6	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

6.3.2 Dermal Absorption of COPCs in Subsurface Soil:

Dermal absorption of arsenic in subsurface soil at Site 5 for a current/future adult industrial worker under an RME scenario was evaluated using the following equations (EPA 1989a; EPA 1995):

$$DermalDose(mg/kg/day) = \frac{CS * ABS * CF * SA * EV * EF * ED}{BW * AT}$$

Where:

Carc-Dermal Dose	= 2.05E-7	= Carcinogenic Dermal exposure dose (mg/kg/day)
Noncarc-Dermal Dose	= 5.74E-7	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

CS	= 3.06 mg/kg	= Arsenic concentration in subsurface soil
SA	= 599 cm^2	= Surface area available for contact
EV	= 1 event/day	= Event frequency
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ABS	= 0.032	= Absorption fraction
CF	= 1E-06 kg/mg	= Conversion Factor
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 9125 days	= Averaging time for noncarcinogens (365 d/yr x 25 yrs)

The RME cancer risk for a current/future adult industrial worker from dermal absorption of arsenic in subsurface soil at Site 5 is estimated as follows:

CA = Dermal Dose * SF

CA	= 3.24E-7	= Incremental cancer risk
SF	= 1.58 $(mg/kg/day)^{-1}$	= Dermal slope factor = (SF_{oral}/GI Factor; [1.5/0.95])
Carc-Dermal Dose	= 2.05E-7	= Carcinogenic Dermal exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a current/future adult industrial worker from dermal absorption of arsenic in subsurface soil at Site 5 is estimated as follows:

NC = Dermal Dose / RfD

NC	= 2.01E-3	= Noncarcinogenic risk
RfD	= 0.000285 mg/kg/day	= Dermal reference dose = (RfD_{Oral}*GI Factor; [0.0003*0.95])
Noncarc-Dermal Dose	= 5.74E-7	= Noncarcinogenic Dermal exposure dose (mg/kg/day)

6.3.3 Inhalation of COPCs in Fugitive Dust:

Inhalation of arsenic** in subsurface soil (via fugitive dust) at Site 5 for a current/future adult industrial worker under an RME scenario was evaluated using the following equations (EPA 1989a; Cowherd 1984; and EPA 1996c):

$$InhalationDose(mg/kg/day) = \frac{CS/_{PEF} * IR_{air} * ET * EF * ED}{BW * AT}$$

Note: Arsenic doesn't have an available inhalation reference dose, therefore only an example calculation based on carcinogenic risk is presented for inhalation of arsenic by a current/future adult industrial worker.

Where:

Carc-Inhalation Dose	= 1.04E-10	= Carcinogenic Inhalation exposure dose (mg/kg/day)

CS	= 3.06 mg/kg	= Arsenic concentration in subsurface soil
PEF	= 1.32E+9 m^3/kg	= Site specific particulate emission factor
IR_{air}	= 1.6 m^3/hr	= Inhalation rate
ET	= 8 hr/day	= Exposure time
EF	= 250 days/yr	= Exposure frequency
ED	= 25 yr	= Exposure duration
BW	= 70 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)

The RME cancer risk for a current/future adult industrial worker from inhalation of arsenic in fugitive dust in subsurface soil at Site 5 is estimated as follows:

CA = Inhalation Dose * SF

CA	= 1.56E-9	= Incremental cancer risk
SF	= 15.1 $(mg/kg/day)^{-1}$	= Inhalation slope factor
Carc-Inhalation Dose	= 1.04E-10	= Carcinogenic Inhalation exposure dose (mg/kg/day)

6.4 Sediment Exposure

Two potential exposure routes are associated with direct exposure to sediment at areas/media of interest at NAWC Warminster Site 5. These exposure routes include ingestion and dermal absorption.

6.4.1 Ingestion of COPCs in Sediment:

Ingestion of arsenic in sediment at Site 5 for a future recreational child (age 6-12) under an RME scenario was evaluated using the following equation (EPA 1989a):

$$IngestionDose(mg/kg/day) = \frac{CS * IR_{Sed} * FI * CF * EF * ED}{BW * AT}$$

Where:

Carc-Ingestion Dose	= 4.73E-8	= Carcinogenic Ingestion exposure dose (mg/kg/day)
Noncarc-Ingestion Dose	= 5.52E-7	= Noncarcinogenic Ingestion exposure dose (mg/kg/day)

CS	= 3.6 mg/kg	= Arsenic concentration in sediment
IR_{soil}	= 200 mg/day	= Ingestion rate
FI	= 100%	= Fraction Ingested
CF	= 1E-06 kg/mg	= Conversion Factor
EF	= 7 days/yr	= Exposure frequency
ED	= 6 yr	= Exposure duration
BW	= 25 kg	= Body weight
ATC	= 25550 days	= Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN	= 2190 days	= Averaging time for noncarcinogens (365 d/yr x 6 yrs)

The RME cancer risk for a future recreational child (age 6-12) from ingestion of arsenic in sediment at Site 5 is estimated as follows:

CA = Ingestion Dose x SF

CA	= 7.1E-8	= Incremental cancer risk

SF = 1.5 $(mg/kg/day)^{-1}$ = Oral slope factor
Carc-Ingestion Dose = 4.73E-8 = Carcinogenic Ingestion exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a future recreational child (age 6-12) from ingestion of arsenic in sediment at Site 5 is estimated as follows:

NC = Ingestion Dose / RfD

NC = 1.8E-3 = Noncarcinogenic risk
RfD = 0.0003 mg/kg/day = Oral reference dose
Noncarc-Ingestion Dose = 5.52E-7 = Noncarcinogenic Ingestion exposure dose (mg/kg/day)

6.4.2 Dermal Absorption of COPCs in Sediment:

Dermal absorption of arsenic in sediment at Site 5 for a future recreational child (age 6-12) under an RME scenario was evaluated using the following equations (EPA 1989; EPA 1995):

$$DermalDose(mg/kg/day) = \frac{CS * ABS * CF * SA * EF * ED}{BW * AT}$$

Where:

Carc-Dermal Dose = 1.87E-9 = Carcinogenic Dermal exposure dose (mg/kg/day)
Noncarc-Dermal Dose = 2.19E-8 = Noncarcinogenic Dermal exposure dose (mg/kg/day)

CS = 3.6 mg/kg = Arsenic concentration in sediment
ABS = 0.01 = Absorption fraction
CF = 1E-06 kg/mg = Conversion Factor
SA = 792 cm^2/day = Skin surface area available for contact
EF = 7 days/yr = Exposure frequency
ED = 6 yr = Exposure duration
BW = 25 kg = Body weight
ATC = 25550 days = Averaging time for carcinogens (365 d/yr x 70 yrs)
ATN = 2190 days = Averaging time for noncarcinogens (365 d/yr x 6 yrs)

The RME cancer risk for a future recreational child (age 6-12) from dermal absorption of arsenic in sediment at Site 5 is estimated as follows:

CA = Dermal Dose x SF

CA = 3.0E-9 = Incremental cancer risk
SF = 1.58 $(mg/kg/day)^{-1}$ = Dermal slope factor = (SF_{oral}/GI Factor; [1.5/0.95])
Carc-Dermal Dose = 1.87E-9 = Carcinogenic Dermal exposure dose (mg/kg/day)

The RME noncarcinogenic risk for a future recreational child (age 6-12) from dermal absorption of arsenic in sediment at Site 5 is estimated as follows:

NC = Dermal Dose / RfD

NC = 7.7E-5 = Noncarcinogenic risk
RfD = 0.000285 mg/kg/day = Dermal reference dose = (RfD_{Oral}*GI Factor; [0.0003*0.95])
Noncarc-Dermal Dose = 2.19E-8 = Noncarcinogenic Dermal exposure dose (mg/kg/day)

APPENDIX H

TOXICITY PROFILES

APPENDIX H

TOXICOLOGICAL PROFILES FOR NAWC WARMINSTER SOIL COCs

J.1 ANTIMONY

Pharmacokinetics

Ingested antimony is absorbed slowly and incompletely from the gastrointestinal (GI) tract (Iffland 1988). Within a few days of acute exposure, highest tissue concentrations are found in the liver, kidney, and thyroid. Organs of storage include skin, bone, and teeth. Highest concentrations in deceased smelter workers (inhalation exposure) occurred in the lungs and skeleton. Excretion is largely via the urine or feces, although some is incorporated into the hair.

Noncancer Toxicity

Acute intoxication from ingestion of large doses of antimony induces GI disturbances, dehydration, and cardiac effects in humans (Iffland 1988). Chronic effects from occupational exposure include irritation of the respiratory tract, pneumoconiosis, pustular eruptions of the skin called "antimony spots," allergic contact dermatitis, and cardiac effects, including abnormalities of the electrocardiograph (ECG) and myocardial changes. Cardiac effects were also observed in rats and rabbits exposed by inhalation for six weeks and in animals (dogs, and possibly other species) treated by intravenous injection (Elinder and Friberg 1986a).

Chronic oral exposure studies in laboratory animals include two briefly reported lifetime drinking water studies in rats and mice (Kanisawa and Schroeder 1969; Schroeder et al. 1970). The only dose tested, 5 ppm potassium antimony tartrate, resulted in reduced longevity in both species and in reduced mean heart weight in the rats. The EPA (1995a) verified an RfD of 0.0004 mg/kg/day for chronic oral exposure to antimony from the LOAEL of 5 ppm potassium antimony tartrate (0.35 mg antimony/kg body weight-day) in the lifetime study in rats (Schroeder et al. 1970). An uncertainty factor of 1000 was applied; factors of 10 each for inter- and intraspecies variation and to estimate an NOAEL from an LOAEL. The heart is considered a likely target organ for chronic oral exposure of humans.

Carcinogenicity

Data were not located regarding the carcinogenicity of antimony to humans. Antimony fed to rats did not produce an excess of tumors (Goyer 1991), but a high frequency of lung tumors was observed in rats exposed by inhalation to antimony trioxide for one year (Elinder and Friberg 1986a). Antimony is classified in EPA cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans) (EPA 1987a).

J.2 ARSENIC

Pharmacokinetics

Several studies confirm that soluble inorganic arsenic compounds and organic arsenic compounds are almost completely (>90 percent) absorbed from the GI tract in both animals and humans (Ishinishi et al. 1986). The absorption efficiency of insoluble inorganic arsenic compounds depends on particle size and stomach pH. Initial distribution of absorbed arsenic is to the liver, kidneys, and lungs, followed by redistribution to hair, nails, teeth, bone, and skin, which are considered tissues of accumulation. Arsenic has a longer half-life in the blood of rats, compared with other animals and humans, because of firm binding to the hemoglobin in erythrocytes.

Metabolism of inorganic arsenic includes reversible oxidation-reduction so that both arsenite (valence of 3) and arsenate (valence of 5) are present in the urine of animals treated with arsenic of either valence (Ishinishi et al. 1986). Arsenite is subsequently oxidized and methylated by a saturable mechanism to form mono- or dimethylarsenate; the latter is the predominant metabolite in the urine of animals or humans. Organic arsenic compounds (arsenilic acid, cacodylic acid) are not readily converted to inorganic arsenic. Excretion of organic or inorganic arsenic is largely via the urine, but considerable species variation exists. Continuously exposed humans appear to excrete 60 to 70 percent of their daily intake of arsenate or arsenite via the urine.

Noncancer Toxicity

A lethal dose of arsenic trioxide in humans is 70 to 180 mg (approximately 50 to 140 mg arsenic; Ishinishi et al. 1986). Acute oral exposure of humans to high doses of arsenic produce liver swelling, skin lesions, disturbed heart function, and neurological effects. The only noncancer effects in humans clearly attributable to chronic oral exposure to arsenic are dermal hyperpigmentation and keratosis, as revealed by studies of several hundred Chinese exposed to naturally occurring arsenic in well water (Tseng 1977; Tseng et al. 1968; EPA 1995a). Similar effects were observed in persons exposed to high levels of arsenic in water in Utah and the northern part of Mexico (Cebrian et al. 1983; Southwick et al. 1983). Occupational (predominantly inhalation) exposure is also associated with neurological deficits, anemia, and cardiovascular effects (Ishinishi et al. 1986), but concomitant exposure to other chemicals cannot be ruled out. The EPA (1995a) derived an RfD of 0.3 mg/kg/day for chronic oral exposure, based on an NOAEL of 0.8 mg/kg/day for skin lesions from the Chinese data. The principal target organ for arsenic appears to be the skin. The nervous system and cardiovascular systems appear to be less significant target organs. Inorganic arsenic may be an essential nutrient, exerting beneficial effects on growth, health, and feed conversion efficiency (Underwood 1977).

Carcinogenicity

Inorganic arsenic is clearly a carcinogen in humans. Inhalation exposure is associated with increased risk of lung cancer in persons employed as smelter workers, in arsenical pesticide applicators, and in a population residing near a pesticide manufacturing plant (EPA 1995a). Oral exposure to high levels in well water is associated with increased risk of skin cancer (Tseng 1977; EPA 1995a). Extensive animal testing with various forms of arsenic given by many routes of exposure to several species, however, has not demonstrated the carcinogenicity of arsenic (International Agency for Research on Cancer [IARC] 1980). The EPA (1995a) classifies inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen) and derived an oral slope factor of 1.5 per mg/kg/day. The EPA (1995a) notes that the uncertainties associated with the oral unit risk are considerably less than those for most carcinogens, so that the unit risk might be reduced an order of magnitude. An inhalation unit risk of 0.0043 per mg/m^3 was derived for inorganic arsenic from the incidence of lung cancer in occupationally exposed men (EPA 1995a), which is equivalent to a RfD of 15.1 per mg/kg/day, assuming a 70 kg adult inhales 20m^3 of air/day.

J.3 BERYLLIUM

Noncancer Toxicity

Beryllium has a low order of toxicity when ingested because it is poorly absorbed from the GI tract (Reeves 1986). Occupational exposure was associated with dermatitis, acute pneumonitis, and chronic pulmonary granulomatosis (berylliosis). Berylliosis was also observed in humans living in the vicinity of a beryllium plant. Similar pulmonary effects were observed in laboratory animals subjected to inhalation exposure. A verified chronic oral RfD value of 0.005 mg/kg/day was based on an NOAEL in a lifetime drinking water study in rats and an uncertainty factor of 100 (EPA 1995b). The EPA (1995b) presented the same value as a provisional subchronic oral RfD. The target organ for inhalation exposure appears to be the lung; a target organ is not identified for oral exposure.

Carcinogenicity

The EPA (1995b) classifies beryllium in cancer weight-of-evidence Group B2 (probable human carcinogen) based on inadequate human (occupational) cancer data and sufficient animal data. A significant increase in lung tumors occurred in rats and in rhesus monkeys subjected to inhalation exposure or intratracheal instillation of a variety of beryllium compounds. Osteogenic sarcomas were induced in rabbits and mice, but not in rats or guinea pigs, injected intravenously with various beryllium compounds. Oral studies in animals yielded inconclusive results. The EPA (1995a) derived an oral slope factor of 4.3 per mg/kg/day from a statistically nonsignificant increase in total tumors in a lifetime drinking water study in rats. An inhalation unit risk of 0.0024 per mg/m^3, equivalent to 8.4 per mg/kg/day (assuming an inhalation rate of 20 m^3/day and body weight of 70 kg for humans), was derived from an occupational study.

J.4 CADMIUM

Pharmacokinetics

Estimates of cadmium uptake by the respiratory tract range from 10 to 50 percent; uptake is greatest for fumes and small particles and least for large dust particles (Friberg et al. 1986; Goyer 1991). GI absorption of ingested cadmium is ordinarily 5 to 8 percent, but may reach 20 percent in cases of serious dietary iron deficiency. Highest tissue levels are normally found in the kidneys followed by the liver, although levels in the liver may exceed those in the kidneys of persons suffering from cadmium-induced renal dysfunction. The half-life of cadmium in the kidneys and liver may be as long as 10-30 years. Fecal and urinary excretion of cadmium are approximately equivalent in normal humans exposed to small amounts. Urinary excretion increases markedly in humans with cadmium-induced renal disease.

Noncancer Toxicity

Acute inhalation exposure to fumes or particles of cadmium induces respiratory symptoms, general weakness, and, in severe cases, respiratory insufficiency, shock, and death (Friberg et al. 1986). Acute oral exposure induces GI disturbances. Chronic inhalation exposure induces pulmonary emphysema, and chronic exposure by either route consistently produces renal tubular disease in humans and laboratory animals. Proteinuria is a reliable early indicator of cadmium-induced kidney disease. The combination of pulmonary emphysema and renal tubular disease, if severe, may result in early mortality. Painful osteomalacia and osteoporosis may arise from altered metabolism of bone minerals secondary to renal damage. The combination of renal and skeletal damage is called itai-itai disease in Japan. Cadmium exposure has been associated with liver damage, but the liver appears to be less sensitive than the kidney. The kidney is the primary target organ of cadmium toxicity. The EPA (1995a) derived chronic oral RfD values of 0.5 mg/kg/day for cadmium ingested in water and 1 mg/kg/day for cadmium ingested in food, based

on a toxicokinetic model that predicted NOAELs from renal cortical concentrations of cadmium. The different RfD values reflect assumed differences in GI absorption of cadmium from water (5 percent) and food (2.5 percent).

Carcinogenicity

Carcinogenicity data in humans consist of several occupational studies that associate cadmium exposure with lung cancer, but concomitant exposure to other carcinogenic chemicals and smoking were not adequately controlled. Other occupational studies reported significantly increased risk of prostatic cancer, but this effect was not observed in the largest occupational study of workers exposed to high levels (Thun et al. 1985). The animal data consist of an inhalation study in rats that showed a significant increase in lung tumors, and several parenteral injection studies that produced injection site tumors. No evidence of carcinogenicity, however, was observed in seven oral studies in rats and mice. The EPA (1995b) classifies cadmium a cancer weight-of-evidence Group B1 substance for inhalation exposure on the basis of limited evidence of carcinogenicity in humans and sufficient evidence in animals. The data were insufficient to classify cadmium as carcinogenic to humans exposed by the oral route. The EPA (1995a) derived an inhalation unit risk of 0.0018 mg/m^3 from the occupational exposure study by Thun et al. (1985).

J.5 COPPER

Noncancer Toxicity

Copper is a nutritionally essential element that functions as a cofactor in several enzyme systems (Aaseth and Norseth 1986). Acute exposure to large oral doses of copper salts was associated with GI disturbances, hemolysis, and liver and kidney lesions. Chronic oral toxicity in humans has not been reported. Chronic oral exposure of animals was associated with an iron-deficiency type of anemia, hemolysis, and lesions in the liver and kidneys. Occupational exposure may induce metal fume fever, and, in cases of chronic exposure to high levels, hemolysis and anemia (ACGIH 1991). Neither oral nor inhalation RfD or RfC values were located for copper. The target organs for copper are the erythrocyte, liver, and kidney, and, for inhalation exposure, the lung.

Carcinogenicity

Copper is classified in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans) (EPA 1995a). Quantitative risk estimates are not derived for Group D chemicals.

J.6 LEAD

Pharmacokinetics

Studies in humans indicate that an average of 10 percent of ingested lead is absorbed, but estimates as high as 40 percent were obtained in some individuals (Tsuchiya 1986). Nutritional factors have a profound effect on GI absorption efficiency. Children absorb ingested lead more efficiently than adults; absorption efficiencies up to 53 percent were recorded for children three months to eight years of age. Similar results were obtained for laboratory animals; absorption efficiencies of 5 to 10 percent were obtained for adults and ³50 percent were obtained for young animals. The deposition rate of inhaled lead averages approximately 30 to 50 percent, depending on particle size, with as much as 60 percent deposition of very small particles (0.03 mm) near highways. All lead deposited in the lungs is eventually absorbed.

Approximately 95 percent of the lead in the blood is located in the erythrocytes (EPA 1990). Lead in the plasma exchanges with several body compartments, including the internal organs, bone, and several

excretory pathways. In humans, lead concentrations in bone increase with age (Tsuchiya, 1986). About 90 percent of the body burden of lead is located in the skeleton. Neonatal blood concentrations are about 85 percent of maternal concentrations (EPA 1990). Excretion of absorbed lead is principally through the urine, although GI secretion, biliary excretion, and loss through hair, nails, and sweat are also significant.

Noncancer Toxicity

The noncancer toxicity of lead to humans has been well characterized through decades of medical observation and scientific research. The principal effects of acute oral exposure are colic with diffuse paroxysmal abdominal pain (probably due to vagal irritation), anemia, and, in severe cases, acute encephalopathy, particularly in children (Tsuchiya 1986). The primary effects of long-term exposure are neurological and hematological. Limited occupational data indicate that long-term exposure to lead may induce kidney damage. The principal target organs of lead toxicity are the erythrocyte and the nervous system. Some of the effects on the blood, particularly changes in levels of certain blood enzymes, and subtle neurobehavioral changes in children, appear to occur at levels so low as to be considered nonthreshold effects.

EPA (1995b) presents no inhalation RfC for lead, but referred to the National Ambient Air Quality Standard (NAAQS) for lead, which could be used in lieu of an inhalation RfC. The NAAQSs are based solely on human health considerations and are designed to protect the most sensitive subgroup of the human population. The NAAQS for lead is 1.5 mg/m^3, averaged quarterly (EPA 1995b). The NAAQS is equivalent to 0.00043 mg/kg/day, assuming a body weight of 70 kg and an inhalation rate of 20 m^3/day.

The EPA (1990) determined that it is inappropriate to derive an RfD for oral exposure to lead for several reasons. First, the use of an RfD assumes that a threshold for toxicity exists, below which adverse effects are not expected to occur; however, the most sensitive effects of lead exposure, impaired neurobehavioral development in children and altered blood enzyme levels associated with anemia, may occur at blood lead concentrations so low as to be considered practically nonthreshold in nature. Second, RfD values are specific for the route of exposure for which they are derived. Lead, however, is ubiquitous, so that exposure occurs from virtually all media and by all pathways simultaneously, making it practically impossible to quantify the contribution to blood lead from any one route of exposure. Finally, the dose-response relationships common to many toxicants, and upon which derivation of an RfD is based, do not hold true for lead. This is because the fate of lead within the body depends, in part, on the amount and rate of previous exposures, the age of the recipient, and the rate of exposure. There is, however, a reasonably good correlation between blood lead concentration and effect. Therefore, blood lead concentration is the appropriate parameter on which to base the regulation of lead.

The EPA IEUBK lead model is an iterated set of equations that estimate blood lead concentration in children aged 0 to 7 years (EPA 1990; 1994b). The biokinetic part of the model describes the movement of lead between the plasma and several body compartments and estimates the resultant blood lead concentration. The rate of the movement of lead between the plasma and each compartment is a function of the transition or residence time (i.e., the mean time for lead to leave the plasma and enter a given compartment, or the mean residence time for lead in that compartment). Compartments modeled include the erythrocytes, liver, kidneys, all the other soft tissue of the body, cortical bone, and trabecular bone. Excretory pathways and their rates are also modeled. These include the mean time for excretion from the plasma to the urine, from the liver to the bile, and from the other soft tissues to the hair, skin, sweat, etc. The model permits the user to adjust the transition and residence times.

EPA guidance (EPA, 1994a) recommends a residential screening level for lead of 400 parts per million (ppm) to be applied at Superfund and RCRA sites. This value is considered by EPA to be protective for direct

contact with lead-contaminated soils in residential settings. The guidance adopts recommendations of the Centers for Disease Control and is to be followed when current or predicted land use is residential.

The residential screening level for lead described in this directive has been calculated with the EPA's new Integrated Exposure Uptake Bikinetic Model (IEUBK) using default parameters (EPA 1994b).

Carcinogenicity

EPA (1995a) classifies lead in cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate evidence of cancer in humans and sufficient animal evidence. The human data consist of several epidemiologic occupational studies that yielded confusing results. All of the studies lacked quantitative exposure data and failed to control for smoking and concomitant exposure to other possibly carcinogenic metals. Rat and mouse bioassays showed statistically significant increases in renal tumors following dietary and subcutaneous exposure to several soluble lead salts. Various lead compounds were observed to induce chromosomal alterations in vivo and in vitro, sister chromatid exchange in exposed workers, and cell transformation in Syrian hamster embryo cells; to enhance simian adenovirus induction; and to alter molecular processes that regulate gene expression. EPA (1995a) declined to estimate risk for oral exposure to lead because many factors (e.g., age, general health, nutritional status, existing body burden and duration of exposure) influence the bioavailability of ingested lead, introducing a great deal of uncertainty into any estimate of risk.

J.6 MANGANESE

Noncancer Toxicity

Manganese is nutritionally required in humans for normal growth and health (EPA 1995a) Humans exposed to approximately 0.8 mg manganese/kg/day in drinking water exhibited lethargy, mental disturbances (1/16 committed suicide), and other neurologic effects. The elderly appeared to be more sensitive than children. Oral treatment of laboratory rodents induced biochemical changes in the brain, but rodents did not exhibit the neurological signs exhibited by humans. Occupational exposure to high concentrations in air induced a generally typical spectrum of neurological effects, and increased incidence of pneumonia (ACGIH 1986).

Very recently, a chronic oral water RfD of 0.005 mg/kg/day has been made available for manganese based on a drinking water study (EPA 1995a) and a chronic oral food RfD of 0.14 mg/kg/day (EPA 1995a) was adopted based on a NOAEL of 0.14 mg/kg/day for humans in a dietary study. An inhalation RfD of 0.0143 ug/kg/day was presented for manganese. The subchronic oral RfDs presented by EPA (1995b) was the same value as the chronic oral RfDs. The EPA (1995a) presented a verified chronic inhalation RfC of 0.00005 mg/m^3 based on an LOAEL for respiratory symptoms and psychomotor disturbances in occupationally exposed humans and an uncertainty factor of 1000. The EPA (1995a) presented the same value as a subchronic inhalation RfC. The inhalation RfC is equivalent to 0.000014 mg/kg/day, assuming humans inhale 20 m^3 of air/day and weigh 70 kg. The CNS and respiratory tract are target organs of inhalation exposure to manganese.

Carcinogenicity

The EPA (1995a) classifies manganese in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans). Quantitative cancer risk estimates are not derived for Group D chemicals.

J.7 POLYAROMATIC HYDROCARBONS (PAHS)

PAHs are a large class of ubiquitous natural and anthropogenic chemicals, all with similar chemical structures (ATSDR 1990). There are eleven individual PAHs listed among the CPCs for Key West.

Pharmacokinetics

Although quantitative absorption data for the PAHs were not located, benzo(a)pyrene was readily absorbed across the GI (Rees et al. 1971) and respiratory epithelia (Kotin et al. 1969; Vainich et al. 1976). The high lipophilicity of other compounds in this class suggests that other PAHs also would be readily absorbed across GI and respiratory epithelia.

Benzo(a)pyrene was distributed widely in the tissues of treated rats and mice, but primarily to tissues high in fat, such as adipose tissue and mammary gland (Kotin et al. 1969; Schlede et al. 1970). Patterns of tissue distribution of other PAHs would be expected to be similar because of the high lipophilicity of the members of this class.

Studies of the metabolism of benzo(a)pyrene provide information relevant to other PAHs because of the structural similarities of all members of the class. Metabolism involves microsomal mixed function oxidase hydroxylation of one or more of the phenyl rings with the formation of phenols and dihydrodiols, probably via formation of arene oxide intermediates (EPA 1979a). The dihydrodiols may be further oxidized to diol epoxides, which, for certain members of the class, are known to be the ultimate carcinogens (LaVoie et al. 1982). Conjugation with glutathione or glucuronic acid, and reduction to tetrahydrotetrols are important detoxification pathways. Metabolism of naphthalene resulted in the formation of 1,2-naphthoquinone, which induced cataract formation and retinal damage in rats and rabbits.

Excretion of benzo(a)pyrene or dibenzo(a,h)anthracene residues was reported to be rapid, although quantitative data were not located (EPA 1979b). Excretion occurred mainly via the feces, probably largely due to biliary secretion (Schlede et al. 1970a, 1970b). The EPA (1980) concluded that accumulation in the body tissues of PAHs from chronic low level exposure would be unlikely.

Noncancer Toxicity

Oral noncancer toxicity data are available for acenaphthene, anthracene, fluoranthene, fluorene, and naphthalene. Newborn infants, children, and adults exposed to naphthalene by ingestion, inhalation, or possibly by skin contact developed hemolytic anemia with associated jaundice and occasionally renal disease (EPA 1979c). In a 13-week gavage study in rats, treatment with 50 mg naphthalene/kg, 5 days/week for 13 weeks (35.7 mg/kg/day) induced no effects; higher doses presumably reduced the growth rate (National Toxicology Program (NTP) 1980). Application of an uncertainty factor of 1000 yielded a provisional RfD for chronic oral exposure of 0.04 mg/kg/day (EPA 1995b)which has recently been withdrawn. The very mild effect (decreased growth rate) apparently observed at higher doses suggests that the RfD is very conservatively protective.

Acenaphthene appears to be a mild hepatotoxicant, and possibly a nephrotoxicant, in rodents (EPA 1995a). In a comprehensive 90-day toxicity study in mice, gavage treatment with 175 mg/kg/day was an NOAEL; liver weight changes accompanied by hepatocellular hypertrophy and elevated cholesterol levels occurred in mice treated with 350 or 700 mg/kg/day (EPA 1989a). Oral treatment of rats and mice for 32 days with 2000 mg/kg/day resulted in weight loss and mild liver and kidney lesions (Knobloch et al. 1969). The EPA (1995a) verified a chronic oral RfD for acenaphthene of 0.06 mg/kg/day based on an NOAEL for liver effects in a subchronic gavage study in mice and an uncertainty factor of 3000. An uncertainty factor of 3000 was used with factors of 10 each for inter- and intraspecies variation and to expand from subchronic to chronic

exposure, and a factor of 3 to reflect gaps in the database, namely lack of adequate data in a second species and lack of developmental and reproductive data. Confidence in the database was low because of the data gaps. Confidence in the critical study was low because the effects were considered adaptive, rather than adverse, which implies that the RfD is extremely conservative. The EPA (1995b) presented a provisional subchronic oral RfD of 0.6 based on the same NOAEL and an uncertainty factor of 300. Target organs for acenaphthene include the liver and kidney.

The toxic potency of anthracene appears to be very low. In a chronic study in rats, doses of 5 to 15 mg/rat (16 to 48 mg/kg/day) via the diet had no effect on longevity or gross or histopathologic appearance on unspecified tissues (Schmahl 1955). Gavage treatment of mice with 1000 mg/kg/day for at least 90 days had no effects on a comprehensive range of toxicologic parameters. The NOEL of 1000 mg/kg/day in mice and an uncertainty factor of 3000 (10 each for inter- and intraspecies variation, and 30 for the use of a subchronic study and an incomplete database) yielded a verified RfD for chronic oral exposure of 0.3 mg/kg/day (EPA 1995a). The EPA (1995b) presented a subchronic oral RfD of 3 mg/kg/day based on the same NOEL and an uncertainty factor of 300. The data were inadequate to define target organs for the toxicity of anthracene.

Fluoranthene appears to be toxic to the liver, kidney, and blood. In a comprehensive 13-week gavage study in mice, 125 mg/kg/day was an NOAEL and 250 mg/kg/day was an LOAEL (EPA 1988). The verified chronic oral RfD for fluoranthene is 0.04 mg/kg/day, based on the NOAEL in a comprehensive 13-week gavage study of 125 mg/kg/day in mice and an uncertainty factor of 3000 (EPA 1995a). The uncertainty factor of 3000 includes factors of 10 each for inter- and intraspecies variation, and a factor of 30 to expand from subchronic to chronic exposure and to reflect an incomplete database. A provisional subchronic oral RfD of 0.4 mg/kg/day was derived from the same NOAEL and an uncertainty factor of 300. The liver, kidney, and blood appear to be the target organs for the toxicity of fluoranthene.

The critical effects of oral exposure to fluorene appear to be hemolytic anemia and CNS effects. In mice treated by gavage for 13 weeks, 125 mg/kg/day was an NOAEL and 250 mg/kg/day was an LOAEL (EPA 1989b). A verified chronic oral RfD for fluorene of 0.04 mg/kg/day was based on the NOAEL of 125 mg/kg/day for hemolytic anemia in mice (EPA 1995a). An uncertainty factor of 3000 was used with factors of 10 each for inter- and intraspecies variation and to expand from subchronic to chronic exposure, and a factor of 3 to reflect gaps in the database. The EPA (1995b) presented a provisional subchronic oral RfD of 0.4 mg/kg/day based on the same NOAEL and an uncertainty factor of 300. The target organs of fluorene toxicity are the erythrocyte and the CNS.

Newborn infants, children, and adults exposed to naphthalene by ingestion, inhalation, or possibly by skin contact developed hemolytic anemia with jaundice and, occasionally, renal disease (EPA 1980a). In a 13-week gavage study in rats, treatment with naphthalene reduced the growth rate (EPA 1992). Application of an uncertainty factor of 1000 to the rat NOEL yielded a provisional RfD for subchronic and chronic oral exposure of 0.04 mg/kg/day (EPA 1992). The erythrocyte and the kidney appear to be the target organs for the toxicity of naphthalene.

Mild kidney lesions appear to be the critical effects of pyrene. In mice treated by gavage for 13 weeks, 75 mg/kg/day was an NOAEL and 125 mg/kg/day was an LOAEL (EPA 1989c). Even in mice treated with 250 mg/kg/day the lesions were considered minimal to mild. The EPA (1993) verified a chronic oral RfD for pyrene of 0.03 mg/kg/day based on the NOAEL in mice and an uncertainty factor of 3000 (10 each for inter- and intraspecies variation and to expand from subchronic to chronic exposure, and a factor of 3 to reflect gaps in the database). The EPA (1995b) presented a provisional subchronic oral RfD of 0.3 mg/kg/day based on the same NOAEL and an uncertainty factor of 300. The kidney is the target organ for the toxicity of pyrene.

Carcinogenicity

The PAHs are ubiquitous, being released to the environment from anthropogenic as well as from natural sources (ATSDR 1987). Benzo(a)pyrene is the most extensively studied member of the class, inducing tumors in multiple tissues of virtually all laboratory species tested by all routes of exposure. Although epidemiology studies suggested that complex mixtures that contain PAHs (coal tar, soots, coke oven emissions, cigarette smoke) are carcinogenic to humans, the carcinogenicity cannot be attributed to PAHs alone because of the presence of other potentially carcinogenic substances in these mixtures (ATSDR 1987). In addition, recent investigations showed that the PAH fraction of roofing tar, cigarette smoke, and coke oven emissions accounted for only 0.1 to 8 percent of the total mutagenic activity of the unfractionated complex mixture in Salmonella (Lewtas 1988). Aromatic amines, nitrogen heterocyclic compounds, highly oxygenated quinones, diones, and nitrooxygenated compounds, none of which would be expected to arise from in vivo metabolism of PAHs, probably accounted for the majority of the mutagenicity of coke oven emissions and cigarette smoke. Furthermore, coal tar, which contains a mixture of many PAHs, has a long history of use in the clinical treatment of a variety of skin disorders in humans (ATSDR 1987).

Because of the lack of human cancer data, assignment of individual PAHs to EPA cancer weight-of-evidence groups was based largely on the results of animal studies with large doses of purified compound. Frequently, unnatural routes of exposure, including implants of the test chemical in beeswax and trioctanoin in the lungs of female Osborne-Mendel rats, intratracheal instillation, and subcutaneous or intraperitoneal injection, were used. Of the PAHs of concern, no EPA cancer weight-of-evidence group classification was provided for acenaphthene (EPA 1995a). Anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, and naphthalene were classified in Group D (not classifiable as to carcinogenicity to humans), and benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were classified in Group B2 (probable human carcinogens).

The EPA (1995a) verified a slope factor for oral exposure to benzo(a)pyrene of 7.3 per mg/kg/day, based on several dietary studies in mice and rats. Neither verified nor provisional quantitative risk estimates were available for the other PAHs in Group B2. The EPA (1980a) promulgated an ambient water quality criterion for "total carcinogenic PAHs," based on an oral slope factor derived from a study with benzo(a)pyrene, as being sufficiently protective for the class. Largely because of this precedent, the quantitative risk estimates for the other carcinogenic PAHs were based on benzo(a)pyrene when quantitative estimates were needed.

Recent reevaluations of the carcinogenicity and mutagenicity of the Group B2 PAHs suggest that there are large differences between individual PAHs in cancer potency (Krewski et al., 1989). Based on the available cancer and mutagenicity data, and assuming that there is a constant relative potency between different carcinogens across different bioassay systems and that the PAHs under consideration have similar dose-response curves, Thorslund and Charnley (1988) derived relative potency values for several PAHs. A more recent Relative Potency Factor (RPF) scheme for the Group B2 PAHs was based only on the induction of lung epidermoid carcinomas in female Osborne-Mendel rats in the lung-implantation experiments (Clement International 1990). The most defensible RPFs and the associated oral and inhalation slope factors are presented in Table 2-22.

Listed below are individual PAH toxicological profiles, if available.

BENZO(B)FLUORANTNENE

Noncancer Toxicity

Little information is available on benzo(b)fluoranthene. However based on the similarities of chemical structures, most properties should be similar to benzo(a)pyrene.

Carcinogenicity

A Clement's relative potency factor (RFP) has been developed (Clement International, 1990) for benzo(b)fluoranthene which allows the estimation of CSFs of 7.3E-01 and 6.1E-01 per mg/kg/day for the oral and inhalation routes respectively. The EPA (1995b) has classified benzo(b)fluoranthene in cancer weight-of-evidence Group B2 (Probable Human Carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) based on lung tumors in mice.

BENZO(G,H,I)PERYLENE

Noncancer Toxicity

Little information is available on benzo(ghi)perylene. However based on the similarities of chemical structures, most properties should be similar to benzo(a)pyrene.

Carcinogenicity

The EPA (1995b) has classified benzo(ghi)perylene in cancer weight-of-evidence Group D (Not classifiable as to Human Carcinogenicity, inadequate or no evidence).

BENZO(K)FLUORANTHENE

Noncancer Toxicity

Little information is available on benzo(k)fluoranthene. However, based on the similarities of the chemical structures, most properties should be similar to benzo(a)pyrene.

Carcinogenicity

A Clement's relative potency factor (RFP) has been developed (Clement International, 1990) for benzo(k)fluoranthene which allows the estimation of 7.3E-02 and 6.1E-02 per mg/kg/day for the CSF for the oral and inhalation route respectively. The EPA (1995a) has classified benzo(k)fluoranthene in cancer weight-of-evidence Group B2 (Probable Human Carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) based on lung tumors in mice.

CHRYSENE

Noncancer Toxicity

Chrysene is absorbed by the oral route of exposure. Absorption may also occur following dermal exposure. Data are not available to determine whether chrysene is absorbed via the lungs. Absorbed chrysene is distributed to several tissues, i.e. it was found in five tissues in a study reported in 1983. It is accumulated preferentially in the adipose and mammary tissue.

There is no information on other toxic effects of chrysene in human and laboratory animals following inhalation, oral and dermal exposures. (ATSDR 1987, draft).

Carcinogenicity

A Clement's relative potency factor (RFP) has been developed for chrysene. This allows the estimation of CSFs of 7.3E-03 and 6.1E-03 per mg/kg/day for the oral and inhalation routes respectively. The EPA (1995a) has classified chrysene in cancer weight-of-evidence Group B2 (Probable Human Carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) based on tumors and malignant lymphoma in mice and chromosomal abnormalities in hamsters.

INDENO(1,2,3-CD)PYRENE

Noncancer Toxicity

Little information was found on the toxicity of indeno(1,2,3-cd)pyrene. Because of its structural similarity its properties should resemble benzo(a)pyrene.

Carcinogenicity

A Clement's relative potency factor (RFP) has been developed for indeno(1,2,3-cd)pyrene. This allows the estimation of CSFs of 7.3E-01 and 6.1E-01 per mg/kg/day for the oral and inhalation routes respectively. The EPA (1995a) has classified indeno(1,2,3-cd)pyrene in cancer weight-of-evidence Group B2 (Probable Human Carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) based on tumors in mice following lung implants.

J.8 POLYCHLORINATED BIPHENYLS

Noncancer Toxicity

Epidemiologic studies of women in the United States associated oral PCB exposure with low birth weight or retarded musculoskeletal or neurobehavioral development of their infants (ATSDR 1991). Oral studies in animals established the liver as the target organ in all species, and the thyroid as an additional target organ in the rat. Effects observed in monkeys included gastritis, anemia, chloracne-like dermatitis, and immunosuppression. Oral treatment of animals induced developmental effects, including retarded neurobehavioral and learning development in monkeys. An oral RfD of 0.07 ug/kg/day was presented for Arochlor-1016. A chronic RfD of 0.02ug/kg/day derived from a LOAEL of 0.005 mg/kg/day based on a 5-year study with monkeys was presented for Arochlor-1254 (EPA 1995a) and a subchronic oral RfD of 0.05ug/kg/day with an uncertainty factor of 100 (EPA 1995b). The target organ was the immune system. Occupational exposure to PCBs was associated with upper respiratory tract and ocular irritation, loss of appetite, liver enlargement, increased serum concentrations of liver enzymes, skin irritation, rashes and chloracne, and, in heavily exposed female workers, decreased birth weight of their infants (ATSDR 1991). Concurrent exposure to other chemicals confounded the interpretation of the occupational exposure studies. Laboratory animals exposed by inhalation to Aroclor-1254 vapors exhibited moderate liver degeneration, decreased body weight gain and slight renal tubular degeneration. Neither subchronic nor chronic inhalation RfC values were available.

Target organs for PCBs include the skin, liver, fetus, and neonate.

Carcinogenicity

The EPA (1995b) classifies the PCBs as EPA cancer weight-of-evidence Group B2 substances (probable human carcinogens), based on inadequate data in humans and sufficient data in animals. The human data consist of several epidemiologic occupational and accidental oral exposure studies with serious limitations,

including poorly quantified concentrations of PCBs and durations of exposure, and probable exposures to other potential carcinogens.

The animal data consist of several oral studies in rats and mice with various aroclors, kanechlors, or clophens (commercial PCB mixtures manufactured in the United States, Japan and Germany, respectively) that reported increased incidence of liver tumors in both species (EPA 1995a).

The EPA (1995a) presents a verified oral slope factor of 7.7 per mg/kg/day for all PCBs based on liver tumors in rats treated with Aroclor-1260.

J.9 TETRACHLORODIBENZODIOXIN (2,3,7,8-TCDD, DIOXINS/FURANS)

Carcinogenicity

EPA (1995b) established an oral and inhalation slope factor of 1.5E+05 based on respiratory and liver tumors in rats. An absorption factor of 0.75 is used to calculate the unit risk from the oral slope factor. Other dioxin/furan congeners have equivalency factors (toxicity based on 2,3,7,8-TCDD) that are presented in Section 2.

J.10 THALLIUM

Noncancer Toxicity

Thallium is highly toxic; acute ingestion by humans or laboratory animals induced gastroenteritis, neurological dysfunction, and renal and liver damage (Kazantzis, 1986). Chronic ingestion of more moderate doses characteristically caused alopecia. Thallium was used medicinally to induce alopecia in cases of ringworm of the scalp, sometimes with disastrous results. In industrial (inhalation, oral, dermal) exposure, neurologic signs preceded alopecia, suggesting that the nervous system is more sensitive than the hair follicle. The EPA (March 1994) presented verified chronic oral RfD values for several thallium compounds (thallium acetate, thallium acetate, thallium carbonate, thallium chloride, thallium nitrate, thallium sulfate, and thallic oxide) based on increased incidence of alopecia and increased serum levels of liver enzymes indicative of hepatocellular damage in rats treated with thallium sulfate for 90 days. An oral RfD for thallium alone was not located. That for thallium sulfate is 8.00E-05 (EPA 1996), based on a lack of effects from an oral subchronic study in which rats received 0.25 mg/kg/day. The uncertainty factor was 3000 and the confidence level was low.

Carcinogenicity

Several thallium compounds (thallic oxide, thallium acetate, thallium carbonate, thallium chloride, thallium nitrate, thallium sulfate) were classified as cancer weight-of-evidence Group D substances (not classifiable as to carcinogenicity to humans) (EPA, 1994c). No weight-of-evidence classification was located for thallium alone.

J.11 VANADIUM

Noncancer Toxicity

The oral toxicity of vanadium compounds to humans is very low (Lagerkvist et al. 1986), probably because little vanadium is absorbed from the GI tract. Effects in humans exposed by inhalation include upper and lower respiratory tract irritation. A provisional subchronic and chronic oral RfD of 0.007 mg/kg/day was derived from a NOEL of 5 ppm in rats in a lifetime drinking water study with an uncertainty factor of 100 (EPA 1995b). A target organ could not be identified for oral exposure. The respiratory tract is the target organ for inhalation exposure.

Carcinogenicity

No information was located regarding the carcinogenicity of vanadium.

J.12 ZINC

Pharmacokinetics

Zinc is a nutritionally required trace element. Estimates of the efficiency of GI absorption of zinc in animals range from <10 to 90 percent (Elinder 1986). Estimates in normal humans range from approximately 20 to 77 percent (Elinder 1986; Goyer 1991). The net absorption of zinc appears to be homeostatically controlled, but it is unclear whether GI absorption, intestinal secretion, or both are regulated. Distribution of absorbed zinc is primarily to the liver (Goyer 1991), with subsequent redistribution to bone, muscle, and kidney (Elinder 1986). Highest tissue concentrations are found in the prostate. Excretion appears to be principally through the feces, in part from biliary secretion, but the relative importance of fecal and urinary excretion is species-dependent. The half-life of zinc absorbed from the GI tracts of humans in normal zinc homeostasis is approximately 162 to 500 days.

Noncancer Toxicity

Humans exposed to high concentrations of aerosols of zinc compounds may experience severe pulmonary damage and death (Elinder 1986). The usual occupational exposure is to freshly formed fumes of zinc, which can induce a reversible syndrome known as metal fume fever. Orally, zinc exhibits a low order of acute toxicity. Animals dosed with 100 times dietary requirement showed no evidence of toxicity (Goyer 1991). In humans, acute poisoning from foods or beverages prepared in galvanized containers is characterized by GI upset (Elinder 1986). Chronic oral toxicity in animals is associated with poor growth, GI inflammation, arthritis, lameness, and a microcytic, hypochromic anemia (Elinder 1986), possibly secondary to copper deficiency (Underwood 1977). The EPA (1995b) presented a verified RfD of 0.3 mg/kg/day for chronic oral exposure to zinc, based on anemia in humans.

Carcinogenicity

The EPA (1995a) classifies zinc in cancer weight-of-evidence Group D (not classifiable as to carcinogenicity to humans) based on inadequate evidence for carcinogenicity in humans and animals. The human data consist largely of occupational exposure studies not designed to detect a carcinogenic response, and of reports that prostatic zinc concentrations were lower in cancerous than in noncancerous tissue. The animal data consist of several dietary, drinking water, and zinc injection studies, none of which provided convincing data for a carcinogenic response.

REFERENCES FOR TOXICOLOGICAL PROFILES

Aaseth, J., and T. Norseth, 1986b, "Copper," Handbook on the Toxicology of Metals, Vol. II, L. Friberg, G.F. Nordberg, and V.B. Vouk, eds., Elsevier Science Publishers B.V., New York, pp. 233 - 254.

ACGIH (American Conference of Governmental Industrial Hygienists), 1986. Documentation of Threshold Limit Values and Biological Exposure Indices. 5th edition, Cincinnati, OH.

ACGIH, 1991. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th edition, Cincinnati, OH.

Agency for Toxic Substances and Disease Registry (ATSDR), 1987, Draft Toxicological Profile for Benzo(a)pyrene, U.S. Public Health Service, Atlanta, GA.

ATSDR, 1990, Draft Toxicological Profile for Polycyclic Aromatic Hydrocarbons, U.S. Public Health Service, Atlanta, GA.

ATSDR, 1991, Toxicological Profile for Selected PCBs (Aroclor-1260, -1254, -1248, -1242, -1232, -1221, and -1016), U.S. Public Health Service, Atlanta, Georgia.

Cebrian, M. E., A. Albores, M. Aguilar, and E. Blakely, 1983. "Chronic Arsenic Poisoning in the North of Mexico," Human Toxicology, Vol. 2, pp. 121-133, (Cited in EPA 1992).

Clement International, 1990. Development of Relative Potency Estimates for PAHs and Hydrocarbon Combustion Product Fractions Compared to Benzo(a)pyrene and Their Use in Carcinogen Risk Assessments. Prepared for the U.S. EPA, Washington, D.C.

Elinder, C.G., and L. Friberg, 1986a, "Antimony," Handbook on the Toxicology of Metals, L. Friberg, G.F. Nordberg, and V.B. Vouk, eds., Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp. 26 - 42.

Elinder, C.G., and L. Friberg, 1986b, "Zinc," Handbook on the Toxicology of Metals, L. Friberg, G.F. Nordberg, and V.B. Vouk, eds., Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp. 664-679.

Friberg, L., T. Kjellstrom, and G. F. Nordberg, 1986, "Cadmium," Handbook on the Toxicology of Metals, Friberg L., G.F. Nordberg, and V.B. Vouk, eds., Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp. 130-184.

Goyer, R.A., 1991, "Toxic Effects of Metals," Casarett and Doull's Toxicology, the Basic Science of Poisons, M.O. Amdur, J.Doull, and C.D. Klassen, eds., 4th ed., Pergamon Press, New York, pp. 623 - 680.

Iffland, R., 1988. "Antimony," Handbook on Toxicity of Inorganic Compounds, Seiler, H.G., H. Sigel and A. Sigel, eds., Marcel Dekker, Inc., New York, NY.

International Agency for Research on Cancer (IARC), 1980. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man, Vol. 23, Some Metals and Metallic Compounds, World Health Organization, Lyon, France, (Cited in EPA 1992).

Ishinishi, N., K. Tsuchiya, M. Vahter, and B.A. Fowler, 1986. "Arsenic",Handbook on the Toxicology of Metals, L. Friberg, G.F. Nordberg, and V.B. Vouk, eds., Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp.43-83.

Kanisawa, M., and H.A. Schroeder, 1969. "Life Term Studies on the Effect of Trace Elements on Spontaneous Tumors in Mice and Rats," Cancer Research, Vol. 29, pp. 892-895, (Cited in EPA 1992).

Kazantzis, G., 1986. "Thallium," Handbook on the Toxicology of Metals. L. Friberg, G.F. Nordberg, and V.B. Vouk, eds., Vol. II, 2nd ed., Elsevier Science Publishers, New York, NY.

Knobloch, K.S, S. Szendzikowski, and A. Slusarczyk-Zablobona, 1969. "Acute and Subacute Toxicity of Acenaphthene and Acenaphthylene," Med. Pracy (Polish), Vol. 20, pp. 210-222, (Pol.), (Cited in EPA 1992).

Kotin, P., et al., 1969, "Distribution, Retention, and Elimination of C^{14}-3,4-Benzopyrene After Administration to Mice and Rats, Journal of the National Cancer Institute, Vol. 23, pp. 541, (Cited in EPA 1980).

Krewski, D., T. Thorslund, and J. Withey, 1989, "Carcinogenic Risk Assessment of Complex Mixtures," Toxicology and Industrial Health, Vol. 5, pp. 851 - 867.

Lagerkvist, B., G.F. Nordberg, and V.B. Vouk, 1986, "Vanadium," Handbook on the Toxicology of Metals,Friberg, L., G.F. Nordberg, and V.B. Vouk, eds. Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp. 638-663.

La Voie, E.J., S. Amin, S.S. Heaht, K. Furuya, and D. Hoffman, 1982, "Tumor Initiating Activity of Dihydrodiols of Benzo(b)fluoranthene, Carcinogenesis," Vol. 3(1), pp. 49 - 52.

Lewtas, J., 1988, "Genotoxicity of Complex Mixtures: Strategies for the Identification and Comparative Assessment of Airborne Mutagens and Carcinogens from Combustion Sources," Fundamentals of Applied Toxicology, Vol. 10, pp. 571 - 589.

National Toxicology Program (NTP), 1980, Unpublished Subchronic Toxicity Study: Naphthalene (c52904), Fisher-344 Rats, Prepared by Battelle's Columbus Laboratories under subcontract No. 76-34-106002, (Cited in EPA 1992).

Rees, E.O., et al., 1971, "A Study of the Mechanism of Intestinal Absorption of Benzo(a)pyrene, Biochemical and Biophysical Act, Vol. 255, p. 96, (Cited in EPA 1980).

Reeves, A.L. , 1986, "Beryllium," Handbook on the Toxicology of Metals, Friberg, L., G.F. Nordberg, and V.B. Vouk, eds., Vol. II Elsevier Science Publishers B.V., New York, pp. 95-116.

Schlede, E., et al., 1970a, "Effect of Enzyme Induction on the Metabolism and Tissue Distribution of Benzo(a)pyrene," Cancer Research, Vol. 30, p. 2893, (Cited in EPA 1980).

Schlede, E., et al., 1970b, " Stimulatory Effect of Benzo(a)pyrene and Phenobarbitol Pretreatment on the Biliary Excretion of Benzo(a)pyrene Metabolites in the Rat," Cancer Research, Vol. 30, p.2898, (Cited in EPA 1980).

Schroeder, H. A., M. Mitchner, and A.P. Nasor, 1970, "Zirconium, Niobium, Antimony, Vanadium and Lead in Rats: Life Term Studies," Journal of Nutrition, Vol. 100, pp. 59-66.

Smith, R.P., 1991, "Toxic Responses of the Blood," Casarett and Doull's Toxicology, the Basic Science of Poisons, M.O. Amdur, J. Doull, and C.D. Klassen, eds., 4th ed., Pergamon Press, New York, pp. 257-281.

Southwick, J.W., A.E. Western, M.M. Beck, et al., 1983, "An Epidemiological Study of Arsenic in Drinking Water in Millard County, Utah," Lederer, W.H., and R.J. Fensterheim, eds. Arsenic: Industrial, Biomedical, Environmental Perspectives, Van Nostrand Reinhold Co., New York, pp. 210-255, (Cited in EPA 1992).

Thorslund, T., and G. Charnley, 1988, "Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons, "ICF-Clement Associates, Washington, D.C., (Cited in Krewski et al., 1989).

Thun, M.J., T.M. Schnorr, A.B. Smith, and W.E. Halperin, 1985, "Mortality Among a Cohort of U.S. Cadmium Production Workers: An Update," Journal of the National Cancer Institute, Vol. 74, pp. 325-333, (Cited in EPA 1992).

Tseng, W.P., H.M. Chu, S.W. How, J.M. Fong, C.S. Lin, and S. Yeh, 1968, "prevalence of Skin Cancer in an Endemic Area of Arsenicism in Taiwan," Journal of the National Cancer Institute, Vol. 40, pp. 453-463, (Cited in EPA 1992).

Tseng, W.P., 1977, "Effects and Dose-response Relationships of Skin Cancer and Blackfoot Disease with Arsenic," Environmental Health Perspectives, Vol. 19, pp. 109-119, (Cited in EPA 1992).

Tsuchiya, K., 1986, "Lead," Handbook on the Toxicology of Metals, Friberg, L., G. F. Nordberg, and V. B. Vouk, eds. Vol. II, 2nd ed., Elsevier Science Publishers B.V., New York, pp. 298-353.

Underwood, E.J., 1977, Trace Elements in Human and Animal Nutrition, 4th ed., Academic Press, New York.

United States Environmental Protection Agency (EPA), 1979a, Multimedia Health Assessment Document for Polycyclic Organic Matter, Prepared under contract by J. Santodonato et al., Syracuse Research Corporation, (Cited in EPA 1980).

EPA, 1979b, Polynuclear Aromatic Hydrocarbons: Ambient Water Quality Criteria (Draft), (Cited in EPA 1980).

EPA, 1979c, Naphthalene: Ambient Water Quality Criteria, (Draft), (Cited in EPA 1980).

EPA, 1980, Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons: Office of Water Regulations and Standards, Washington, D.C., EPA 440/5-80-069, NTIS PB81-117806, (Cited in ATSDR 1987).

EPA, 1987, Health Effects Assessment for Antimony and Compounds, Prepared by Office of Health and Environment Assessment, Cincinnati, OH, for the Office of Solid Waste and Emergency Response, Washington, D.C., EPA/600/8-88/018,NTIS PB 88-179445.

EPA, 1988, 13-Week mouse oral subchronic toxicity study, Prepared by Toxicity Research Laboratories, Ltd., Muskegon, MI for Office of Solid Waste, Washington, D.C., (Cited in EPA 1992).

EPA, 1989a, Mouse oral subchronic study with acenaphthene, Study conducted by Hazelton Laboratories, Inc., for the Office of Solid Waste, Washington, D.C., (Cited in EPA 1992).

EPA, 1989b. Mouse oral subchronic toxicity study, Prepared by Toxicity Research Laboratories, Ltd., Muskegon, MI for Office of Solid Waste, Washington, D.C., (Cited in EPA 1992).

EPA, 1989c. Mouse oral subchronic toxicity of pyrene, Study conducted by Toxicity Research Laboratories, Muskegon, MI for the Office of Solid Waste, Washington, D.C., (Cited in EPA 1992a).

EPA, 1990, Technical Support Document for Lead, Prepared by the Chemical Hazard Assessment Division, Syracuse Research Corporation, under contract to the Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA, 1991a, "User's Guide for Lead: A PC Software Application of the Uptake/Biokinetic Model Version 0.50," Prepared by Syracuse Research Corporation under Contract No. 68-CO-0043 for the Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA, 1991b, "Update on OSWER Soil Lead Cleanup Guidance, Memorandum from D.R. Clay, Office of Solid Waste and Emergency Response, August 1991.

EPA, 1993, "Integrated Risk Information System (IRIS)," Computer Database, EPA, Washington, D.C.

EPA, 1994a. "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities," OSWER Directive #9355.4-12.

EPA, 1994b. "Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children," EPA/540/R-93/081 PB 93-963510, February 1994.

EPA, 1994c. Health Effects Assessment Summary Tables (HEAST) - Annual Update FY 1994. Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA, 1995a, "Integrated Risk Information System (IRIS)," Computer Database, EPA, Washington, D.C.

EPA, 1995b. Health Effects Assessment Summary Tables (HEAST) - Annual Update FY 1995. National Center for Environmental Assessment, Cincinnati, OH.

EPA, 1996. Integrated Risk Information System (IRIS) online database. Washington, D.C.

Vainich, et al., 1976, "The Fate of Intratracheally Instilled Benzo(a)pyrene in the Isolated Perfused Rat Lung of Both Control and 20-Methylcholanthrene Pretreated," Research Communications in Chemical Pathology and Pharmacology, Vol. 13, pp. 259, (Cited in EPA 1980).

APPENDIX I

SUPPLEMENTAL SITE 5 SAMPLING AND ANALYSIS PLAN (NOVEMBER 23, 1999)

TETRA TECH NUS, INC.
600 Clark Avenue, Suite 3 ▪ King of Prussia, PA 19406-1433
(610) 491-9688 ▪ FAX (610) 491-9645 ▪ www.tetratech.com

PHIL-13582

November 23, 1999

Project Number 7606

Mr. Lonnie Monaco
Naval Facilities Engineering Command (NAVFACENGCOM)
Northern Division
Environmental Contracts Branch, Mail Stop No. 82
10 Industrial Highway
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N624272-D-1298
Contract Task Order (CTO) No. 291

Subject: Final Supplemental Sampling and Analysis Plan
Site 5 and Suspected Trench Area Investigation
Naval Air Warfare Center (NAWC) Warminster, Pennsylvania

Dear Mr. Monaco:

This sampling and analysis plan (SAP) addresses additional soil investigations and sampling for the Site 5 area. This final plan reflects changes made to the previous draft and proposed SAPs submitted in June 1998 and August 1999 (C-51-6-8-54 and C-51-8-9-10). Revisions have been made to those previous plans in response to comments received from EPA dated August 25, 1999 and as discussed in a teleconference with Darius Ostrauskas and you on November 16, 1999. Those previous plans present the background and history of the Site 5 area.

Subsurface Soil Sampling and Analysis

Sampling locations are shown in Figure 1. Actual sample locations may vary slightly due to the presence of obstructions including utilities, trees, shrubs, etc. The sampling locations shown on Figure 1 are the minimum number of locations where subsurface samples will be taken. If evidence of waste is encountered in borings that are thought to coincide with the end of the trench and/or waste disposal areas, additional borings will be advanced along the axis of the suspected area until the apparent end of the waste area has been established. These additional sampling locations will be spaced 10 to 20 feet from the previous sampling location until no evidence of waste is noted.

Borings will be advanced in each of the subsurface soil sampling locations. Continuous split spoon sampling, with spoon retrieval every 2 feet, will be conducted at each location. Each boring will be advanced to bedrock or refusal. At least one sample will be collected from each boring. Split spoon samples will be visually inspected, logged, and monitored with a Photoionization Detector (PID). If a waste layer is noted within the boring, a sample will be collected from the waste layer and the soil immediately below the waste layer. If PID readings of 25 parts per million (ppm) above background are encountered, an additional sample will be collected from that depth. If no evidence of waste material is encountered, a sample will be collected at the mid-depth range between the ground surface and bedrock.

All samples will be analyzed for target compound list (TCL) volatile organics, semivolatile organics, pesticides, PCBs, target analyte list (TAL) metals, and hexavalent chromium.

Surface Soil Sampling and Analysis

Sampling locations are shown in Figure 1. Those sampling locations that coincide with subsurface samples may vary based on the need to relocate subsurface sampling locations as indicated above. All samples will be collected from within 2 feet of the ground surface. In areas that are covered with pavement or have recently received topsoil (some areas were re-graded and/or repaired after recent flooding) the sample will be collected within the 18-inch soil horizon immediately below the cover material. All samples will be analyzed for TCL volatile organics, semivolatile organics, pesticides, PCBs, TAL metals, and hexavalent chromium.

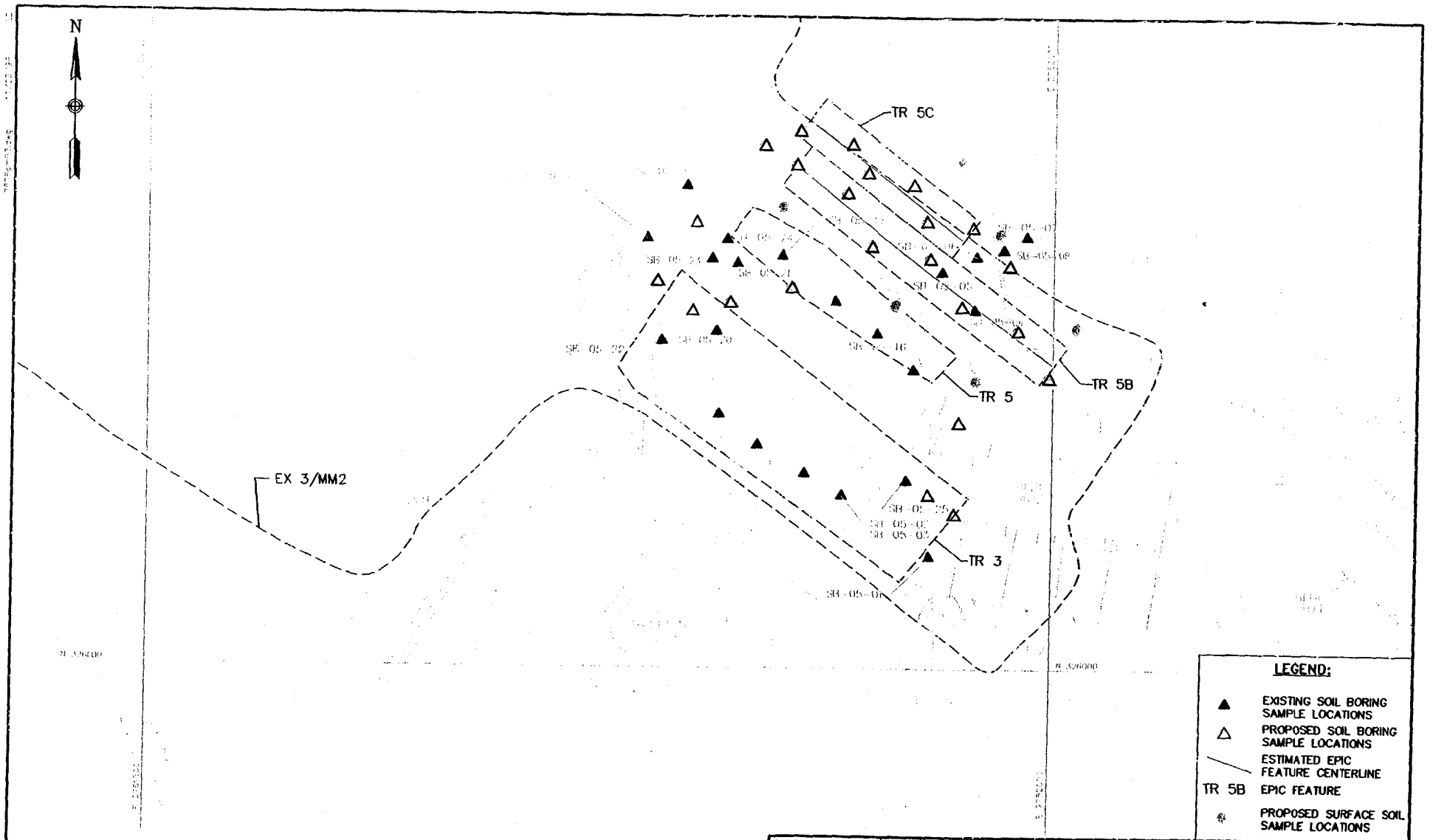
Terta Tech NUS (TtNUS) anticipates conducting this work early in December 1999. If you have any questions or comments or if this plan does not accurately reflect the agreements [illegible] during the November 16, 1999 teleconference please contact me.

Respectfully,

Garth Glenn
Project Manager

GG/ejc

C: Tom Ames (NAVFACENGCOM)
Mike Fohner (NAVFACENGCOM)
Darius Ostrauskas (EPA Region III)
April Flipse (PADEP)
Neil Teamerson (TtNUS)
Jeff Orient (TtNUS)



DRAWN BY LDL	DATE 11/23/99	Tetra Tech NUS, Inc.	PROPOSED SOIL BORING AND SURFACE SOIL SAMPLE LOCATIONS AREA A – SITE 5 NAWC, WARMINSTER, PA
CHECKED BY CWM	DATE 11/23/99		CONTRACT NO. 7606
REVISED BY	DATE		DRAWING NO.
SCALE AS NOTED			APPROVED BY DATE 11/23/99
			DRAWING NO. FIGURE 1 REV.

REFERENCES
o1412am08.dwg PROPOSED SOIL BORING SAMPLES AREA B – SITE 5

7606c-03.dwg

APPENDIX J

DERMAL DERIVATIONS FOR EXPOSURE ASSESSMENT

APPENDIX J
DERMAL DERIVATIONS FOR EXPOSURE ASSESSMENT
NAWC WARMINSTER, PENNSYLVANIA
NOTE: BOLDED VALUES WERE SELECTED FOR USE IN THE TABLE 4'S

AGE	Male Body Wt. (1) kg	Female Body Wt. (1) kg	Avg. Body Wt. kg	Male SA (1) cm^2	Female SA (1) cm^2	Avg. SA (1) cm^2	% Total SA Face (2)	% Total SA Forearms (1,2)*	% Total SA Hands (1,2)	% Total SA Lower Legs (1,2)**	% Total SA Feet (1,2)
1-2	11.8	10.8		—	—		3.7	5.7825	5.89	9.04	6.885
2-3	13.6	13.0		6030	5790		3.5	5.6025	5.15	9.2	6.885
3-4	15.7	14.9		6640	6490		3.4	6.2325	5.885	10.26	7.305
4-5	17.8	17.0		7310	7060		2.9	6.0975	5.6	10.58	7.445
5-6	19.8	19.6		7930	7790		2.9	6.0975	5.6	10.58	7.445
6-7	23.0	22.1		8660	8430		3.8	6.0525	4.955	10.98	7.25
1 through 6 yr			**16.6**			7213	3.367	5.978	5.513	10.107	7.203

AGE		Avg. SA (1) cm^2	SA Face cm^2***	SA Forearms cm^2	SA Hands cm^2	SA Lower Legs cm^2	SA Feet cm^2
Adult Male		19400	429	1310	990	2560	1310
Adult Female		16900	366.3	1035	817	2180	1140
Average Adult		18150	397.65	1172.5	903.5	2370	1225

	ADHERENCE FACTORS (1) - SOIL				
	Face	Forearms	Hands	Lower Legs	Feet
Residential Child (Daycare Kids)	NA	0.023	0.092	0.02	0.065
Residential Adult (Gardeners No. 2)	0.047	0.054	0.18	0.022	0.26
Industrial Worker (Utility Workers No. 1 and 2)	0.1	0.25	0.295	NA	NA

	SURFACE AREA * ADHERENCE FACTOR (1) - SOIL					
	Face	Forearms	Hands	Lower Legs	Feet	SUM
Residential Child	NA	9.92	36.59	14.58	33.77	**95**
Residential Adult	18.69	63.32	162.63	52.14	NA	**297**
Industrial Worker	39.77	293.13	266.53	NA	NA	**599**

(1) EPA, 1997. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.
(2) EPA, 1985. Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments. EPA/600/8-85/010. Office of Research and Development.
Table 3-3. Percent of Total Body Surface Areas or Parts by Sex and Age of Japanese Students.
(1,2) Percent Surface Area is an Average of EPA (1997) and EPA (1985) values
* = Forearms for children are estimated from the assumption that the ratio of forearm to arm in a child is the same as the ratio in an adult (Approx = 45%; EPA, 1997).
** = Lower Legs for children are estimated from the assumption that the ratio of lower leg to leg in a child is the same as the ratio in an adult (Approx = 40%; EPA, 1997).
*** = Assumed to be 33% of head.
NA = Not Available

APPENDIX K

FOOD-WEB MODELING SUPPORTING INFORMATION

LIST OF TOXICITY REFERENCE VALUES (TRVs) FOR USE IN FOOD-WEB MODELING (using Estimated Wildlife NOAEL (mg/kg-bw/day))

NOAEL TRV data from Sample et al. (1996), Dashed line (--) indicates no TRV available

ECOC	Raccoon*	Wren	Mallard	Heron	Note
Acenaphthene	0.29	NA	NA	NA	
Alpha chlordane	1.3	2.1	2.1	2.1	Used NOAEL values for chlordane.
Anthracene	0.29	NA	NA	NA	
Aroclor 1260	0.096	0.18	0.18	0.18	Used NOAEL values for Aroclor-1254.
Benz(a)anthracene	0.29	NA	NA	NA	
Benzo(a)pyrene	0.29	NA	NA	NA	
Benzo(b)fluoranthene	0.29	NA	NA	NA	
Benzo(g,h,i)perylene	0.29	NA	NA	NA	
Beryllium	0.35	NA	NA	NA	
bis(2-Ethylhexyl)phthalate	5.2	1.1	1.1	1.1	
Butylbenzylphthalate	NA	NA	NA	NA	
Cadmium	0.509	1.45	1.45	1.45	
Carbazole	NA	NA	NA	NA	
Chromium	1445	1	1	1	
Chrysene	0.29	NA	NA	NA	
Copper	8	47	47	47	
DDE	0.42	0.003	0.003	0.003	
DDT	0.42	0.003	0.003	0.003	
Dieldrin	0.011	0.077	0.077	0.077	
Fluoranthene	0.29	NA	NA	NA	
Fluorene	0.29	NA	NA	NA	
Indeno(1,2,3-cd)pyrene	0.29	NA	NA	NA	
Lead	4.22	3.85	3.85	3.85	
Manganese	46	997	997	997	
n-nitrosodiphenylamine	NA	NA	NA	NA	
Pyrene	0.29	NA	NA	NA	
Thallium	0.004	NA	NA	NA	
Vanadium	0.103	11.4	11.4	11.4	
Zinc	84.5	14.5	14.5	14.5	

TRV values for a medium sized mammal (red fox) used for the raccoon.

Value for benzo(a)pyrene used for other PAH TRVs.

COPC
Assumption : * Concentration of COPC in food items is equal to concentration in soil or sediment

COPC	Surface Soil Maximum (mg/kg)	Water Conc (mg/L)	Food Maximum * (mg/kg)
Acenaphthene	0.47	0	0.47
Alpha chlordane	0.015	0	0.015
Anthracene	1.4	0	1.4
Aroclor 1260	1.9	0	1.9
Benz(a)anthracene	5.2	0	5.2
Benzo(a)pyrene	4.4	0	4.4
Benzo(b)fluoranthene	7.1	0	7.1
Benzo(g,h,i)perylene	2	0	2
Beryllium	0.88	0	0.88
bis(2-Ethylhexyl)phthalate	18	0	18
Butylbenzylphthalate	0.12	0	0.12
Cadmium	1.9	0	1.9
Carbazole	1.1	0	1.1
Chromium	18.3	0	18.3
Chrysene	5.6	0	5.6
Copper	59.5	0	59.5
DDE	0.024	0	0.024
DDT	0.43	0	0.43
Dieldrin	0.013	0	0.013
Fluoranthene	17	0	17
Fluorene	0.6	0	0.6
Indeno(1,2,3-cd)pyrene	2.4	0	2.4
Lead	168	0	168
Manganese	554.78	0	554.78
n-nitrosodiphenylamine	1.7	0	1.7
Pyrene	9.9	0	9.9
Thallium	0.96	0	0.96
Vanadium	22.7	0	22.7
Zinc	486	0	486

Raccoon

Body Weight	7.4000000 kg
Food Ingestion Rate	0.3550000 kg/day
Water Ingestion Rate	0.6000000 L/day
Soil Ingestion Rate	0.03337 kg/day

Maximum Concentrations

Contaminant of Potential Concern	Soil Concentration (mg/kg)	Water Concentration (mg/L)	Food Concentration (mg/kg)	Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL HQ_n
Acenaphthene	0.47	0	0.47	0.025	0.29	0.09
Alpha chlordane	0.015	0	0.015	0.001	1.3	0.00
Anthracene	1.4	0	1.4	0.073	0.29	0.25
Aroclor 1260	1.9	0	1.9	0.100	0.096	1.04
Benz(a)anthracene	5.2	0	5.2	0.273	0.29	0.94
Benzo(a)pyrene	4.4	0	4.4	0.231	0.29	0.80
Benzo(b)fluoranthene	7.1	0	7.1	0.373	0.29	1.28
Benzo(g,h,i)perylene	2	0	2	0.105	0.29	0.36
Beryllium	0.88	0	0.88	0.046	0.35	0.13
bis(2-Ethylhexyl)phthalate	18	0	18	0.945	5.2	0.18
Butylbenzylphthalate	0.12	0	0.12	0.006	NA	NA
Cadmium	1.9	0	1.9	0.100	0.509	0.20
Carbazole	1.1	0	1.1	0.058	NA	NA
Chromium	18.3	0	18.3	0.960	1445	0.00
Chrysene	5.6	0	5.6	0.294	0.29	1.01
Copper	59.5	0	59.5	3.123	8	0.39
DDE	0.024	0	0.024	0.001	0.42	0.00
DDT	0.43	0	0.43	0.023	0.42	0.05
Dieldrin	0.013	0	0.013	0.001	0.011	0.06
Fluoranthene	17	0	17	0.892	0.29	3.08
Fluorene	0.6	0	0.6	0.031	0.29	0.11
Indeno(1,2,3-cd)pyrene	2.4	0	2.4	0.126	0.29	0.43
Lead	168	0	168	8.817	4.22	2.09
Manganese	554.78	0	554.78	29.116	46	0.63
n-nitrosodiphenylamine	1.7	0	1.7	0.089	NA	NA
Pyrene	9.9	0	9.9	0.520	0.29	1.79
Thallium	0.96	0	0.96	0.050	0.004	12.60
Vanadium	22.7	0	22.7	1.191	0.103	11.57
Zinc	486	0	486	25.506	84.5	0.30

Marsh wren

Body Weight	0.0161000 kg
Food Ingestion Rate	0.0036000 kg/day
Water Ingestion Rate	0.0000000 L/day
Soil Ingestion Rate	0.0000000 kg/day

Maximum Concentrations

Contaminant of Potential Concern	Soil Concentration (mg/kg)	Water Concentration (mg/L)	Food Concentration (mg/kg)	Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL HQ_n
Acenaphthene	0.47	0	0.47	0.105	NA	NA
Alpha chlordane	0.015	0	0.015	0.003	2.1	0.00
Anthracene	1.4	0	1.4	0.313	NA	NA
Aroclor 1260	1.9	0	1.9	0.425	0.18	2.36
Benz(a)anthracene	5.2	0	5.2	1.163	NA	NA
Benzo(a)pyrene	4.4	0	4.4	0.984	NA	NA
Benzo(b)fluoranthene	7.1	0	7.1	1.588	NA	NA
Benzo(g,h,i)perylene	2	0	2	0.447	NA	NA
Beryllium	0.88	0	0.88	0.197	NA	NA
bis(2-Ethylhexyl)phthalate	18	0	18	4.025	1.1	3.66
Butylbenzylphthalate	0.12	0	0.12	0.027	NA	NA
Cadmium	1.9	0	1.9	0.425	1.45	0.29
Carbazole	1.1	0	1.1	0.246	NA	NA
Chromium	18.3	0	18.3	4.092	1	4.09
Chrysene	5.6	0	5.6	1.252	NA	NA
Copper	59.5	0	59.5	13.304	47	0.28
DDE	0.024	0	0.024	0.005	0.003	1.79
DDT	0.43	0	0.43	0.096	0.003	32.05
Dieldrin	0.013	0	0.013	0.003	0.077	0.04
Fluoranthene	17	0	17	3.801	NA	NA
Fluorene	0.6	0	0.6	0.134	NA	NA
Indeno(1,2,3-cd)pyrene	2.4	0	2.4	0.537	NA	NA
Lead	168	0	168	37.565	3.85	9.76
Manganese	554.78	0	554.78	124.050	997	0.12
n-nitrosodiphenylamine	1.7	0	1.7	0.380	NA	NA
Pyrene	9.9	0	9.9	2.214	NA	NA
Thallium	0.96	0	0.96	0.215	NA	NA
Vanadium	22.7	0	22.7	5.076	11.4	0.45
Zinc	486	0	486	108.671	14.5	7.49

Mallard

Body Weight	1.1620000 kg
Food Ingestion Rate	0.0589050 kg/day
Water Ingestion Rate	0.0000000 L/day
Soil Ingestion Rate	0.0000000 kg/day

Maximum Concentrations

Contaminant of Potential Concern	Soil Concentration (mg/kg)	Water Concentration (mg/L)	Food Concentration (mg/kg)	Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL HQ_n
Acenaphthene	0.47	0	0.47	0.024	NA	NA
Alpha chlordane	0.015	0	0.015	0.001	2.1	0.00
Anthracene	1.4	0	1.4	0.071	NA	NA
Aroclor 1260	1.9	0	1.9	0.096	0.18	0.54
Benz(a)anthracene	5.2	0	5.2	0.264	NA	NA
Benzo(a)pyrene	4.4	0	4.4	0.223	NA	NA
Benzo(b)fluoranthene	7.1	0	7.1	0.360	NA	NA
Benzo(g,h,i)perylene	2	0	2	0.101	NA	NA
Beryllium	0.88	0	0.88	0.045	NA	NA
bis(2-Ethylhexyl)phthalate	18	0	18	0.912	1.1	0.83
Butylbenzylphthalate	0.12	0	0.12	0.006	NA	NA
Cadmium	1.9	0	1.9	0.096	1.45	0.07
Carbazole	1.1	0	1.1	0.056	NA	NA
Chromium	18.3	0	18.3	0.928	1	0.93
Chrysene	5.6	0	5.6	0.284	NA	NA
Copper	59.5	0	59.5	3.016	47	0.06
DDE	0.024	0	0.024	0.001	0.003	0.41
DDT	0.43	0	0.43	0.022	0.003	7.27
Dieldrin	0.013	0	0.013	0.001	0.077	0.01
Fluoranthene	17	0	17	0.862	NA	NA
Fluorene	0.6	0	0.6	0.030	NA	NA
Indeno(1,2,3-cd)pyrene	2.4	0	2.4	0.122	NA	NA
Lead	168	0	168	8.516	3.85	2.21
Manganese	554.78	0	554.78	28.123	997	0.03
n-nitrosodiphenylamine	1.7	0	1.7	0.086	NA	NA
Pyrene	9.9	0	9.9	0.502	NA	NA
Thallium	0.96	0	0.96	0.049	NA	NA
Vanadium	22.7	0	22.7	1.151	11.4	0.10
Zinc	486	0	486	24.637	14.5	1.70

Heron

Body Weight	0.2120000 kg
Food Ingestion Rate	0.0400000 kg/day
Water Ingestion Rate	0.0000000 L/day
Soil Ingestion Rate	0.0000000 kg/day

Maximum Concentrations

Contaminant of Potential Concern	Soil Concentration (mg/kg)	Water Concentration (mg/L)	Food Concentration (mg/kg)	Dose (mg/kg/day)	NOAEL (mg/kg/day)	NOAEL HQ_n
Acenaphthene	0.47	0	0.47	0.089	NA	NA
Alpha chlordane	0.015	0	0.015	0.003	2.1	0.00
Anthracene	1.4	0	1.4	0.264	NA	NA
Aroclor 1260	1.9	0	1.9	0.358	0.18	1.99
Benz(a)anthracene	5.2	0	5.2	0.981	NA	NA
Benzo(a)pyrene	4.4	0	4.4	0.830	NA	NA
Benzo(b)fluoranthene	7.1	0	7.1	1.340	NA	NA
Benzo(g,h,i)perylene	2	0	2	0.377	NA	NA
Beryllium	0.88	0	0.88	0.166	NA	NA
bis(2-Ethylhexyl)phthalate	18	0	18	3.396	1.1	3.09
Butylbenzylphthalate	0.12	0	0.12	0.023	NA	NA
Cadmium	1.9	0	1.9	0.358	1.45	0.25
Carbazole	1.1	0	1.1	0.208	NA	NA
Chromium	18.3	0	18.3	3.453	1	3.45
Chrysene	5.6	0	5.6	1.057	NA	NA
Copper	59.5	0	59.5	11.226	47	0.24
DDE	0.024	0	0.024	0.005	0.003	1.51
DDT	0.43	0	0.43	0.081	0.003	27.04
Dieldrin	0.013	0	0.013	0.002	0.077	0.03
Fluoranthene	17	0	17	3.208	NA	NA
Fluorene	0.6	0	0.6	0.113	NA	NA
Indeno(1,2,3-cd)pyrene	2.4	0	2.4	0.453	NA	NA
Lead	168	0	168	31.698	3.85	8.23
Manganese	554.78	0	554.78	104.675	997	0.10
n-nitrosodiphenylamine	1.7	0	1.7	0.321	NA	NA
Pyrene	9.9	0	9.9	1.868	NA	NA
Thallium	0.96	0	0.96	0.181	NA	NA
Vanadium	22.7	0	22.7	4.283	11.4	0.38
Zinc	486	0	486	91.698	14.5	6.32