# Final Site Characterization and Focused Feasibility Study for the RVAAP-51 Dump Along Paris-Windham Road

**Former Ravenna Army Ammunition Plant**
**Portage and Trumbull Counties, Ohio**

Prepared for:
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This Site Characterization/Focused Feasibility Study presents physical characteristics and nature and extent of contamination; evaluates contaminant fate and transport; provides human health and ecological risk assessments; identifies response actions, screening of remedial technologies and process options; develops remedial alternatives to address chemicals of concern (COCs) for the Dump and Paris-Windham Road AOC. This report presents a recommended alternative to meet the remedial action objective at this AOC. The recommended alternative for this AOC is "Alternative 2: Land Use Controls."

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Reset

**STATEMENT OF INDEPENDENT TECHNICAL REVIEW**

U.S. Army Corps of Engineers (USACE) has completed the preparation of this Site Characterization/Focused Feasibility Study for RVAAP-51 the Dump along Paris-Windham Road for Former RVAAP/Camp Ravenna, Portage and Trumbull Counties, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This independent technical review included evaluation of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing USACE policy.

N. Peters for Joan Cullen 9/22/14

Study/Design Team Leader Date

Angela Schmidt 9/22/2014

Study/Design Team Member Date

Nathaniel Peters, II 9/22/14

Independent Technical Review Team Leader Date

**CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW**

Science Applications International Corporation (SAIC) has completed the Site Characterization and Focused Feasibility Study for the RVAAP-51 Dump Along Paris-Windham Road at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing United States Army Corps of Engineers (USACE) policy.

Jill Kovalchik — 1/7/11
Jill Kovalchik — Date
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1/7/11
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1/7/11
Jed Thomas
Feasibility Study Reviewer

Significant concerns and the explanation of the resolution are as follows:

Internal SAIC Independent Technical Review was conducted on the Preliminary Draft version of this document. Subsequent versions of this document (e.g., Draft and Final) incorporated changes based on the technical reviews of USACE, the Ohio Army National Guard, and the Ohio Environmental Protection Agency. Internal SAIC Independent Technical Review comments are recorded on a Document Review Record per SAIC quality assurance procedure QAAP 3.1. This Document Review Record is maintained in the project file. Changes to the report addressing the comments have been verified by the Study/Design Team Leader. As noted above, all concerns resulting from independent technical review of the project have been considered.

W. Kevin Jago — 1/10/11
Kevin Jago — Date
Principal w/ A-E firm

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# TABLE OF CONTENTS

LIST OF TABLES ..... vii
LIST OF FIGURES ..... viii
LIST OF PHOTOGRAPHS ..... viii
LIST OF APPENDICES ..... viii
ACRONYMS AND ABBREVIATIONS ..... ix

**EXECUTIVE SUMMARY ..... XII**

**1.0 INTRODUCTION ..... 1-1**
1.1 PURPOSE ..... 1-1
1.2 SCOPE ..... 1-2
1.3 REPORT ORGANIZATION ..... 1-4

**2.0 BACKGROUND INFORMATION ..... 2-1**
2.1 RAVENNA ARMY AMMUNITION PLANT FACILITY DESCRIPTION ..... 2-1
2.2 DUMP ALONG PARIS-WINDHAM ROAD DESCRIPTION ..... 2-2

**3.0 SUMMARY OF HISTORICAL DATA AND OCCURRENCE AND DISTRIBUTION OF CONTAMINATION ..... 3-1**
3.1 PREVIOUS INVESTIGATIONS AND ACTIVITIES ..... 3-1
3.1.1 Relative Risk Site Evaluation ..... 3-1
3.1.2 Decision Document for a Removal Action at the Paris-Windham Road Dumpsite ..... 3-1
3.1.3 Limited Remedial Design/Remedial Action ..... 3-2
3.1.3.1 Limited Remedial Design/Remedial Action Sampling Results ..... 3-3
3.1.3.2 Limited Remedial Design/Remedial Action Conclusions ..... 3-9
3.2 NATURE AND EXTENT OF CONTAMINATION ..... 3-10
3.2.1 Site-Related Contaminants ..... 3-10
3.2.2 Occurrence and Distribution of Contaminants ..... 3-12
3.2.2.1 Soil ..... 3-12
3.2.2.2 Surface Water ..... 3-12
3.2.3 Soil to Groundwater Leaching Screen ..... 3-13
3.2.4 Conceptual Site Model ..... 3-13
3.2.4.1 Primary and Secondary Sources ..... 3-13
3.2.4.2 Migration Pathways and Receptors ..... 3-14
3.2.4.3 Uncertainties and Data Gaps ..... 3-15

**4.0 HUMAN HEALTH RISK ASSESSMENT AND ECOLOGICAL RISK ASSESSMENT ..... 4-1**
4.1 CONCEPTUAL SITE EXPOSURE MODEL ..... 4-1
4.2 DATA EVALUATION FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS ..... 4-4
4.2.1 Data Aggregate – Soil ..... 4-4
4.2.2 Data Aggregate – Surface Water ..... 4-5
4.3 HUMAN HEALTH RISK ASSESSMENT ..... 4-6
4.3.1 Identify Media of Concern ..... 4-7

## TABLE OF CONTENTS (continued)


4.3.2 Identify Chemicals of Potential Concern ....4-8
4.3.2.1 Chemicals of Potential Concern in the Fill Area Exposure Unit for Soil .... 4-10
4.3.2.2 Chemicals of Potential Concern in the Surface Area Exposure Unit for Soil.... 4-10
4.3.2.3 Chemicals of Potential Concern in Incremental Sampling Method Soil Samples .... 4-10
4.3.2.4 Chemicals of Potential Concern in Surface Water.... 4-10
4.3.3 Determine Area of Concern Land Use and Appropriate Receptors ....4-11
4.3.4 Compare to Appropriate Facility-Wide Cleanup Goals ....4-12
4.3.4.1 Selection of Appropriate Facility-Wide Cleanup Goals for the Dump Along Paris-Windham Road.... 4-13
4.3.4.2 Exposure Point Concentrations for Comparison to Facility-Wide Cleanup Goals .... 4-14
4.3.4.3 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Range Maintenance Soldier Scenario .... 4-14
4.3.4.4 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Trespasser Scenario .... 4-15
4.3.4.5 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Resident Farmer Scenario .... 4-16
4.3.5 Uncertainty Assessment ....4-16
4.3.5.1 Uncertainty in Estimating Potential Exposure .... 4-17
4.3.5.2 Uncertainty in Use of Facility-Wide Cleanup Goals .... 4-18
4.3.5.3 Uncertainty in the Identification of Chemicals of Concern .... 4-19
4.3.6 Summary of Human Health Risk Assessment....4-19
4.4 ECOLOGICAL RISK ASSESSMENT....4-20
4.4.1 Introduction ....4-20
4.4.2 Scope and Objective....4-21
4.4.3 Level I: Scoping Level Ecological Risk Assessment ....4-21
4.4.3.1 AOC Description and Land Use .... 4-21
4.4.3.2 Evidence of Chemical Contamination .... 4-22
4.4.3.3 Ecological Significance .... 4-28
4.4.3.4 Evaluation of Chemical Contamination and Ecological Significance .... 4-41
4.4.3.5 Summary and Recommendations of Scoping Level Ecological Risk Assessment .... 4-42
4.4.4 Conclusions ....4-43

**5.0 REMEDIAL ACTION OBJECTIVE ....5-1**
5.1 REMEDIAL ACTION OBJECTIVE....5-1
5.2 REASONABLE AND ANTICIPATED FUTURE LAND USE....5-1
5.3 FACILITY-WIDE CLEANUP GOALS ....5-2

**6.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ....6-1**
6.1 INTRODUCTION....6-1
6.2 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ....6-3
6.3 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ....6-4
6.4 POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ....6-4
6.5 POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS ....6-5

## TABLE OF CONTENTS (CONTINUED)


**7.0 TECHNOLOGY TYPES AND PROCESS OPTIONS ..... 7-1**
7.1 NO ACTION ..... 7-1
7.2 LAND USE CONTROLS ..... 7-1

**8.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES ..... 8-1**
8.1 NO ACTION ..... 8-1
8.2 LAND USE CONTROLS ..... 8-1

**9.0 ANALYSIS OF REMEDIAL ALTERNATIVES ..... 9-1**
9.1 INTRODUCTION ..... 9-1
9.1.1 Threshold Criteria ..... 9-2
9.1.2 Balancing Criteria ..... 9-2
9.1.3 Modifying Criteria ..... 9-3
9.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES ..... 9-4
9.2.1 Alternative 1: No Action ..... 9-4
9.2.1.1 Overall Protection of Human Health and the Environment ..... 9-4
9.2.1.2 Compliance with ARARs ..... 9-4
9.2.1.3 Long-Term Effectiveness and Permanence ..... 9-5
9.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment ..... 9-5
9.2.1.5 Short-Term Effectiveness ..... 9-5
9.2.1.6 Implementability ..... 9-5
9.2.1.7 Cost ..... 9-5
9.2.2 Alternative 2: Land Use Controls ..... 9-5
9.2.2.1 Overall Protection of Human Health and the Environment ..... 9-6
9.2.2.2 Compliance with ARARs ..... 9-6
9.2.2.3 Long-Term Effectiveness and Permanence ..... 9-6
9.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment ..... 9-6
9.2.2.5 Short-Term Effectiveness ..... 9-7
9.2.2.6 Implementability ..... 9-7
9.2.2.7 Cost ..... 9-7
9.3 COMPARATIVE ANALYSIS ..... 9-7

**10.0 AGENCY COORDINATION AND PUBLIC INVOLVEMENT ..... 10-1**
10.1 STATE ACCEPTANCE ..... 10-1
10.2 COMMUNITY ACCEPTANCE ..... 10-1

**11.0 CONCLUSIONS ..... 11-1**
11.1 CONCLUSIONS ..... 11-1
11.2 RECOMMENDED ALTERNATIVE ..... 11-1

**12.0 REFERENCES ..... 12-1**

# LIST OF TABLES

Table 3-1. Results of Limited "RD/RA" Confirmatory Surface Soil Discrete Samples – Inorganic Chemicals....3-5
Table 3-2. Results of Limited "RD/RA" Confirmatory Surface Soil and Dry Sediment Discrete Samples – Organic Chemicals....3-6
Table 3-3. Results of Limited "RD/RA" Confirmatory Surface Water Discrete Samples....3-7
Table 3-4. Results of Limited "RD/RA" Confirmatory Dry Sediment Discrete Samples – Inorganic Chemicals....3-8
Table 3-5. Results of Limited "RD/RA" Contingency Incremental Sampling Method Surface Soil Samples....3-9
Table 3-6. Soil SRCs....3-11
Table 3-7. Surface Water SRCs....3-12
Table 3-8. Results of Contaminant Migration Soil to Groundwater Screening....3-14
Table 4-1. Risk Assessment Datasets for Soil....4-5
Table 4-2. Risk Assessment Dataset for Surface Water....4-6
Table 4-3. Summary of COPCs....4-10
Table 4-4. FWCUGs for COPCs in Soil....4-13
Table 4-5. FWCUGs for COPCs in Surface Water....4-14
Table 4-6. Summary of COCs and FWCUGs....4-20
Table 4-7. Summary of COPECs for Surface Soil at the Fill Area EU....4-26
Table 4-8. Summary of COPECs for Surface Soil at the Surface Area EU....4-27
Table 4-9. Summary of COPECs for Surface Water....4-28
Table 4-10. Summary of COPEC Concentrations for Dry Sediment and Surface Water at and in the Vicinity of the Dump Along Paris-Windham Road....4-36
Table 4-11. Comparison of Five Assessment Techniques at Sampling Stations Near the Dump Along Paris-Windham Road....4-39
Table 4-12. Survey of Proximity to the AOC of Various Ecological Resources....4-40
Table 5-1. Chemicals of Concern and Cleanup Goals by Media and Receptor....5-2
Table 6-1. Potential Action ARARs for Disposal of RCRA Hazardous Waste....6-5
Table 9-1. Comparison of Alternatives by Evaluation Criteria....9-7

# LIST OF FIGURES

Figure 2-1. General Location of RVAAP....2-3
Figure 2-2. Location of Dump Along Paris-Windham Road Within RVAAP....2-4
Figure 2-3. Dump Along Paris-Windham Road....2-5
Figure 3-1. Limited "RD/RA" Location Map....3-16
Figure 3-2. Cross Sectional Diagram Illustrating Site Restoration....3-17
Figure 4-1. Conceptual Site Exposure Model....4-3
Figure 4-2. Risk Assessment Input to Support Remediation Decisions....4-9
Figure 4-3. Exposure Units at the Dump Along Paris-Windham Road....4-25
Figure 4-4. Natural Resources (OHARNG 2008) Inside and Near Habitat Area at the Dump Along Paris-Windham Road....4-31
Table 5-1. Chemicals of Concern and Cleanup Goals by Media and Receptor....5-2
Table 6-1. Potential Action ARARs for Disposal of RCRA Hazardous Waste....6-5
Table 9-1. Comparison of Alternatives by Evaluation Criteria....9-7

# LIST OF PHOTOGRAPHS

Photograph 4-1. Looking South along Paris-Windham Road; Green Ash, American Elm, and Hackberry Temporary Flooded Forest Alliance in Background....4-32
Photograph 4-2. Drainage Swale with no Standing Water Along the Northwest Portion of the AOC; Green Ash, American Elm, and Hackberry Temporary Flooded Forest Alliance in Background....4-32

# LIST OF APPENDICES

Appendix A. Photographs
Appendix B. Human Health Risk Assessment Supporting Data
Appendix C. Ecological Risk Assessment Information and Data
Appendix D. Detailed Cost Estimates
Appendix E. Ohio EPA Correspondence

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACM | Asbestos-Containing Material |
| amsl | Above Mean Sea Level |
| AOC | Area of Concern |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| bgs | Below Ground Surface |
| BRAC | Base Realignment and Closure |
| C&D | Construction and Demolition |
| Camp Ravenna | Camp Ravenna Joint Military Training Center |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| *CFR* | *Code of Federal Regulations* |
| CMCOPC | Contaminant Migration Chemical of Potential Concern |
| COC | Chemical of Concern |
| COPC | Chemical of Potential Concern |
| COPEC | Chemical of Potential Ecological Concern |
| CSM | Conceptual Site Model |
| CUG | Cleanup Goal |
| DD | Decision Document |
| DERR | Division of Emergency and Remedial Response |
| DFFO | Director's Final Findings and Orders |
| ERA | Ecological Risk Assessment |
| EPC | Exposure Point Concentration |
| ESA | Endangered Species Act |
| ESL | Ecological Screening Level |
| ESV | Ecological Screening Value |
| EU | Exposure Unit |
| FFS | Focused Feasibility Study |
| FS | Feasibility Study |
| FWCUG | Facility-Wide Cleanup Goal |
| FWERWP | Facility-Wide Ecological Risk Work Plan |
| FWHHRAM | Facility-Wide Human Health Risk Assessor Manual |
| GRA | General Response Action |
| HHRA | Human Health Risk Assessment |
| HQ | Hazard Quotient |
| IBI | Index of Biotic Integrity |
| ICI | Invertebrate Community Index |
| INRMP | Integrated Natural Resources Management Plan |
| IRP | Installation Restoration Program |
| ISM | Incremental Sampling Method |
| LUC | Land Use Control |
| MCL | Maximum Contaminant Level |
| MDC | Maximum Detected Concentration |
| MDL | Method Detection Limit |
| MFL | Million Fibers per Liter |
| MKM | MKM Engineers, Inc. |

# ACRONYMS AND ABBREVIATIONS (CONTINUED)

| | |
|---|---|
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NFA | No Further Action |
| O&M | Operation and Maintenance |
| OAC | Ohio Administrative Code |
| OHARNG | Ohio Army National Guard |
| Ohio EPA | Ohio Environmental Protection Agency |
| ORAM | Ohio Rapid Assessment Method |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PBT | Persistent, Bioaccumulative, and Toxic |
| PCB | Polychlorinated Biphenyl |
| PMP | Property Management Plan |
| PP | Proposed Plan |
| PRG | Preliminary Remediation Goal |
| QA | Quality Assurance |
| QC | Quality Control |
| QHEI | Qualitative Habitat Evaluation Index |
| RA | Remedial Action |
| RAFLU | Reasonable and Anticipated Future Land Use |
| RAO | Remedial Action Objective |
| RCRA | Resource Conservation and Recovery Act |
| RD | Remedial Design |
| RI | Remedial Investigation |
| RM | River Mile |
| ROD | Record of Decision |
| RRSE | Relative Risk Site Evaluation |
| RSL | Regional Screening Level |
| RVAAP | Ravenna Army Ammunition Plant |
| SAIC | Science Applications International Corporation |
| SC | Site Characterization |
| SDZ | Safety Danger Zone |
| SOR | Sum-of-Ratios |
| SRC | Site-related Contaminant |
| SRV | Sediment Reference Value |
| SSL | Soil Screening Level |
| SVOC | Semi-volatile Organic Compound |
| T&E | Threatened and Endangered |
| TAL | Target Analyte List |
| TEC | Threshold Effects Concentration |
| TNT | 2,4,6-Trinitrotoluene |
| TOC | Total Organic Carbon |
| TR | Target Risk |
| TSCA | Toxic Substances Control Act |
| $UCL_{95}$ | 95% Upper Confidence Limit of the Mean |
| USACHPPM | United States Army Center for Health Promotion and Preventive Medicine |

# ACRONYMS AND ABBREVIATIONS (CONTINUED)

| | |
|---|---|
| USACE | United States Army Corps of Engineers |
| USEPA | Unites States Environmental Protection Agency |
| USFS | United States Forest Service |
| VOC | Volatile Organic Compound |
| WOE | Weight-of-Evidence |
| WP | Work Plan |
| WQS | Water Quality Standard |
| WWH | Warm Water Habitat |

# EXECUTIVE SUMMARY

This Site Characterization and Focused Feasibility Study (SC/FFS) Report documents the findings and conclusions of previous remedial investigations/activities for the Dump Along Paris-Windham Road Area of Concern (AOC) at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull Counties, Ohio. This SC/FFS also evaluates the nature and extent of contamination, identifies chemicals of potential concern (COPCs), identifies chemicals of concern (COCs), and evaluates the remedial alternatives. The Dump Along Paris-Windham Road is designated as AOC RVAAP-51 in the RVAAP Installation Restoration Program (IRP). This work was initiated under Contract Number W912QR-08-D-0008, Delivery Order Number 0014, issued by the United States Army Corps of Engineers, Louisville District (USACE) on June 16, 2009 to Science Applications International Corporation (SAIC, now known as Leidos). The Contract Delivery Order Number 0014 has since expired; therefore, the USACE has completed the finalization of this SC/FFS Report by addressing changes resulting from review comments from the Ohio Environmental Protection Agency (Ohio EPA).

In addition, a Memorandum "*Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program, Portage /Trumbull Counties, Ohio* (Tech Memo) (Memorandum between ARNG-ILE Cleanup and the Ohio Environmental Protection Agency; dated 4 February 2014)" has been accepted by the Ohio EPA. The Tech Memo requires certain modifications to remedial investigation documents for the RVAAP restoration program that include Risk Assessments or discussion of Land Uses. The main modification required in the Tech Memo regarding risk assessment is that the risk assessment should include an evaluation of the potential fulltime occupational exposure for a Commercial Industrial Land Use at AOCs/Munitions Response Sites (MRSs) using the USEPA's Industrial Regional Screening Levels (RSLs) as the decision criteria.

The most recent Revised Draft SC/FFS Report (replacement pages and Responses in Comment Response Table) was sent to the Ohio EPA on January 24, 2013. The Ohio EPA provided conditional approval of the proposed changes pending approval and finalization of the Tech Memo via Certified Mail #7012010000094675182 dated March 1, 2013. The letter indicated that the SC/FFS should be updated based on the Tech Memo once finalized. The Revised Draft SC/FFS report did not have an Executive Summary. The Tech Memo was finalized and approved on February 10, 2014. USACE has prepared this Executive Summary to provide updated information related to the approved Tech Memo to the Ohio EPA in order to finalize the SC/FFS Report. This Executive Summary describes why modifications to the human health risk assessment (HHRA) process introduced in the Tech Memo do not necessitate changes to this SC/FFS Report. Additionally, this Executive Summary relates the approach presented in this SC/FFS Report to modifications introduced in the Tech Memo, thereby assisting in the preparation and review of future remedial action documents such as the Record of Decision or a Five Year Review.

The work for this SC/FFS Report was completed in compliance with the *Site Characterization and Focused Feasibility Study Work Plan for the RVAAP-51 Dump Along Paris-Windham Road* (USACE 2010c). In addition, planning and performance of all elements of this work are in accordance with the requirements of the Ohio EPA *Director's Final Findings and Orders* (DFFO) dated June 10, 2004 (Ohio EPA 2004).

This SC/FFS was completed to characterize the AOC, following an interim removal action (IRA), and identifies the final remedial action alternatives for soil at the Dump Along Paris-Windham Road. The IRA was called a limited remedial design/remedial action ("RD/RA") by the U.S. Army Base Realignment and Closure (BRAC) Division, at the time it was performed in 2003. Activities included the removal of surface debris, excavation of transite (roofing and siding debris that was identified to contain asbestos) along the embankment to the extent practicable (without undermining Paris-Windham Road), confirmatory sampling to evaluate the success of the IRA, and placement of a protective soil and vegetation cover over portions of the AOC. The limited "RD/RA" terminology has been retained within this SC/FFS to be consistent with historical documents; however, the Ohio EPA commented that the "RD/RA" should be considered an IRA and not a final remedy (MKM 2004). The limited "RD/RA" did not evaluate the nature and extent of contamination or identify COPCs or COCs. This SC/FFS completes these tasks and evaluates the remedial alternatives, as required, to address impacts to environmental media in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

## ES.1 AOC Description

The Dump Along Paris-Windham Road is located in the east-central portion of the facility, along a steep embankment on the west side of Paris-Windham Road between the bridge over Sand Creek and the intersection of Paris-Windham Road with Remalia Road. The AOC was used as an open dump for a variety of miscellaneous construction and demolition material, including asbestos-containing material (ACM) (e.g., transite roofing and siding), laboratory bottles and drums, concrete, brick, glass, scrap metal, fencing, and wood debris. There are no records indicating the quantities of material dumped at the AOC or the dates of operation. The former dump was approximately 400 ft long by 30 ft wide and slopes east to west, away from Paris-Windham Road (Figure 2-3). The slope face ranges from 40 to 60 degrees from horizontal. There are no structures or dwellings on the AOC.

## ES.2 AOC Risk Assessment Summary

The Human Health Risk Assessment (HHRA) was completed to evaluate if residual contamination has the potential to cause adverse effects to current and future receptors. The residual asbestos, remaining at the AOC after the limited RD/RA was completed, was one of the constraints affecting future Land Use known before completion of the HHRA and this SC/FFS. The Dump Along Paris Windham Road is an atypical AOC in terms of the types of activities assessed in an HHRA to evaluate exposure to receptors. The AOC is located along Paris-Windham Road which is used for transportation purposes. Most of the former dump site was removed during the limited "RD/RA." Visible subsurface transite debris was excavated to the extent possible without undermining and compromising the integrity of Paris-Windham Road (MKM 2004). After the excavation was completed, several feet of fill and protective soil and vegetation cover were placed over the excavated

portions of the AOC. The fill consisted of a combination of clean, hard fill and Ohio EPA-approved soil backfill.

Two Land Uses were assessed in the HHRA: Unrestricted Land Use represented by the Residential Receptor (called Resident Farmer in this SC/FSS) and the Military Training Land Use represented by the Range Maintenance Soldier. The Adult and Juvenile Trespassers were also evaluated in the HHRA. The Resident Farmer was evaluated in the HHRA in order to determine baseline conditions. Although this SC/FFS was initiated before finalization of the Tech Memo, the Army also considered the requirements of the Tech Memo regarding the evaluation of a third Land Use, Commercial Industrial. Due to residual asbestos at the AOC, which will restrict use at the AOC, no Commercial Industrial Land Use is plausible. Additionally, evaluating the AOC for the Commercial Industrial Land Use would result in no change to the proposed remedial action that is recommended by this SC/FFS Report (i.e., LUCs which complement the previously completed IRA).

The evaluation of the Military Training Land Use, using the Range Maintenance Soldier Receptor, appropriately represented the future activity anticipated at the time this report was produced, which was to be part of a range complex. The Unrestricted (Residential) Land Use could not be readily obtained for the AOC without undermining Paris-Windham Road and removing all the residual (covered) ACM. The AOC is not currently used for training activities, as it is marked as off-limits with siebert stakes and signs, due to residual asbestos. The steep bank along the Paris-Windham Road, as well as the presence of residual ACM at the AOC, makes the AOC unsuitable for regular training and residential use. Therefore, the National Guard Trainee was not chosen as the likely receptor and was not evaluated. The SC/FFS recommends LUCs to control access and digging on the AOC due to residual asbestos; therefore, it was not necessary to modify the SC/FFS to include additional LUCs per the Tech Memo. If the Land Use changes in the future, then the AOC would have to be re-evaluated for that Land Use depending upon the AOC conditions at that time.

The HHRA was completed following the stream-lined process in the Facility-wide Cleanup Goals (FWCUGs) Report (USACE 2010a). These FWCUGs are the remediation levels for the designated user for any COCs at the Dump Along Paris-Windham Road, unless there are additive effects to be considered. No COCs were identified in soil or surface water for the Range Maintenance Soldier or Adult and Juvenile Trespassers. Two COCs (benzo(a)pyrene and dibenz(a,h)anthracene were identified in the surface soil (0 to 1 foot below ground surface-bgs) for the Resident Farmer.

The results of the Ecological Risk Assessment recommended that No Further Action (NFA) for protection of ecological resources was required.

## ES 3 Focused Feasibility

The FFS developed a remedial action objective (RAO) to protect receptors from impacted environmental media and COCs and identified applicable or relevant and appropriate requirements (ARARs). In accordance with the RAO, a focused technology screening was performed and remedial alternatives were developed to provide options to reduce risks to the environment and human health.

The FS was identified as a Focused FS (FFS) on the basis that the AOC would continue to be used with LUCs and could not be used for Unrestricted (Residential) Land Use unless the residual asbestos under Paris-Windham Road was removed. However, RAOs still had to be evaluated in the FFS. The FFS specifies the requirements that remedial alternatives must fulfill to protect human health and the environment from COCs at the Dump Along Paris-Windham Road. Media-specific objectives that identify major contaminants and associated media-specific cleanup goals (CUGs) were developed to provide this protection. These objectives specify COCs, exposure routes and receptors, and acceptable constituent concentrations for long-term protection of receptors. Based upon the SC results, the RAO at the Dump Along Paris-Windham Road is to prevent exposure of the Resident Farmer to shallow surface soil (0-1 ft bgs) with COC levels exceeding the TR of 1E-05 and an HQ of 1.0.

Two remedial alternatives, Alternative 1 (No Action Alternative) and Alternative 2 (Land Use Controls), were carried through the detailed analyses in the FFS. Alternative 1 (No Action) was not considered protective for human health and did not comply with most of the evaluation criteria (i.e., reduction in toxicity) for human health. The FFS showed that Alternative 1 allows for sustainability of terrestrial habitat for ecological receptors.

Alternative 2 maintains the current status/condition of the Dump Along Paris-Windham Road and includes LUCs and annual inspections to identify changes in the nature or extent of residual contamination left at the AOC and evaluate if LUCs are working properly. These LUCs would be implemented in accordance with an approved RD and Property Management Plan (PMP) appendix for the AOC. In addition, signs would be posted at the AOC stating that the area was a former ACM disposal location. Pursuant to CERCLA, a review would be conducted every five (5) years, as contaminants remain on-site above unlimited use and unrestricted exposure FWCUGs. These 5-year reviews will evaluate the effectiveness of LUCs and ensure any land use changes are identified. Under Alternative 2, the Representative Receptor (Range Maintenance Soldier) and possible Adult and Juvenile Trespassers are not exposed to unacceptable risk levels due to contaminants in shallow surface or subsurface soil at the AOC. Implementation of LUCs prevents exposure to the Resident Farmer. Alternative 2 is considered protective for human receptors and allows for sustainability of terrestrial habitat for ecological receptors. Therefore, Alternative 2 was selected as the Preferred Alternative.

## ES. 4 Conclusions

- The SC was completed to determine if residual contamination, remaining after an IRA (a limited "RD/RA"), presented risks to human and ecological receptors by evaluating the nature and extent of the residual contamination in soil, surface water, and soil as a source to groundwater. Soil included dry sediment. Wet sediment was not an exposure medium on this site.

- The presence of the residual ACM makes this AOC unsuitable for residential occupancy or regular military training.

- The HHRA evaluated two Land Uses: Unrestricted (Residential) Land Use (as a baseline) and Military Training Land Use (Range Maintenance Soldier). No COCs were identified for surface water for either of the two Land Uses. No COCs were identified in soil for the Military Training Land Use (Range Maintenance Soldier). Two COCs were identified for the Resident Receptor in 0 to 1 bgs surface soil for the Unrestricted (Residential) Land Use.

- The Alternative 2 – Land Use Controls was selected as the preferred alternative in the FFS.

- The next step for this AOC in the CERCLA process is to proceed to a Proposed Plan.

- For the Proposed Plan and other future documents prepared for this AOC, the following modifications will be made for consistency with the Tech Memo:
    - The use of the term Resident Farmer will be replaced with the term Resident Receptor.
    - The LUCs will be protective of the National Guard Trainee, as well as the range maintenance soldier, since the National Guard Trainee is now considered the default receptor for Military Training Land Use under the Tech Memo.

# 1.0 INTRODUCTION

Science Applications International Corporation (SAIC, now known as Leidos) was contracted by the United States Army Corps of Engineers (USACE), Louisville District to perform a Site Characterization (SC)/Focused Feasibility Study (FFS) for the Dump Along Paris-Windham Road at the Ravenna Army Ammunition Plant (RVAAP). The Dump Along Paris-Windham Road is designated as Area of Concern (AOC) RVAAP-51 in the RVAAP Installation Restoration Program (IRP).

This work was performed under Contract Number W912QR-08-D-0008, Delivery Order Number 0014, issued by USACE, Louisville District on June 16, 2009, and in compliance with the *Site Characterization and Focused Feasibility Study Work Plan for the RVAAP-51 Dump Along Paris-Windham Road* (USACE 2010c) [herein referred to as the SC/FFS Work Plan (WP)]. In addition, planning and performance of all elements of this work are in accordance with the requirements of the Ohio Environmental Protection Agency (Ohio EPA) *Director's Final Findings and Orders* (DFFO) dated June 10, 2004 (Ohio EPA 2004).

## 1.1 PURPOSE

This SC/FFS characterizes the AOC [following a limited remedial design/remedial action (RD/RA)] and identifies the final RA alternatives for soil at the Dump Along Paris-Windham Road. The limited "RD/RA," as titled by the U.S. Army Base Realignment and Closure (BRAC) Division, was performed in 2003. Activities included the removal of surface debris, excavation of transite along the embankment to the extent practicable (without undermining Paris-Windham Road), confirmatory sampling to evaluate the success of the RA, and placement of a protective soil and vegetation cover over portions of the AOC. The limited "RD/RA" terminology has been retained within this SC/FFS to be consistent with historical documents; however, the Ohio EPA commented the "RD/RA" should be considered an interim removal action and not a final remedy (MKM 2004). The limited "RD/RA" did not evaluate the nature and extent of contamination or identify chemicals of potential concern (COPCs) or chemicals of concern (COCs). This SC/FFS completes these tasks and evaluates the remedial alternatives, as required, to address impacts to environmental media in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The SC portion of this document:

- Describes the AOC conditions;
- Summarizes historical data;
- Evaluates the nature and extent of contamination at the AOC;
- Presents a conceptual site model (CSM);
- Evaluates contaminant risk to human and ecological receptors;
- Determines COPCs and COCs; and
- Identifies applicable facility-wide cleanup goals (FWCUGs).

Groundwater data do not exist for the vicinity of this AOC; therefore, only a qualitative evaluation of potential impacts of residual soil contaminants on groundwater quality is included in the SC portion of this document. The U.S. Army will address groundwater at this AOC under a future decision for the RVAAP Facility-Wide Groundwater AOC (RVAAP-66). Surface water at the AOC occurs intermittently in a drainage swale located at the base of the slope face of the dump. As discussed in Sections 1.2 and 4.0, surface water within this AOC is evaluated in the SC; however, no further action (NFA) is recommended based on assessment of human health and ecological risks. Therefore, the FFS portion of this document evaluates remedial alternatives to obtain a final remedy for soil at the Dump Along Paris-Windham Road.

For the purposes of this SC/FFS, the term "surface soil" includes dry sediment. Dry sediment refers to unconsolidated inorganic and organic material within conveyances, ditches, or low-lying areas that occasionally may be covered with water, usually following a precipitation event or due to snowmelt. Dry sediment is not covered with water for extended periods and typically is dry within 7 days (USACE 2008). It does not function as a permanent habitat for aquatic organisms; although, it may serve as a natural medium for the growth of terrestrial organisms. Dry sediment is addressed in the same manner as surface soil [0-1 ft below ground surface (bgs)] in terms of contaminant nature and extent, fate and transport, and risk exposure models. The definitions and terminology usages for dry sediment within this SC/FFS are consistent with the *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2010a) (herein referred to as the FWCUG Report).

An FFS develops a remedial action objective (RAO) to protect receptors from impacted environmental media and COCs and identifies applicable or relevant and appropriate requirements (ARARs). In accordance with the RAO, a focused technology screening is performed and remedial alternatives are developed to provide options to reduce risks to the environment and human health.

The recommended alternative listed in the FFS will be presented in a Proposed Plan (PP) for public review and comment. Public comments will be considered in the final selection of a remedy, which will be documented in a Record of Decision (ROD). Responses to public comments will be addressed in the responsiveness summary of the ROD.

## 1.2 SCOPE

This SC/FFS uses historical data to characterize the nature and extent of contaminants in soil (inclusive of dry sediment) and intermittent surface water at the Dump Along Paris-Windham Road. Risks to human and ecological receptors posed by contaminants in soil and surface water are assessed, and potential impacts to groundwater from residual soil contaminants are evaluated. The assessments of human health and ecological risks for surface water (Section 4.0) address temporal exposures due to the fact that surface water is present at the AOC on an intermittent basis. No human health COCs were identified for surface water, and the ecological risk assessment (ERA) recommended NFA with respect to ecological receptors. Based on the risk assessment results, the FFS does not include remedial alternatives for surface water. Potential final remedies for soil are

presented along with a detailed analysis and comparative evaluation. This document provides the information and decisions necessary for a subsequent PP and ROD to address soil media at the AOC.

The Ohio Army National Guard (OHARNG) has established a Reasonable and Anticipated Future Land Use (RAFLU) for the Dump Along Paris-Windham Road as follows (OHARNG 2008b):

- Military Training.

- Representative Receptor – National Guard Range Maintenance Soldier

RVAAP is a controlled-access facility that is fenced and patrolled by security personnel. Full-time OHARNG, BRAC, and contractor staff work at the facility. Military training and operations are conducted at the facility. The AOC is located in the eastern central portion of the facility. The AOC is not currently used for military training activities but may receive periodic foot traffic. The most representative receptor is the National Guard Range Maintenance Soldier. The basis for selecting the Range Maintenance Soldier as the Representative Receptor for the Dump Along Paris-Windham Road is that the area is not conducive for regular training (steep slope), there is residual asbestos at the AOC, and a safety danger zone (SDZ) for a proposed future range complex overlaps the AOC (OHARNG 2008b). This anticipated future land use, in conjunction with the evaluation of agricultural-residential land uses and associated receptors, forms the basis for identifying COCs in this SC/FFS. Residential Land Use, specifically the Resident (adult and child) Farmer scenario, is included in the human health risk assessment (HHRA) (Section 4.3) to evaluate COCs for unrestricted land use at the AOC as required by the CERCLA process and as outlined in the *Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (USACE 2005b) (herein referred to as the FWHHRAM); however, the topography of the area (i.e., steep slope and floodplain), precludes Residential Land Use. As described in the approved SC/FFS WP (USACE 2010c) and further discussed in the FFS (Section 5.0), a remedial alternative based on Residential Land Use is not evaluated due to these location and physical characteristics of the AOC, as well as waste remaining in place [construction and demolition (C&D) material, including transite, glass, concrete, brick, metal, and wood debris].

Because the AOC is located immediately adjacent to a primary road, trespassers may potentially visit the AOC; therefore, Adult and Juvenile Trespassers are also considered in the HHRA. The exposure assumptions for the Range Maintenance Soldier are also protective of the Adult and Child trespasser. Per guidelines in the FWCUG Report (USACE 2010a), the application of these receptor scenarios to the Dump Along Paris-Windham Road is described in more detail in Section 4.3.

The following key points relate to the scope of this SC/FFS:

- This SC/FFS includes an evaluation of contaminant nature and extent and incorporates existing data. Based on the results of the SC, any remaining data gaps are identified and additional sampling, if required, is recommended.

- Data previously collected for the limited "RD/RA" were of good quality; however, the data screening processes employed in the limited "RD/RA" (MKM 2004) were not in conformance with current RVAAP protocols. This SC/FFS includes an HHRA (Section 4.3), which follows the processes outlined in the FWCUG Report (USACE 2010a), identifies COPCs, COCs, and applicable FWCUGs. This SC/FFS also includes an ERA (Section 4.4), which follows a unified approach of methods integrating U.S. Army, Ohio EPA, and United States Environmental Protection Agency (USEPA) guidance.

- Residual fragments of transite covered in place during the limited "RD/RA" are qualitatively evaluated in this SC/FFS with respect to the potential for human exposure (e.g. friable or non-friable asbestos and any mitigating effect of the soil/vegetation cover placed over the dump following the limited "RD/RA").

## 1.3 REPORT ORGANIZATION

This report is organized in accordance with USEPA guidance for CERCLA remedial investigations (RIs) and feasibility studies (FSs) and the proposed outline included in Section 7.0 of the approved SC/FFS WP (USACE 2010c). This report combines an SC and FFS for the Dump Along Paris-Windham Road and is organized as follows:

- Section 1.0 provides an introduction.

- Section 2.0 presents facility and AOC background information.

- Section 3.0 summarizes historical data and evaluates the occurrence and distribution of contaminants at the Dump Along Paris-Windham Road.

- Section 4.0 presents the HHRA and ERA.

- Section 5.0 identifies the RAO.

- Section 6.0 discusses ARARs.

- Section 7.0 presents the limited technology types and process options for RAs.

- Section 8.0 discusses the development of remedial alternatives for the AOC.

- Section 9.0 presents detailed and comparative analyses of the remedial alternatives.

- Section 10.0 summarizes the partnering and public involvement activities.

- Section 11.0 presents the conclusions.

- Section 12.0 provides the references used in this report.

Appendices A through E provide information supporting the evaluations presented within this SC/FFS and are organized as follows:

- Appendix A contains photographs.
- Appendix B presents HHRA supporting data.
- Appendix C presents ERA supporting data.
- Appendix D includes the cost evaluations.
- Appendix E provides correspondence from the Ohio EPA.

# 2.0 BACKGROUND INFORMATION

## 2.1 RAVENNA ARMY AMMUNITION PLANT FACILITY DESCRIPTION

When the RVAAP IRP began in 1989, RVAAP was identified as a 21,419-acre facility. The property boundary was resurveyed by OHARNG over a 2-year period (2002 and 2003), and the total acreage of the property was found to be 21,683 acres.

As of June 2010, a total of 20,423 acres of the former 21,683-acre RVAAP has been transferred to the National Guard Bureau and subsequently licensed to OHARNG for use as a military training site (Camp Ravenna Joint Military Training Center). These transferred portions are now referred to as Camp Ravenna. The current RVAAP consists of 1,260 acres in various parcels throughout Camp Ravenna.

Camp Ravenna is in northeastern Ohio within Portage and Trumbull counties, approximately 3 miles east-northeast of the city of Ravenna and approximately 1 mile northwest of the city of Newton Falls (Figure 2-1). The RVAAP portions of the property are solely located within Portage County. Camp Ravenna/RVAAP is a parcel of property approximately 11 miles long and 3.5 miles wide, bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east. Camp Ravenna is surrounded by several communities: Windham on the north; Garrettsville 6 miles to the northwest; Newton Falls 1 mile to the southeast; Charlestown to the southwest; and Wayland 3 miles to the south.

The entire 21,683-acre parcel was an industrial facility that was government-owned, contractor-operated when RVAAP was operational (Camp Ravenna did not exist at that time). The RVAAP IRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP. References to RVAAP in this document are considered to be inclusive of the historical extent of RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

Industrial operations at the former RVAAP consisted of 12 munitions-assembly facilities referred to as "load lines." Load Lines 1 through 4 were used to melt and load 2,4,6-trinitrotoluene (TNT) and Composition B into large-caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. Following cleaning, the wastewater containing TNT and Composition B was known as "pink water" for its characteristic color. Pink water was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds,

and explosives. Load Line 12 was used from 1946 to 1949 to produce ammonium nitrate for explosives and fertilizers, and portions of the AOC were later used for weapons demilitarization.
In 1950, the facility was placed on standby status, and operations were limited to renovation, demilitarization, normal maintenance of equipment, and munitions storage. Production activities were resumed from July 1954 to October 1957 and again from May 1968 to August 1972. In addition to production missions, various demilitarization activities were conducted at facilities constructed at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembly of munitions and explosives melt-out and recovery operations using hot water and steam processes. Periodic demilitarization of various munitions continued through 1992.

In addition to production and demilitarization activities at the load lines, other facilities at RVAAP include AOCs that were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consist of large parcels of open space or abandoned quarries. Potential contaminants at these AOCs include explosives, propellants, inorganic chemicals, and waste oils. Other types of AOCs present at RVAAP include landfills, an aircraft fuel tank testing facility, and various general industrial support and maintenance facilities.

## 2.2 DUMP ALONG PARIS-WINDHAM ROAD DESCRIPTION

The Dump Along Paris-Windham Road is located in the east-central portion of RVAAP, along a steep embankment on the west side of Paris-Windham Road between the bridge over Sand Creek and the intersection of Paris-Windham Road with Remalia Road (Figure 2-2). The AOC was used as an open dump for a variety of miscellaneous C&D material, including asbestos-containing material (ACM) (e.g. transite roofing and siding), laboratory bottles and drums, concrete, brick, glass, scrap metal, fencing, and wood debris. There are no records indicating the quantities of material dumped at the AOC or the dates of operation.

The former dump was approximately 400 ft long by 30 ft wide and slopes east to west, away from Paris-Windham Road (Figure 2-3). The slope face ranges 40 to 60 degrees from horizontal. There are no structures or dwellings on the AOC.

Sand Creek is located to the west and north at distances ranging from approximately 30 ft (north end of the AOC) to 170 ft (south-central portion of the AOC). Surface water runoff follows the topography and flows in a westerly direction through a drainage swale at the base of the dump slope, entering Sand Creek. Surface water within the drainage swale occurs intermittently during and after rainfall events and periods of snow melt. During an August 2009 walkover, SAIC noted the sediment in the drainage swale had high moisture content, but no standing water was observed. During a November 2011 walkover following an extended rainfall event, water was observed. The Sand Creek floodplain occupies the land between the dump and Sand Creek.

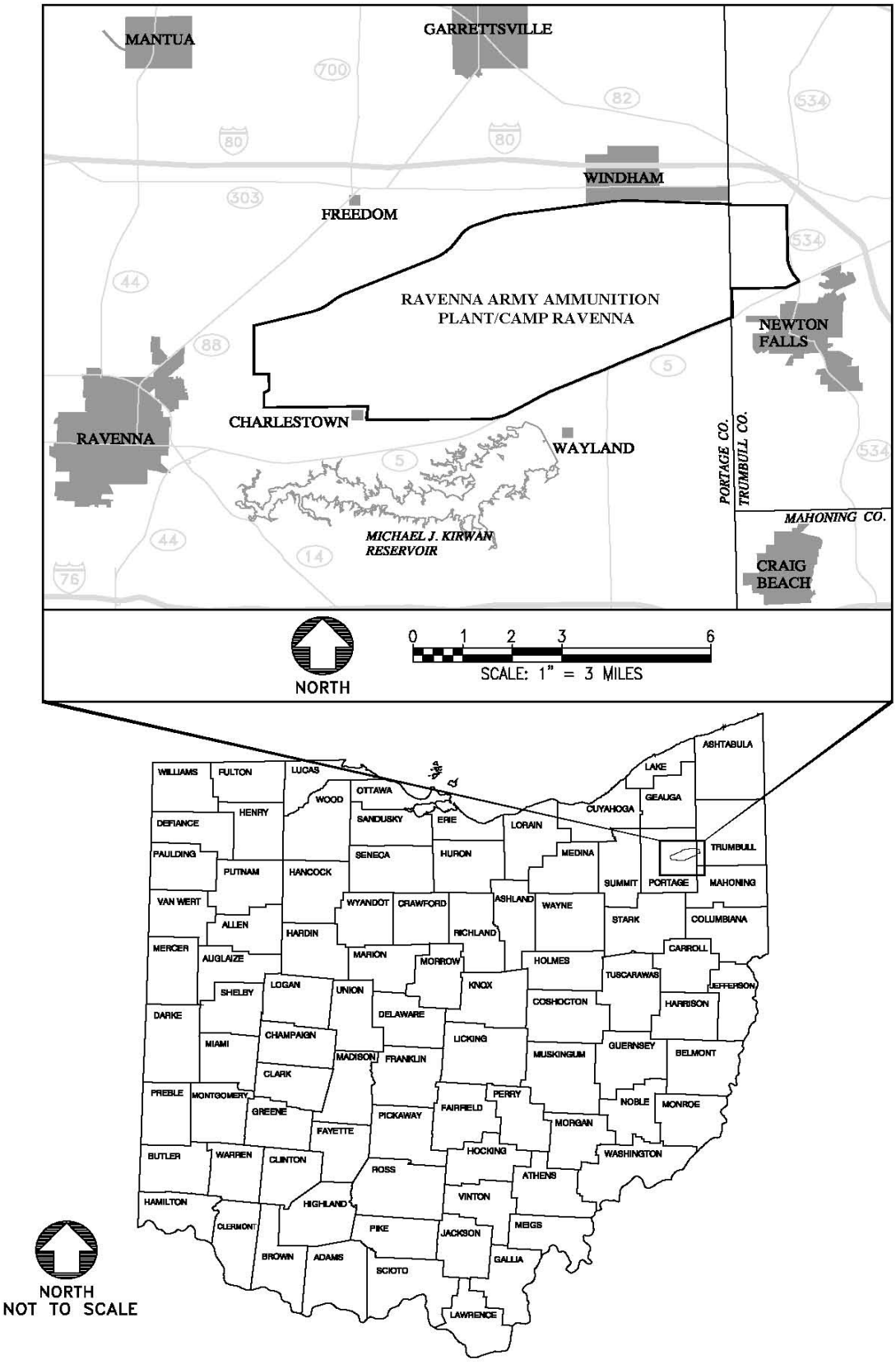
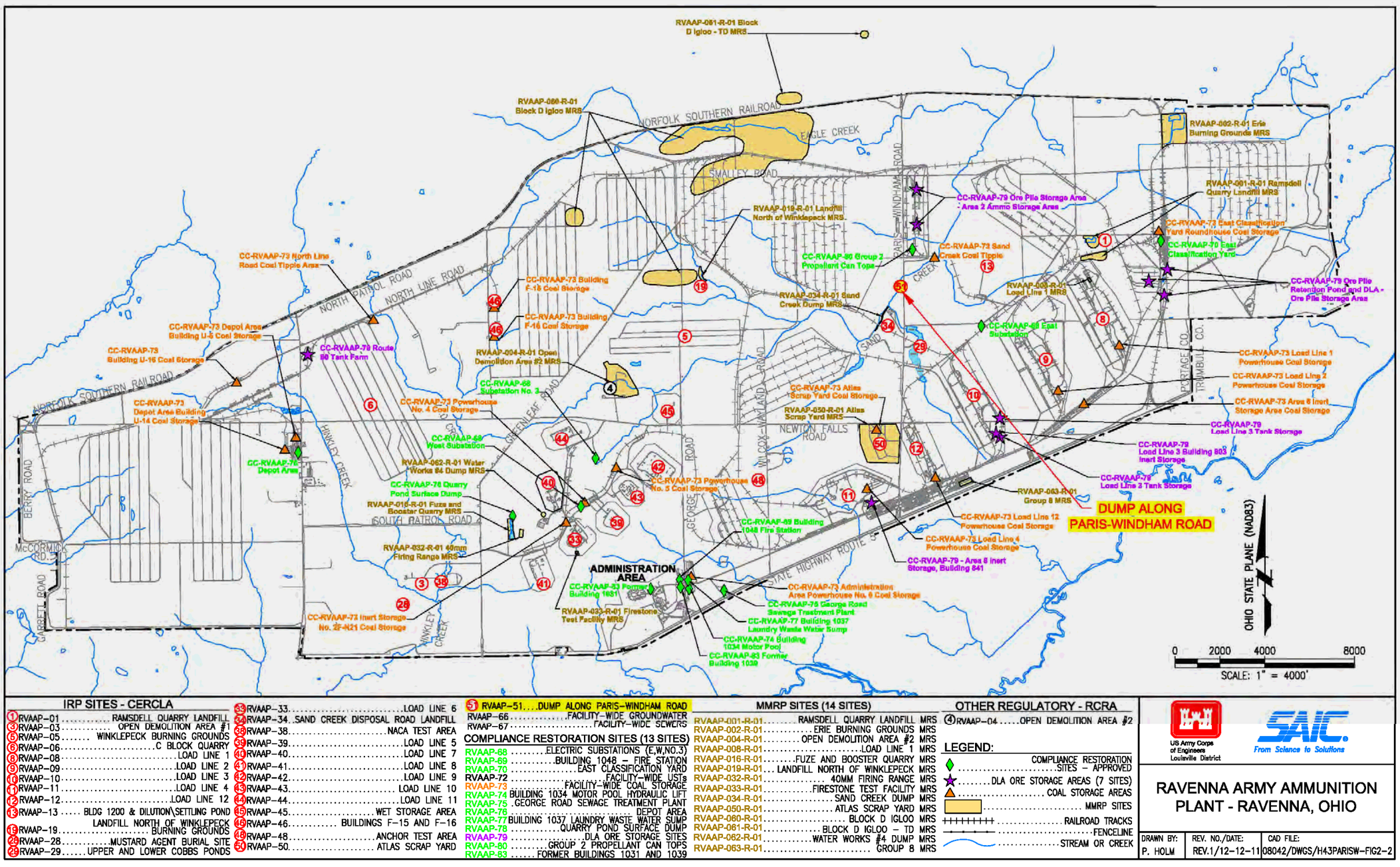



**Figure 2-1. General Location of RVAAP**




**IRP SITES - CERCLA**

1 RVAAP-01 ..... RAMSDELL QUARRY LANDFILL
3 RVAAP-03 ..... OPEN DEMOLITION AREA #1
5 RVAAP-05 ..... WINKLEPECK BURNING GROUNDS
6 RVAAP-06 ..... C BLOCK QUARRY
8 RVAAP-08 ..... LOAD LINE 1
9 RVAAP-09 ..... LOAD LINE 2
10 RVAAP-10 ..... LOAD LINE 3
11 RVAAP-11 ..... LOAD LINE 4
12 RVAAP-12 ..... LOAD LINE 12
13 RVAAP-13 ..... BLDG 1200 & DILUTION\SETTLING POND
19 RVAAP-19 ..... LANDFILL NORTH OF WINKLEPECK BURNING GROUNDS
28 RVAAP-28 ..... MUSTARD AGENT BURIAL SITE
29 RVAAP-29 ..... UPPER AND LOWER COBBS PONDS
33 RVAAP-33 ..... LOAD LINE 6
34 RVAAP-34 ..... SAND CREEK DISPOSAL ROAD LANDFILL
38 RVAAP-38 ..... NACA TEST AREA
39 RVAAP-39 ..... LOAD LINE 5
40 RVAAP-40 ..... LOAD LINE 7
41 RVAAP-41 ..... LOAD LINE 8
42 RVAAP-42 ..... LOAD LINE 9
43 RVAAP-43 ..... LOAD LINE 10
44 RVAAP-44 ..... LOAD LINE 11
45 RVAAP-45 ..... WET STORAGE AREA
46 RVAAP-46 ..... BUILDINGS F-15 AND F-16
48 RVAAP-48 ..... ANCHOR TEST AREA
50 RVAAP-50 ..... ATLAS SCRAP YARD
51 RVAAP-51 ..... DUMP ALONG PARIS-WINDHAM ROAD
RVAAP-66 ..... FACILITY-WIDE GROUNDWATER
RVAAP-67 ..... FACILITY-WIDE SEWERS

**COMPLIANCE RESTORATION SITES (13 SITES)**

RVAAP-68 ..... ELECTRIC SUBSTATIONS (E,W,NO.3)
RVAAP-69 ..... BUILDING 1048 – FIRE STATION
RVAAP-70 ..... EAST CLASSIFICATION YARD
RVAAP-72 ..... FACILITY-WIDE USTs
RVAAP-73 ..... FACILITY-WIDE COAL STORAGE
RVAAP-74 ..... BUILDING 1034 MOTOR POOL HYDRAULIC LIFT
RVAAP-75 ..... GEORGE ROAD SEWAGE TREATMENT PLANT
RVAAP-76 ..... DEPOT AREA
RVAAP-77 ..... BUILDING 1037 LAUNDRY WASTE WATER SUMP
RVAAP-78 ..... QUARRY POND SURFACE DUMP
RVAAP-79 ..... DLA ORE STORAGE SITES
RVAAP-80 ..... GROUP 2 PROPELLANT CAN TOPS
RVAAP-83 ..... FORMER BUILDINGS 1031 AND 1039

**MMRP SITES (14 SITES)**

RVAAP-001-R-01 ..... RAMSDELL QUARRY LANDFILL MRS
RVAAP-002-R-01 ..... ERIE BURNING GROUNDS MRS
RVAAP-004-R-01 ..... OPEN DEMOLITION AREA #2 MRS
RVAAP-008-R-01 ..... LOAD LINE 1 MRS
RVAAP-016-R-01 ..... FUZE AND BOOSTER QUARRY MRS
RVAAP-019-R-01 ..... LANDFILL NORTH OF WINKLEPECK MRS
RVAAP-032-R-01 ..... 40MM FIRING RANGE MRS
RVAAP-033-R-01 ..... FIRESTONE TEST FACILITY MRS
RVAAP-034-R-01 ..... SAND CREEK DUMP MRS
RVAAP-050-R-01 ..... ATLAS SCRAP YARD MRS
RVAAP-060-R-01 ..... BLOCK D IGLOO MRS
RVAAP-061-R-01 ..... BLOCK D IGLOO – TD MRS
RVAAP-062-R-01 ..... WATER WORKS #4 DUMP MRS
RVAAP-063-R-01 ..... GROUP 8 MRS

**OTHER REGULATORY - RCRA**

4 RVAAP-04 ..... OPEN DEMOLITION AREA #2

**LEGEND:**

COMPLIANCE RESTORATION SITES – APPROVED
DLA ORE STORAGE AREAS (7 SITES)
COAL STORAGE AREAS
MMRP SITES
RAILROAD TRACKS
FENCELINE
STREAM OR CREEK

US Army Corps of Engineers Louisville District

SAIC. From Science to Solutions

**RAVENNA ARMY AMMUNITION PLANT - RAVENNA, OHIO**

| DRAWN BY: | REV. NO./DATE: | CAD FILE: |
|---|---|---|
| P. HOLM | REV.1/12-12-11 | 08042/DWGS/H43PARISW-FIG2-2 |

**Figure 2-2. Location of Dump Along Paris-Windham Road Within RVAAP**

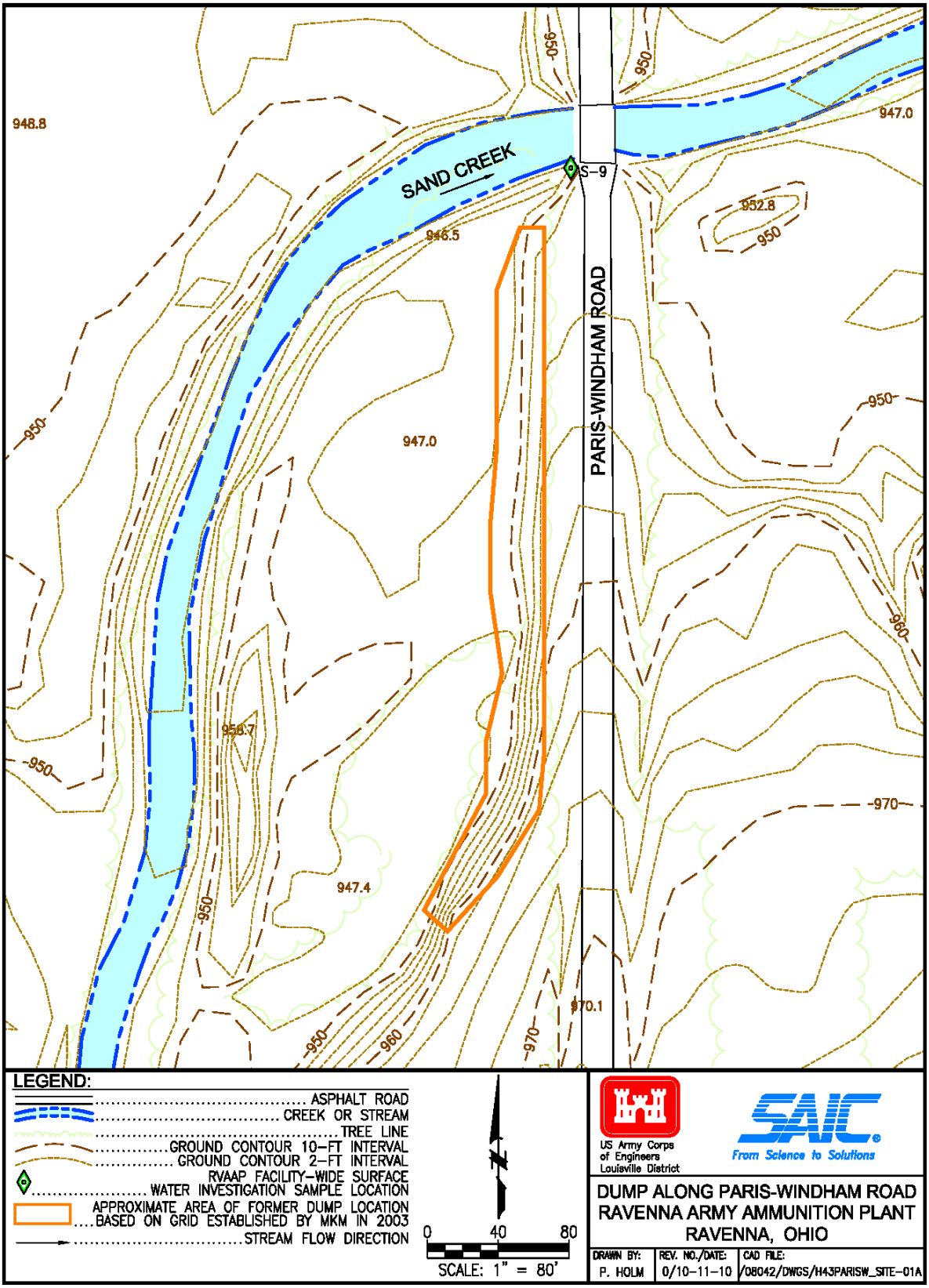



**Figure 2-3. Dump Along Paris-Windham Road**

# 3.0 SUMMARY OF HISTORICAL DATA AND OCCURRENCE AND DISTRIBUTION OF CONTAMINATION

## 3.1 PREVIOUS INVESTIGATIONS AND ACTIVITIES

Previous investigative activities at the Dump Along Paris-Windham Road include a Relative Risk Site Evaluation (RRSE) in 1998, environmental sampling conducted by USACE, Louisville District in 2001, and confirmatory/contingency sampling performed during the 2003 limited "RD/RA." The investigations and results are summarized in the following sections.

### 3.1.1 Relative Risk Site Evaluation

The United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) conducted an RRSE for newly added AOCs at RVAAP in 1998. Thirteen AOCs, including the Dump Along Paris-Windham Road, were evaluated. Three surface soil samples and one sediment sample was collected from the AOC on October 19, 1998 and analyzed for semi-volatile organic compounds (SVOCs), explosives, and inorganic chemicals. No groundwater or surface water samples were collected. The RRSE was summarized in the *Relative Risk Site Evaluation for Newly Added Sites* (USACHPPM 1998).

The RRSE found the AOC contained C&D debris, including ACM (e.g., transite roofing and siding) and inorganic contaminants. The study identified potential human and ecological receptors for surface soil and sediment contamination and assumed complete exposure pathways because there were no access controls (e.g., fence) in place and due to the AOC's proximity to Sand Creek. As a result, the RRSE score for this AOC was "High." Data collected during the 1998 RRSE are not assessed qualitatively or quantitatively in this SC/FFS because these data were minimal Level III data, as defined by the USEPA, and were not intended to be used as definitive evidence of contamination presence or absence or to support quantitative health risk assessment (USACHPPM 1998). Additionally, these data were collected five years prior to the limited "RD/RA" and do not reflect current conditions at the AOC.

### 3.1.2 Decision Document for a Removal Action at the Paris-Windham Road Dumpsite

In 2003, USACE, Louisville District prepared a *Decision Document for a Removal Action at Paris-Windham Road Dumpsite (RVAAP-51)* (USACE 2003a). The Decision Document (DD) is included in Appendix E of the *Final Report for Remedial Design/Removal Action Plan at Paris-Windham Road Dump* (MKM 2004). As stated in the DD, chemicals in soil include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and inorganic chemicals. The DD reported the principal contaminants with potential impact to human health were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. Chemicals with potential impact to ecological receptors were cadmium, polychlorinated biphenyls (PCBs), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene.

The DD outlined four potential remedial alternatives for the AOC: (1) no action; (2) land use controls (LUCs); (3) multi-layer cap and LUCs; and (4) removal/disposal of solvent drums, gas cylinders, laboratory bottles, and miscellaneous debris with confirmation sampling. Following a public meeting and 30-day open comment period, Alternative 4 (Removal/Disposal of Solvent Drums, Gas Cylinders, Lab Bottles, and Miscellaneous Debris with Confirmation Sampling) was selected for implementation under a limited "RD/RA."

### 3.1.3 Limited Remedial Design/Remedial Action

The 2003 limited "RD/RA" activities are summarized in the *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004). The limited "RD/RA" was conducted in accordance with CERCLA to mitigate risks related to potential contact with exposed waste material. The limited "RD/RA" was not intended to be a final remedy, and (as noted in Section 1.0) the U.S. Army planned for future evaluation of the need for additional characterization and RAs under an SC/FFS and the completion of the CERCLA process (USACE 2010c).

On April 19, 2003, the limited "RD/RA" was initiated at the Dump Along Paris-Windham Road. Initial AOC preparation and mobilization activities included an ordnance and explosive survey. The limited "RD/RA" removal activities consisted of removing all existing surface debris, limited removal of subsurface debris, transportation and disposal of debris, performing confirmation sampling, and AOC restoration. A combined total of 300.66 tons of surface and subsurface debris was removed from the AOC. During the debris removal operations, subsurface pockets of buried transite debris were exposed at several different locations at the AOC. Although removal of subsurface debris was not included in the original limited "RD/RA" scope, visible subsurface transite debris was excavated to the extent possible without undermining and compromising the integrity of Paris-Windham Road (MKM 2004).

The majority of the subsurface transite removed during the limited "RD/RA" was concentrated at the southern end of the AOC; one small pocket of transite debris was located near the central portion of the AOC. Test pits were excavated in 10-ft intervals along the extent of the AOC to ensure all subsurface transite was located. Where transite debris was encountered in the test pits, it was excavated to the extent possible without compromising the integrity of Paris-Windham Road.

Upon completion of the debris removal operations and prior to application of the soil cover, confirmation and contingency samples were collected to evaluate the success of the limited "RD/RA" and provide data for future evaluation of a final remedy. The dump area was divided into 10 equally sized grids, each measuring approximately 40 ft by 20 ft, to facilitate collection of discrete and incremental sampling method (ISM) soil samples (Figure 3-1).

Confirmation sampling activities included collecting 1 discrete surface (0-1 ft bgs) soil sample from each of the 10 grids. Additionally, six confirmatory co-located discrete sediment and surface water samples were collected. Five of these sample locations (PWsw/PWsd-002 through PWsw/PWsd-006) were located within the adjacent Sand Creek floodplain in the intermittent drainage swale between the

dump and Sand Creek, which contained water at that time. One sample location (PWsw/PWsd-001) was located on the northern end of the AOC, outside of the drainage swale (Figure 3-1).

Confirmation samples were analyzed for target analyte list (TAL) metals and asbestos. In addition, 10% of the samples (one sample from Grid 9) were analyzed for a full suite of parameters, including explosives, SVOCs, cyanide, volatile organic compounds (VOCs), propellants, pesticides, PCBs, and asbestos. A full suite of analyses was also performed for sediment/surface water sampling location PWsd/PWsd-004 (Figure 3-1). All six sediment confirmation samples were also analyzed for grain size, and four of the six samples were analyzed for total organic carbon (TOC) (PWsd-001 through PWsd-004). The remaining two sediment samples were not analyzed for TOC due to an error on the chain of custody (MKM 2004).

During confirmatory sampling activities, additional transite debris was found in the excavated areas on the southern portion of the AOC. These small fragments had not been visible during the removal action but were exposed following a heavy rain event. As cited in the *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump,* RVAAP stakeholders and the Akron Regional Air Quality Management District agreed to proceed with AOC restoration activities because further excavation had the potential to undermine and compromise the integrity of Paris-Windham Road (MKM 2004). The transite material was subsequently covered in place during AOC restoration activities.

Based on the results of confirmatory sampling and due to the presence of detected SVOCs, MKM Engineers, Inc. (MKM) collected an ISM contingency sample in September 2003 from an approximate 5-ft by 5-ft area surrounding soil sample location PWss-009. In November 2003, a second ISM contingency sample was collected across the 10 sampling grids prior to placement of a final soil cover and AOC restoration.

The excavation area was restored to grade in November 2003 using a combination of clean, hard fill and soil backfill from an Ohio EPA-approved source. Approximately 480 tons of non-contaminated concrete demolition material of various sizes obtained from a stockpile at Load Line 6 was used to create a layer of clean, hard fill for stability in excavated areas, followed by approximately 2 ft (277 tons) of soil backfill material for cover. The area was then seeded and mulched (Figure 3-2).

#### 3.1.3.1 Limited Remedial Design/Remedial Action Sampling Results

This section summarizes the 2003 sampling results by environmental media at the Dump Along Paris-Windham Road. During preparation of the SC/FFS WP, conditions within the drainage swale at the base of the dump were evaluated, including an AOC walkover. Based on available information summarized below, sediment samples within the drainage swale are considered "dry" sediment in accordance with RVAAP guidelines and are treated as surface soil in the SC (USACE 2010c).

- Surface water in the swale occurs only during occasional storms, periods of snowmelt, or overflow conditions from Sand Creek.

- Samples were collected using a hand trowel in 2003, which, in accordance with the RVAAP *Facility-Wide Sampling and Analysis Plan for Environmental Investigations* (USACE 2001a), applies when the water depth is less than 6 inches.

- During an August 2009 AOC walkover, SAIC observed no standing water in the swale.

- During a November 2011 AOC walkover, SAIC observed water in the drainage swale following an extended precipitation event.

Thirteen SVOCs, 21 inorganic chemicals, and PCB-1254 were detected in discrete soil samples collected in April 2003 (Tables 3-1 and 3-2). Asbestos was not detected in any of the 10 shallow soil samples.

Fifteen inorganic chemicals and nitrocellulose were detected in surface water samples collected in April 2003 (Table 3-3). Asbestos was not detected in any of the six surface water samples.

One VOC (acetone), 7 SVOCs, 21 inorganic chemicals, PCB-1254, and nitrocellulose were detected in dry sediment samples collected in April 2003 (Tables 3-2 and 3-4). Grain size in the six dry sediment samples was classified as coarse to medium sand. Four dry sediment samples were analyzed for TOC (PWsd-001 through PWsd-004). TOC concentrations in these four samples ranged from 10,000 mg/kg to 34,000 mg/kg. Twenty-three SVOCs were detected in the two contingency ISM soil samples collected in the fall of 2003 (Table 3-5).

**Table 3-1. Results of Limited "RD/RA" Confirmatory Surface Soil Discrete Samples – Inorganic Chemicals**

| Station | | | RVAAP | PWss-001 | PWss-002 | PWss-003 | PWss-004 | PWss-005 | PWss-006 | PWss-007 | PWss-008 | PWss-009 | PWss-010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | CAS | | Surface Soil Background | PWss-001-0001-SO | PWss-002-0001-SO | PWss-003-0001-SO | PWss-004-0001-SO | PWss-005-0001-SO | PWss-006-0001-SO | PWss-007-0001-SO | PWss-008-0001-SO | PWss-009-0001-SO | PWss-010-0001-SO |
| Date | Number | Units | Criteria | 04/28/03 | 04/28/03 | 04/28/03 | 04/28/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/28/03 | 04/28/03 |
| ***Inorganic Chemicals*** | | | | | | | | | | | | | |
| Aluminum | 7429905 | mg/kg | 17,700 | 7,500 = | **18,000 =** | 7,000 = | 5,600 = | 11,000 = | 6,500 = | 6,500 = | 8,600 = | 8,600 = | 7,700 = |
| Antimony | 7440360 | mg/kg | 0.96 | 0.6 = | 0.42 U | 0.36 U | 0.39 U | 0.34 U | 0.36 U | 0.33 U | 0.34 U | 0.36 U | 0.49 = |
| Arsenic | 7440382 | mg/kg | 15.4 | 10 = | 11 = | 11 = | 8.5 = | 12 = | 9.7 = | 9.2 = | 13 = | 12 = | 13 = |
| Barium | 7440393 | mg/kg | 88.4 | 46 = | **150 =** | 50 = | 43 = | **180 =** | 51 = | 47 = | 49 = | 56 = | 78 = |
| Beryllium | 7440417 | mg/kg | 0.88 | 0.42 J | **1.9 =** | 0.4 J | 0.34 J | **1.2 =** | 0.35 J | 0.34 J | 0.54 = | 0.45 = | 0.47 = |
| Cadmium | 7440439 | mg/kg | 0 | **0.1 J** | **0.3 =** | **0.22 J** | **0.24 U** | **0.2 U** | **0.23 U** | **0.21 U** | **0.2 U** | **0.22 U** | **0.23 U** |
| Calcium[a] | 7440702 | mg/kg | 15,800 | 2,500 = | **55,000 =** | 2,700 = | 3,100 = | **39,000 =** | 2,500 = | 1,500 = | 4,300 = | 2,000 = | 1,800 = |
| Chromium | 7440473 | mg/kg | 17.4 | 14 = | 9.7 = | 12 = | 8.1 = | 8.3 = | 9.5 = | 10 = | 11 = | 11 = | 12 = |
| Cobalt | 7440484 | mg/kg | 10.4 | 6.7 = | 4.7 = | 6.6 = | 5.1 = | 4.3 = | 5.6 = | 6.3 = | 6.6 = | 7.1 = | 7.5 = |
| Copper | 7440508 | mg/kg | 17.7 | 16 = | 15 = | 16 = | 9.7 = | **19 =** | 9.6 = | 9.3 = | **18 =** | 14 = | 16 = |
| Iron[a] | 7439896 | mg/kg | 23,100 | 18,000 = | 13,000 = | 18,000 = | 12,000 = | 22,000 = | 14,000 = | 15,000 = | 22,000 = | 17,000 = | 17,000 = |
| Lead | 7439921 | mg/kg | 26.1 | 16 = | **29 =** | 15 = | 17 = | 19 = | 15 = | 19 = | 14 = | 14 = | 22 = |
| Magnesium[a] | 7439954 | mg/kg | 3,030 | 2,100 = | **10,000 =** | 1,800 = | 1,400 = | **6,100 =** | 1,500 = | 1,600 = | 1,900 = | 1,800 = | 1,800 = |
| Manganese | 7439965 | mg/kg | 1,450 | 270 = | **1,900 =** | 520 = | 380 = | 880 = | 410 = | 390 = | 530 = | 490 = | 790 = |
| Mercury | 7439976 | mg/kg | 0.036 | **0.06 =** | **0.078 =** | **0.064 =** | **0.047 =** | **0.043 =** | **0.048 =** | 0.025 = | 0.025 = | **0.039 =** | **0.06 =** |
| Nickel | 7440020 | mg/kg | 21.1 | 19 = | 12 = | 15 = | 10 = | 10 = | 11 = | 13 = | 16 = | 21 = | **22 =** |
| Potassium[a] | 7440097 | mg/kg | 927 | 910 = | **1,400 =** | 860 = | 780 = | **1,100 =** | 760 = | 740 = | **970 =** | 890 = | **1,200 =** |
| Silver | 7440224 | mg/kg | 0 | **0.39 J** | **0.66 U** | **0.57 U** | **0.6 U** | **0.51 U** | **0.58 U** | **0.53 U** | **0.51 U** | **0.55 U** | **0.57 U** |
| Sodium[a] | 7440235 | mg/kg | 123 | **170 =** | **480 =** | **180 =** | 120 = | **380 =** | **130 =** | **130 =** | **190 =** | **180 =** | **160 =** |
| Vanadium | 7440622 | mg/kg | 31.1 | 13 = | 9.8 = | 13 = | 9.5 = | 10 = | 11 = | 11 = | 15 = | 14 = | 14 = |
| Zinc | 7440666 | mg/kg | 61.8 | **97 =** | **78 =** | **70 =** | 52 = | **100 =** | 59 = | 50 = | **63 =** | **62 =** | **88 =** |
| ***Miscellaneous*** | | | | | | | | | | | | | |
| Asbestos | 1332214 | Percent | None | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** |

Source: *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004)
*Note:* All constituents with at least one detection are shown. All asbestos results are shown as reported.
*Note:* All samples were collected from 0-1 foot interval.
[a]Essential human nutrient; not evaluated as a site-related contaminant.
**Bold** text indicates the concentration exceeds background concentration.
CAS = Chemical Abstract Service
RA = Remedial Action
RD = Remedial Design
RVAAP = Ravenna Army Ammunition Plant

Data Qualifiers:
"=" = Detected at the concentration shown
J = Estimated concentration
U = Not detected at the concentration shown

**Table 3-2. Results of Limited "RD/RA" Confirmatory Surface Soil and Dry Sediment Discrete Samples – Organic Chemicals**

| Station | CAS Number | Units | RVAAP Background Criteria | PWss-009 | PWsd-004 |
|---|---|---|---|---|---|
| Sample ID | | | | PWss-009-0001-SO | PWsd-004-0001-SD |
| Date | | | | 04/28/03 | 04/29/03 |
| ***Volatile Organic Compounds*** | | | | | |
| Acetone | 67641 | mg/kg | None | 0.062 U | 0.041 = |
| ***Semi-volatile Organic Compounds*** | | | | | |
| Acenaphthylene | 208968 | mg/kg | None | 0.13 J | 0.83 U |
| Anthracene | 120127 | mg/kg | None | 0.12 J | 0.83 U |
| Benzo(*a*)anthracene | 56553 | mg/kg | None | 1.0 = | 0.25 J |
| Benzo(*a*)pyrene | 50328 | mg/kg | None | 1.3 = | 0.33 J |
| Benzo(*b*)fluoranthene | 205992 | mg/kg | None | 1.2 = | 0.39 J |
| Benzo(*ghi*)perylene | 191242 | mg/kg | None | 0.75 = | 0.83 U |
| Benzo(*k*)fluoranthene | 207089 | mg/kg | None | 1.4 = | 0.33 J |
| Chrysene | 218019 | mg/kg | None | 1.1 = | 0.33 J |
| Dibenz(*a,h*)anthracene | 53703 | mg/kg | None | 0.24 J | 0.83 U |
| Fluoranthene | 206440 | mg/kg | None | 1.7 = | 0.44 J |
| Indeno(1,2,3-*cd*)pyrene | 193395 | mg/kg | None | 0.75 = | 0.83 U |
| Phenanthrene | 85018 | mg/kg | None | 0.32 J | 0.83 U |
| Pyrene | 129000 | mg/kg | None | 1.4 = | 0.44 J |
| ***Polychlorinated Biphenyls*** | | | | | |
| PCB-1254 | 11097691 | mg/kg | None | 0.23 = | 0.086 = |
| ***Miscellaneous*** | | | | | |
| Nitrocellulose | 9004700 | mg/kg | None | NA | 2 J |

Source: *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004)
*Note*: All constituents with at least one detection are shown.
*Note:* All soil samples were collected from 0-1 feet interval.
Data Qualifiers:
"=" = Detected at the concentration shown
J = Estimated concentration
U = Not detected at the concentration shown
CAS = Chemical Abstract Service
NA = Not analyzed
None = No background concentration; all detected values are considered above background concentration
PCB = Polychlorinated Biphenyl
RA = Remedial Action
RD = Remedial Design
RVAAP = Ravenna Army Ammunition Plant

**Table 3-3. Results of Limited "RD/RA" Confirmatory Surface Water Discrete Samples**

| Station | | | RVAAP Surface Water Background Criteria | PWsw-001 | PWsw-002 | PWsw-003 | PWsw-004 | PWsw-005 | PWsw-006 |
|---|---|---|---|---|---|---|---|---|---|
| Sample ID | CAS Number | Units | | PWsw-001-0001-SW | PWsw-002-0001-SW | PWsw-003-0001-SW | PWsw-004-0001-SW | PWsw-005-0001-SW | PWsw-006-0001-SW |
| Date | | | | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 |
| ***Inorganic Chemicals*** | | | | | | | | | |
| Aluminum | 7429905 | mg/L | 3.37 | 0.091 J | 0.065 J | 0.066 J | 0.28 = | 0.081 J | 0.1 J |
| Arsenic | 7440382 | mg/L | 0.0032 | 0.0028 = | **0.0058** | **0.0052 =** | **0.0074** = | **0.0082** = | **0.0041 =** |
| Barium | 7440393 | mg/L | 0.0475 | 0.035 = | **0.065 =** | **0.063 =** | **0.12 =** | **0.059 =** | **0.055 =** |
| Calcium[a] | 7440702 | mg/L | 41.4 | **60 =** | 40 = | 40 = | **52 =** | 34 = | 23 = |
| Cobalt | 7440484 | mg/L | 0 | **0.0013 J** | **0.05 U** | **0.005 U** | **0.0011 J** | **0.001 J** | **0.015 J** |
| Copper | 7440508 | mg/L | 0.0079 | 022 J | 022 J | 022 J | 039 J | 024 J | 024 J |
| Iron | 7439896 | mg/L | 2.56 | **4.3 =** | **3.7 =** | **3.9 =** | **5.3 =** | **9.4 =** | **5.1 =** |
| Lead | 7439921 | mg/L | 0 | 0.002 U | 0.002 U | 0.002 U | **0.0027 =** | **0.0019 J** | 0.002 U |
| Magnesium[a] | 7439954 | mg/L | 10.8 | 10 = | 9.8 = | 9.8 = | **12 =** | 8.3 = | 6 = |
| Manganese | 7439965 | mg/L | 0.391 | 0.32 = | 0.27 = | 0.26 = | **0.51 =** | **0.47 =** | **0.56 =** |
| Mercury | 7439976 | mg/L | 0 | **0.0007 J** | **0.00009 J** | **0.00009 J** | **0.0002 U** | **0.0001 J** | **0.00008 J** |
| Nickel | 7440020 | mg/L | 0 | **0.002 J** | **0.01 U** | **0.01 U** | **0.0024 J** | **0.0072 J** | **0.0075 J** |
| Potassium[a] | 7440097 | mg/L | 3.17 | 1.7 = | **4.8 =** | **4.8 =** | **5.4 =** | **4.4 =** | **3.5 =** |
| Sodium[a] | 7440235 | mg/L | 21.3 | 8.8 = | 8.9 = | 8.5 = | 9.9 = | 5.8 = | 4.2 = |
| Zinc | 7440666 | mg/L | 0.042 | 0.02 = | 0.02 U | 0.02 U | 0.024 = | 0.02 U | 0.017 J |
| ***Miscellaneous*** | | | | | | | | | |
| Asbestos (total fibers) | 1332214 | MFL | None | 5.900 U | 13.02 U | 7.812 U | 13.02 U | 39.06 U | 7.812 U |
| Nitrocellulose | 9004700 | mg/L | None | NA | NA | NA | **0.094 J** | NA | NA |

Source: *Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004)
*Note*: All constituents with at least one detection are shown.
*Note:* All soil samples were collected from 0-1 feet interval.
[a]Essential human nutrient; not evaluated as a site-related contaminant
Data Qualifiers:
"=" = Detected at the concentration shown
J = Estimated concentration
U = Not detected at the concentration shown
**Bold** text indicates the concentration exceeds background concentration
CAS = Chemical Abstract Service
MFL = Million Fibers Per Liter
NA = Not analyzed
None = No background concentration; all detected values are considered above background concentration
RA = Remedial Action
RD = Remedial Design
RVAAP = Ravenna Army Ammunition Plant

**Table 3-4. Results of Limited "RD/RA" Confirmatory Dry Sediment Discrete Samples – Inorganic Chemicals**

| Station | | | RVAAP | PWsd-001 | PWsd-002 | PWsd-003 | PWsd-004 | PWsd-005 | PWsd-006 |
|---|---|---|---|---|---|---|---|---|---|
| Sample ID | CAS | | Surface Soil Background | PWsd-001-0001-SD | PWsd-002-0001-SD | PWsd-003-0001-SD | PWsd-004-0001-SD | PWsd-005-0001-SD | PWsd-006-0001-SD |
| Date | Number | Units | Criteria | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 | 04/29/03 |
| ***Inorganic Chemicals*** | | | | | | | | | |
| Aluminum | 7429905 | mg/kg | 17,700 | 8,000 = | 9,000 = | 7,100 = | 8,400 = | 9,900 = | 7,600 = |
| Antimony | 7440360 | mg/kg | 0.96 | 0.47 U | 0.72 U | 0.59 U | 0.73 U | 0.73 U | 0.46 U |
| Arsenic | 7440382 | mg/kg | 15.4 | 6.1 = | 2.6 = | 5.1 = | 3.8 = | 8.4 = | 5.6 = |
| Barium | 7440393 | mg/kg | 88.4 | 53 = | **140 =** | 61 = | **110 =** | 77 = | 64 = |
| Beryllium | 7440417 | mg/kg | 0.88 | 0.44 J | 0.49 J | 0.47 J | 0.54 J | 0.61 J | 0.52 J |
| Cadmium | 7440439 | mg/kg | 0 | **0.31 U** | **0.59 =** | **0.36 U** | **0.43 U** | **0.46 U** | **0.27 U** |
| Calcium[a] | 7440702 | mg/kg | 15,800 | 2,000 = | 4,400 = | 2,500 = | 4,000 = | 1,900 = | 1,700 = |
| Chromium | 7440473 | mg/kg | 17.4 | 13 = | 14 = | 12 = | 14 = | 15 = | 17 = |
| Cobalt | 7440484 | mg/kg | 10.4 | 5.8 = | 5.5 = | 5.5 = | 6.7 = | 6.1 = | 5.7 = |
| Copper | 7440508 | mg/kg | 17.7 | 17 = | **24 =** | **21 =** | **25 =** | **27 =** | **23 =** |
| Iron | 7439896 | mg/kg | 23,100 | 14,000 = | 12,000 = | 18,000 = | 15,000 = | 15,000 = | 17,000 = |
| Lead | 7439921 | mg/kg | 26.1 | 19 = | 25 = | 19 = | 18 = | 16 = | 20 = |
| Magnesium[a] | 7439954 | mg/kg | 3,030 | 2,200 = | 2,800 = | 2,000 = | 2,600 = | 2,700 = | 2,300 = |
| Manganese | 7439965 | mg/kg | 1,450 | 99 = | 150 = | 97 = | 120 = | 100 = | 150 = |
| Mercury | 7439976 | mg/kg | 0.036 | **0.059 =** | **0.08 =** | **0.058 =** | **0.073 =** | **0.077 =** | **0.05 =** |
| Nickel | 7440020 | mg/kg | 21.1 | 17 = | **24 =** | 19 = | **23 =** | **37 =** | **23 =** |
| Potassium[a] | 7440097 | mg/kg | 927 | 890 = | **1,300 =** | **1,000 =** | **1,600 =** | **1,700 =** | **1,900 =** |
| Silver | 7440224 | mg/kg | 0 | **0.79 U** | **1.1 U** | **0.89 U** | **1.1 U** | **1.1 U** | **0.66 U** |
| Sodium[a] | 7440235 | mg/kg | 123 | **150 J** | **210 U** | **210 =** | **200 J** | **230 U** | **190 =** |
| Vanadium | 7440622 | mg/kg | 31.1 | 13 = | 13 = | 14 = | 15 = | 18 = | 14 = |
| Zinc | 7440666 | mg/kg | 61.8 | **81 =** | **120 =** | **75 =** | **88 =** | **99 =** | **90 =** |
| ***Miscellaneous*** | | | | | | | | | |
| Asbestos | 1332214 | Percent | None | **<1** | **<1** | **<1** | **<1** | **<1** | **<1** |

Source: *Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004)
*Note:* All constituents with at least one detection are shown. All asbestos results are shown.
*Note:* All soil samples were collected from 0-1 feet interval.
[a]Essential human nutrient; not evaluated as a site-related contaminant.
Data Qualifiers:
"=" = Detected at the concentration shown
J = Estimated concentration
U = Not detected at the concentration shown
**Bold** text indicates the concentration exceeds background concentration
CAS = Chemical Abstract Service
RA = Remedial Action
RD = Remedial Design
RVAAP = Ravenna Army Ammunition Plant

**Table 3-5. Results of Limited "RD/RA" Contingency Incremental Sampling Method Surface Soil Samples**

| Location | | | | Grid 9 | Grids 1 through 10 |
|---|---|---|---|---|---|
| Sample ID | CAS Number | Units | RVAAP Background Criteria | PWss-CONT1-00010-SO | PWss-CONT2-00010-SO |
| Date | | | | 09/30/03 | 10/28/03 |
| ***Semi-volatile Organic Compounds*** | | | | | |
| 1,4-Dichlorobenzene | 106467 | mg/kg | None | 0.18 U | 0.23 = |
| 2-Methylnaphthalene | 91576 | mg/kg | None | 0.0055 J | 0.064 = |
| Acenaphthene | 83329 | mg/kg | None | 0.035 U | 0.12 = |
| Acenaphthylene | 208968 | mg/kg | None | 0.056 = | 0.12 = |
| Anthracene | 120127 | mg/kg | None | 0.041 = | 0.22 = |
| Benzo(a)anthracene | 56553 | mg/kg | None | 0.36 = | 1.0 = |
| Benzo(a)pyrene | 50328 | mg/kg | None | 0.46 = | 1.4 = |
| Benzo(b)fluoranthene | 205992 | mg/kg | None | 0.5 = | 1.4 = |
| Benzo(ghi)perylene | 191242 | mg/kg | None | 0.3 = | 0.79 = |
| Benzo(k)fluoranthene | 207089 | mg/kg | None | 0.45 = | 1.4 = |
| Bis(2-ethylhexyl)phthalate | 117817 | mg/kg | None | 0.18 U | 0.025 J |
| Carbazole | 86748 | mg/kg | None | 0.18 U | 0.19 = |
| Chrysene | 218019 | mg/kg | None | 0.41 = | 1.2 = |
| Di-n-butyl phthalate | 84742 | mg/kg | None | 0.18 U | 0.041 J |
| Dibenz(a,h)anthracene | 53703 | mg/kg | None | 0.14 = | 0.36 = |
| Dibenzofuran | 132649 | mg/kg | None | 0.0064 J | 0.051 J |
| Diethyl phthalate | 84662 | mg/kg | None | 0.0093 J | 0.067 U |
| Fluoranthene | 206440 | mg/kg | None | 0.67 = | 2.9 = |
| Fluorene | 86737 | mg/kg | None | 0.011 J | 0.1 = |
| Indeno(1,2,3-cd)pyrene | 193395 | mg/kg | None | 0.31 = | 0.7 = |
| Naphthalene | 91203 | mg/kg | None | 0.035 U | 0.039 = |
| Phenanthrene | 85018 | mg/kg | None | 0.16 = | 1.1 = |
| Pyrene | 129000 | mg/kg | None | 0.62 = | 2.0 = |

Source: *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004)
*Note:* All soil samples were collected from 0-1 feet interval.
Data Qualifiers:
"=" = Detected at the concentration shown
J = Estimated concentration
U = Not detected at the concentration shown
CAS = Chemical Abstract Service
None = No background concentration; all detected values are considered above background concentration
RA = Remedial Action
RD = Remedial Design
RVAAP = Ravenna Army Ammunition Plant

### 3.1.3.2 Limited Remedial Design/Remedial Action Conclusions

The limited "RD/RA" compared results of the 2003 sampling to RVAAP facility-wide background concentrations for inorganic chemicals and USEPA Region 9 preliminary remediation goals (PRGs) in use at the time (MKM 2004). The data screening indicated elevated concentrations of arsenic above its background concentration and/or PRGs in soil, dry sediment, and surface water. Elevated concentrations of SVOCs also were detected in the soil and dry sediment (Grid 9 and dry sediment

location PWsd-004). No SVOCs were detected in the surface water sample collected at PWsw-004. Asbestos was below laboratory reporting limits in all soil, dry sediment, and surface water samples. The results of ISM surface soil sampling verified that elevated levels of the following SVOCs were present in soil prior to placement of the soil cover: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd) pyrene, and dibenz(a,h)anthracene.

Based on the results of the limited "RD/RA" confirmation samples, MKM recommended an evaluation of risk for the AOC, followed by regulatory AOC closure or additional remedial efforts, as necessary.

## 3.2 NATURE AND EXTENT OF CONTAMINATION

This section presents the nature and extent of contamination at the Dump Along Paris-Windham Road based upon sampling conducted in 2003 after the removal action. As discussed in Section 3.1.1, data collected during the 1998 RRSE are not included in the current AOC characterization because these data were not intended to be used as definitive evidence of contamination presence or absence or to support quantitative health risk assessment, and they do not reflect current conditions at the AOC.

Available soil data were screened with respect to potential leaching and impacts to groundwater. Numerical modeling for soil leaching or contaminant migration in groundwater was not conducted for this SC as no groundwater data are currently available for the AOC for model validation purposes. A CSM is provided to discuss contaminant sources, migration pathways, and potential receptors.

### 3.2.1 Site-Related Contaminants

The purpose of identifying site-related contaminants (SRCs) is to determine the presence or absence of contamination that is site-related and above naturally occurring levels. The SRC screening process includes three steps, as outlined in the FWCUG Report (USACE 2010a).

- **Background screening.** The maximum detected concentrations (MDCs) of naturally occurring inorganic chemicals were compared to the facility-wide background concentrations for RVAAP, published in the *Phase II Remedial Investigation Report for the Winklepeck Burning Grounds* (USACE 2001b). Inorganic chemicals detected above background concentrations were retained as SRCs.

- **Screening of essential human nutrients.** Chemicals considered essential nutrients (e.g., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) are an integral part of the human food supply and are often added to foods as supplements. USEPA recommends these chemicals not be evaluated provided they are present at low concentrations (i.e., only slightly elevated above naturally occurring levels) and toxic only at very high doses (i.e., much higher than those that could be associated with contact at the AOC) (USEPA 1989). Essential nutrients detected near or below their recommended daily allowance/recommended daily intake-based screening levels were eliminated as SRCs.

- **Frequency-of-detection screening.** Analytes detected in less than 5% of the samples may be subject to a weight-of-evidence (WOE) evaluation and may be screened out from further consideration. This frequency-of-detection screen only applies to datasets containing 20 or more samples. No frequency-of-detection screening was performed for this SC/FFS because fewer than 20 discrete samples were available for each of the datasets. Frequency-of-detection screening was not used for ISM samples.

SRC screening was conducted separately for discrete and ISM sample results. The SRCs identified for the Dump Along Paris-Windham Road are summarized in Tables 3-6 and 3-7 (soil and surface water, respectively). Appendix Tables B-1 through B-4, present summary statistics and results of the SRC screening process for data included for evaluation in the SC/FFS.

**Table 3-6. Soil SRCs**

| Discrete Samples | | ISM Samples | |
|---|---|---|---|
| **Inorganic Chemicals** | | **Inorganic Chemicals** | |
| Aluminum | Lead | NA | |
| Barium | Manganese | | |
| Beryllium | Mercury | | |
| Cadmium | Nickel | | |
| Copper | Silver | | |
| | Zinc | | |
| **SVOCs** | | **SVOCs** | |
| Acenaphthylene | | 1,4-Dichlorobenzene | Chrysene |
| Anthracene | | 2-Methylnaphthalene | Dibenz(a,h)anthracene |
| Benzo(a)anthracene | | Acenaphthene | Dibenzofuran |
| Benzo(a)pyrene | | Acenaphthylene | Diethyl phthalate |
| Benzo(b)fluoranthene | | Anthracene | Di-n-butyl phthalate |
| Benzo(ghi)perylene | | Benzo(a)anthracene | Fluoranthene |
| Benzo(k)fluoranthene | | Benzo(a)pyrene | Fluorene |
| Chrysene | | Benzo(b)fluoranthene | Indeno(1,2,3-cd)pyrene |
| Dibenz(a,h)anthracene | | Benzo(ghi)perylene | Naphthalene |
| Fluoranthene | | Benzo(k)fluoranthene | Phenanthrene |
| Indeno(1,2,3-cd)pyrene | | Bis(2-ethylhexyl)phthalate | Pyrene |
| Phenanthrene | | Carbazole | |
| Pyrene | | | |
| **Pesticides/PCBs** | | | |
| PCB-1254 | | | |
| **Explosives/Propellants** | | | |
| Nitrocellulose | | | |
| **VOCs** | | | |
| Acetone | | | |

ISM = Incremental Sampling Method
NA = Not analyzed
PCB = Polychlorinated Biphenyl
SRC = Site-related Contaminant
SVOC = Semi-volatile Organic Compound
VOC = Volatile Organic Compound

**Table 3-7. Surface Water SRCs**

| Surface Water | |
|---|---|
| **Inorganic Chemicals** | **Explosives/Propellants** |
| Arsenic | Nitrocellulose |
| Barium | |
| Cobalt | |
| Lead | |
| Manganese | |
| Mercury | |
| Nickel | |

SRC = Site-related Contaminant

### 3.2.2 Occurrence and Distribution of Contaminants

#### 3.2.2.1 Soil

Eleven inorganic chemicals were identified as SRCs in soil: aluminum, barium, beryllium, cadmium, copper, lead, manganese, mercury, nickel, silver, and zinc. All but three were detected at concentrations above background concentrations at soil sample location PWss-02. Concentrations of mercury and zinc exceeding background concentrations were detected consistently throughout the AOC (13 of 16 and 14 of 16 samples, respectively). Copper and nickel also were frequently detected at concentrations exceeding background concentrations, particularly within the drainage swale (five of six and four of six discrete samples, respectively, from the drainage swale).

Twenty-three SVOCs were identified as SRCs in soil; 13 of those were detected above background concentrations in the April 2003 discrete samples. Ten additional SRCs were identified in the ISM samples collected later that year. Initial SVOC detections in the soil sample collected from Grid 9 suggested the location may have contained a localized release of SVOCs. The contingency ISM sample collected from Grid 9 supports this concept because concentrations of SVOCs are lower in the ISM sample than in the original April grab sample. However, results of the contingency ISM sample collected from Grids 1 through 10 indicate detectable SVOCs, primarily polycyclic aromatic hydrocarbons (PAHs), were present in soil throughout the AOC prior to placement of the soil cover.

Only one VOC (acetone) was detected in sample PWsd-004 collected from the drainage swale; no VOCs were detected in soil sample PWss-09. Additionally, nitrocellulose was detected in sample PWsd-004.

#### 3.2.2.2 Surface Water

Seven inorganic chemicals were identified as SRCs in surface water at the AOC: arsenic, barium, cobalt, lead, manganese, mercury, and nickel. Mercury was detected in all six samples at concentrations exceeding background concentrations; arsenic and barium were each detected in five of six samples at concentrations exceeding background concentrations; and cobalt and mercury were both detected in four of six samples at concentrations exceeding background concentrations. In

general, surface water from locations PWsw-002 and PWsw-003 displayed the lowest concentrations of inorganic chemicals, with two exceptions: the highest detected concentrations of barium and mercury were detected at PWsw-002 and PWsw-003.

No VOCs or SVOCs were detected in surface water sample PWsw-004. Nitrocellulose was detected in this surface water sample as well as in the corresponding dry sediment sample. Asbestos was not detected in any of the surface water samples.

### 3.2.3 Soil to Groundwater Leaching Screen

To evaluate potential impacts to groundwater from contaminants in soil (inclusive of dry sediment), the April 2003 dataset was compared to the USEPA regional screening level (RSL) (USEPA 2010). When available, the maximum contaminant level (MCL)-based soil screening level (SSL) was used; for analytes without an MCL-based SSL, the risk-based SSL was used. Table 3-8 presents the results of this comparison. Six SVOCs, four inorganic chemicals, and one PCB were identified as contaminant migration chemicals of potential concern (CMCOPCs). Barium, lead, and manganese had the highest frequency of SSL exceedances; however, the SSLs for these three inorganic chemicals are less than their respective RVAAP surface soil background concentrations.

### 3.2.4 Conceptual Site Model

#### 3.2.4.1 Primary and Secondary Sources

The primary source of contamination at the Dump Along Paris-Windham Road was exposed waste material. However, as part of the 2003 limited "RD/RA," approximately 300 tons of debris was removed, and a minimum 2-ft-thick soil cover was placed over the remaining waste. The soil cover isolates waste and prevents direct exposure. The soil and vegetative cover also prevents direct contact of waste with surface water runoff and helps to limit infiltration of rainfall and snow melt.

Secondary contaminant sources include dry sediment and runoff accumulation points along the drainage swale at the base of the dump. The drainage swale was not excavated or capped with clean soil during the limited "RD/RA" (Figure 3-1). The drainage swale is estimated to be 15 ft wide by 400 ft long (approximately 0.15 acres). In the swale, surface water is present during occasional storms or periods of snow melt or during overflow conditions from nearby Sand Creek. Prior to capping the dump, surface runoff potentially carried contaminants sorbed to particulates and/or contaminants in the dissolved phase to the drainage swale. Percolating rainfall also may have contributed to migration of contaminants from the dump to the drainage swale. Thus, contaminants in surface water and dry sediment in the drainage swale represent secondary sources. Installation of the soil cap minimized direct contact between surface water and waste and reduced infiltration rates through waste material; therefore, the process for continuing contaminant migration to and deposition in the drainage swale has been largely mitigated.

**Table 3-8. Results of Contaminant Migration Soil to Groundwater Screening**

| Analyte | CAS Number | Freq of Detect | Maximum Detected (mg/kg) | USEPA SSL[a] (mg/kg) | SSL Type[b] | CMCOPC?[c] (yes/no) | Number >SSL/ Total Analyses |
|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | | | | |
| Acetone | 67-64-1 | 1 / 2 | 0.041 | 4.5 | Risk | No | 0 / 2 |
| ***Semi-volatile Organic Compounds*** | | | | | | | |
| Acenaphthylene | 208-96-8 | 1 / 2 | 0.13 | 22 | Risk | No | 0 / 2 |
| Anthracene | 120-12-7 | 1 / 2 | 0.12 | 360 | Risk | No | 0 / 2 |
| Benzo(*a*)anthracene | 56-55-3 | 2 / 2 | 1 | 0.01 | Risk | Yes | 2 / 2 |
| Benzo(*a*)pyrene | 50-32-8 | 2 / 2 | 1.3 | 0.24 | MCL | Yes | 2 / 2 |
| Benzo(*b*)fluoranthene | 205-99-2 | 2 / 2 | 1.2 | 0.035 | Risk | Yes | 2 / 2 |
| Benzo(*ghi*)perylene | 191-24-2 | 1 / 2 | 0.75 | 0.35 | Risk | Yes | 1 / 2 |
| Benzo(*k*)fluoranthene | 207-08-9 | 2 / 2 | 1.4 | 0.35 | Risk | Yes | 1 / 2 |
| Chrysene | 218-01-9 | 2 / 2 | 1.1 | 1.1 | Risk | No | 0 / 2 |
| Dibenz(*a*,*h*)anthracene | 53-70-3 | 1 / 2 | 0.24 | 0.011 | Risk | Yes | 1 / 2 |
| Fluoranthene | 206-44-0 | 2 / 2 | 1.7 | 160 | Risk | No | 0 / 2 |
| Indeno(1,2,3-*cd*)pyrene | 193-39-5 | 1 / 2 | 0.75 | 0.12 | Risk | Yes | 1 / 2 |
| Phenanthrene | 85-01-8 | 1 / 2 | 0.32 | 120 | Risk | No | 0 / 2 |
| Pyrene | 129-00-0 | 2 / 2 | 1.4 | 120 | Risk | No | 0 / 2 |
| ***Inorganic Chemicals*** | | | | | | | |
| Aluminum | 7429-90-5 | 18 / 18 | 18,000 | 55,000 | Risk | No | 0 / 18 |
| Barium | 7440-39-3 | 18 / 18 | 180 | **82** | MCL | Yes | 4 / 18 |
| Beryllium | 7440-41-7 | 18 / 18 | 1.9 | 3.2 | MCL | No | 0 / 18 |
| Cadmium | 7440-43-9 | 4 / 18 | 0.59 | 0.38 | MCL | Yes | 1 / 18 |
| Copper | 7440-50-8 | 18 / 18 | 27 | 46 | MCL | No | 0 / 18 |
| Lead | 7439-92-1 | 18 / 18 | 29 | **14** | MCL | Yes | 16 / 18 |
| Manganese | 7439-96-5 | 18 / 18 | 1,900 | **57** | Risk | Yes | 18 / 18 |
| Mercury | 7439-97-6 | 18 / 18 | 0.08 | 0.1 | MCL | No | 0 /18 |
| Nickel | 7440-02-0 | 18 / 18 | 37 | 48 | Risk | No | 0 /18 |
| Silver | 7440-22-4 | 1 / 18 | 0.39 | 1.6 | Risk | No | 0 /18 |
| Zinc | 7440-66-6 | 18 / 18 | 120 | 680 | Risk | No | 0 / 18 |
| ***Polychlorinated Biphenyls*** | | | | | | | |
| PCB-1254 | 11097-69-1 | 2 / 2 | 0.23 | 0.0088 | Risk | Yes | 2 / 2 |
| ***Miscellaneous*** | | | | | | | |
| Nitrocellulose | 9004-70-0 | 1 / 1 | 2 | 24,000 | Risk | No | 0 / 1 |

[a]USEPA SSL for protection of groundwater criteria from regional screening level tables (USEPA 2010)
[b]Maximum contaminant level criteria were used when available; otherwise, risk-based criteria are shown
[c]Constituent is considered a CMCOPC when one or more detected concentrations exceed the SSL
**Bold** values indicate the SSL is less than the surface soil background concentration
CAS = Chemical Abstract Service
CMCOPC = Contaminant Migration Chemical of Potential Concern
PCB = Polychlorinated Biphenyl
SSL = Soil Screening Level
USEPA = United States Environmental Protection Agency

#### 3.2.4.2 Migration Pathways and Receptors

The primary contaminant migration pathway at the AOC is surface water runoff. The steep topography and surface water flow patterns through the drainage swale facilitate contaminant migration from the AOC into nearby Sand Creek, which is located at distances ranging 30-170 ft. Infiltration of rainfall through remaining waste, with discharge into the drainage swale at the base of

the slope may still occur; however, the soil cover and current dense vegetation maximize evapotranspiration rates (particularly during the growing season) and help minimize contaminant migration via this pathway. Surface water samples collected in 2003 immediately following the limited "RD/RA" indicated the presence of inorganic SRCs but did not contain explosives, VOCs, SVOCs, pesticides, or PCBs.

Groundwater may be a potential migration pathway; although, the occurrence of contaminants in groundwater is not documented by sampling because of a lack of monitoring wells. The January 2010 unconsolidated aquifer facility-wide potentiometric map (EQM 2010) indicates the potentiometric head in the vicinity of the Dump Along Paris-Windham Road likely falls between 950 and 975 ft above mean sea level (amsl). Sand Creek lies approximately 945 ft amsl to the west of the AOC, and the sample grid areas outlined in the limited "RD/RA" range from 950 to 960 ft amsl (Figure 3-1). Sand Creek, which lies approximately 30 ft to the north of the AOC on the northern end to about 170 ft west of the AOC on the southern end, is assumed to be an expression of the water table and the downgradient receptor for groundwater discharge. Therefore, available data indicate relatively short vertical (5-15 ft) and horizontal (less than 200 ft) flow paths exist for contaminant migration to the saturated zone and lateral transport to Sand Creek.

Results of the RVAAP facility-wide biological and water quality study sampling at station S9 at river mile (RM) 1.9 (Figure 3-1) were evaluated to determine possible surface water and groundwater contaminant migration to Sand Creek (USACE 2005a). This monitoring station is located at the southwest corner of the Paris-Windham Road bridge over Sand Creek and is immediately downstream of the AOC. As discussed in Section 4.4, results of chemical and biological samples collected during the facility-wide surface water study at this sampling station indicate any potential groundwater or surface water contamination due to past activities at the Dump Along Paris-Windham Road is not contributing to a decline in water quality in Sand Creek immediately downstream of the AOC.

#### 3.2.4.3 Uncertainties and Data Gaps

Characterization of the nature and extent of contamination in soil (including dry sediment) and surface water at the Dump Along Paris-Windham Road is considered sufficient for risk assessment (Section 4.0) and development and analysis of remedial alternatives in the FFS (Sections 8.0 and 9.0). No residual data gaps are identified for these media.

As previously stated, groundwater in the vicinity of the AOC has not been characterized to date. Therefore, uncertainty exists with respect to predicted impacts and the potential for contaminant migration in groundwater. Groundwater will be assessed in a future report as part of the RVAAP Facility-Wide Groundwater AOC (RVAAP- 66).

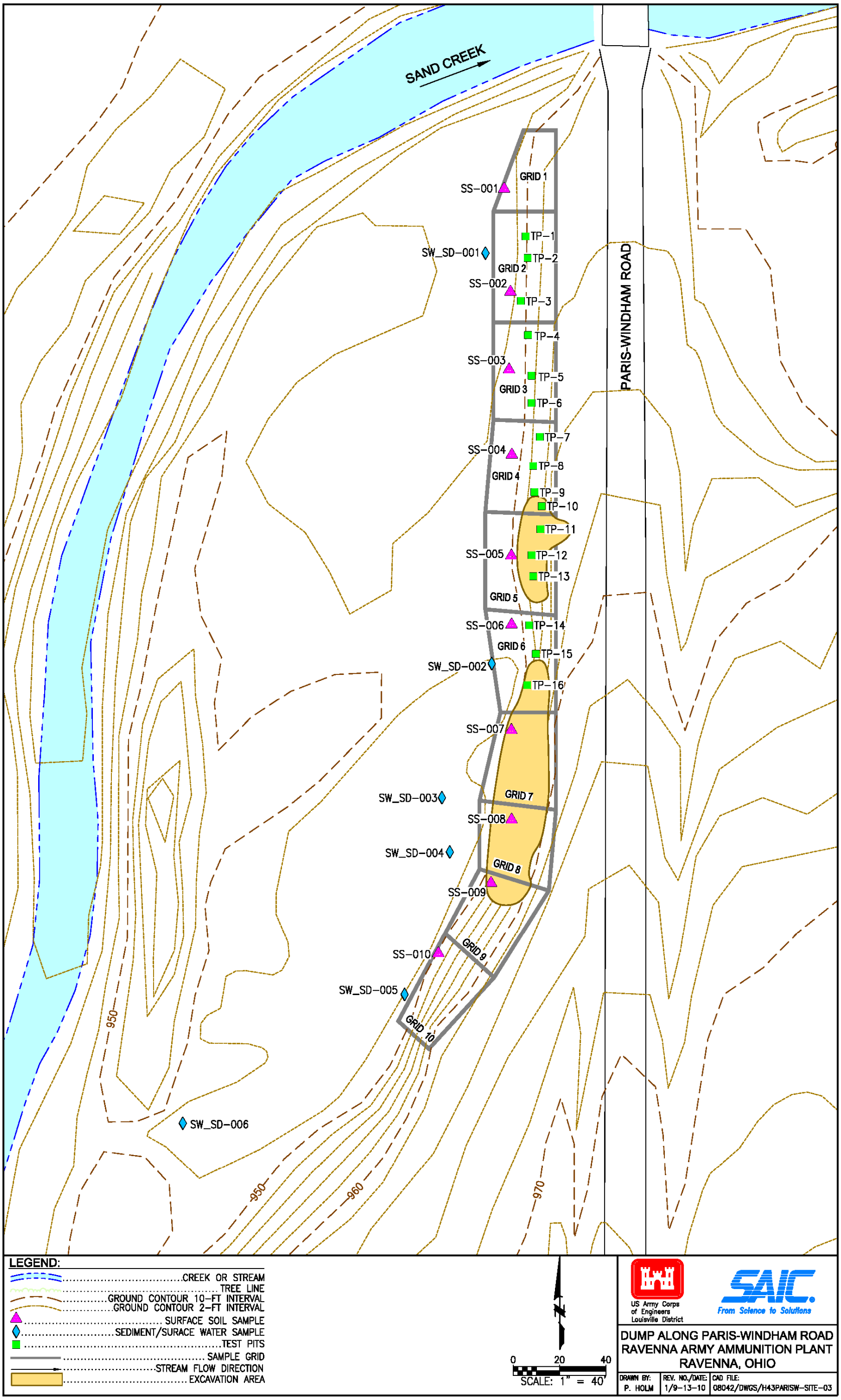



**Figure 3-1. Limited "RD/RA" Location Map**

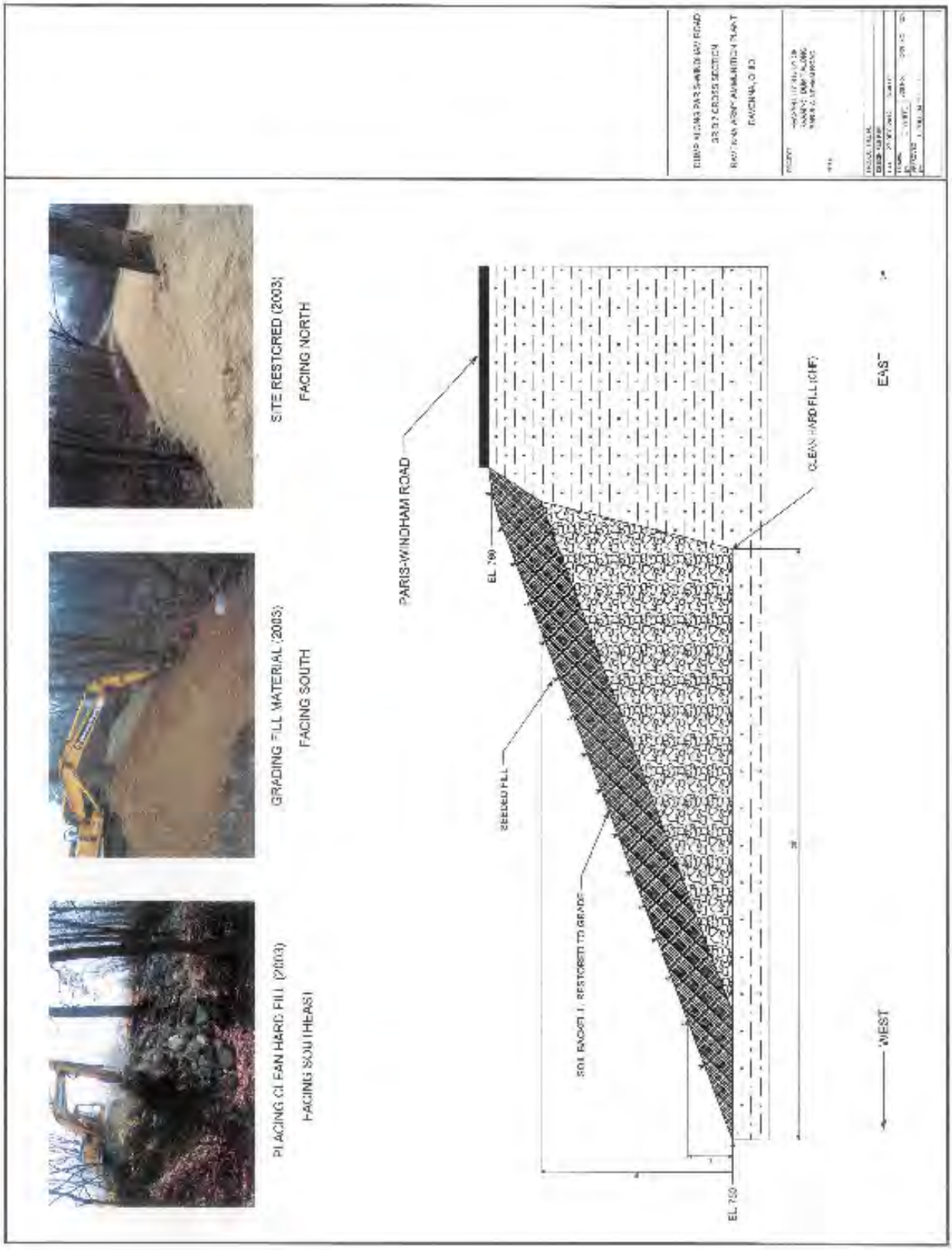



**Figure 3-2. Cross Sectional Diagram Illustrating Site Restoration**

# 4.0 HUMAN HEALTH RISK ASSESSMENT AND ECOLOGICAL RISK ASSESSMENT

Based on the confirmation sampling data, the limited "RD/RA" recommended that an evaluation of risk be performed for the AOC to determine if additional removal actions were required or if the limited "RD/RA" actions were sufficient to allow for regulatory AOC closure (MKM 2004). This portion of the SC presents the results of the recommended risk assessment. Potential exposure pathways and receptors, based on the CSM discussed in Section 3.0, are shown in the conceptual site exposure model (Section 4.1). Data evaluation for use in the risk assessments is described in Section 4.2. Methods and results are discussed in the HHRA (Section 4.3) and the ERA (Section 4.4).

## 4.1 CONCEPTUAL SITE EXPOSURE MODEL

The limited "RD/RA" for the Dump Along Paris-Windham Road consisted of removing all existing unconsolidated surface debris and some subsurface debris. Soil samples were collected from the excavated area following excavation and prior to AOC restoration. In addition, six co-located sediment/surface water samples were collected from a drainage swale at the base of the toe slope and within the neighboring floodplain to characterize impacts associated with runoff. The excavation area was restored to grade using a combination of clean, hard fill and Ohio EPA-approved soil backfill. The area was seeded and mulched. Reconnaissance data from an AOC walkover conducted by SAIC in August 2009 show extensive healthy re-vegetation of the area (Appendix A).

Figure 4-1 illustrates the conceptual site exposure model for the AOC. The primary source of contamination is the residual dump material located in the AOC. The potential migration pathway is surface water runoff with three secondary sources: surface water in the drainage swale, dry sediment/soil in the drainage swale, and subsurface soil and debris under the layers of clean hard fill. Human receptors evaluated for the Dump Along Paris-Windham Road are the National Guard Range Maintenance Soldier (Representative Receptor), Adult and Juvenile Trespassers, and Resident Farmer Adult and Child, as described in Section 4.3.3. The human receptor exposure pathways are based on the FWCUG Report (USACE 2010a). Potential ecological receptors are aquatic organisms (such as fish and stream macroinvertebrates) for surface water and terrestrial organisms (such as plants and wildlife) for soil.

In the swale to the west of the AOC, surface water from storm runoff, periods of snow melt, and occasional overflow conditions from nearby Sand Creek has been observed on a periodic basis. The presence of surface water in the drainage swale is most prevalent during seasonally wet periods of the year. Although field observations show surface water exists in the drainage swale on an intermittent basis, it is present at sufficient frequency and duration to be evaluated as a potential exposure pathway for human and ecological receptors. Sand Creek flows northward about 170 ft west of the south-central edge of the AOC. At the northern end of the AOC, the former dump limits are about 30 ft from Sand Creek near the bridge on Paris-Windham Road. Receptors also may be exposed to soil (inclusive of dry sediment for this evaluation). Exposure to sampled soil and residual waste in the

area that was excavated during the limited "RD/RA" is precluded by the presence of the clean, hard fill and a minimum of 2 ft of clean soil backfill placed on top of the excavated grids (MKM 2004).

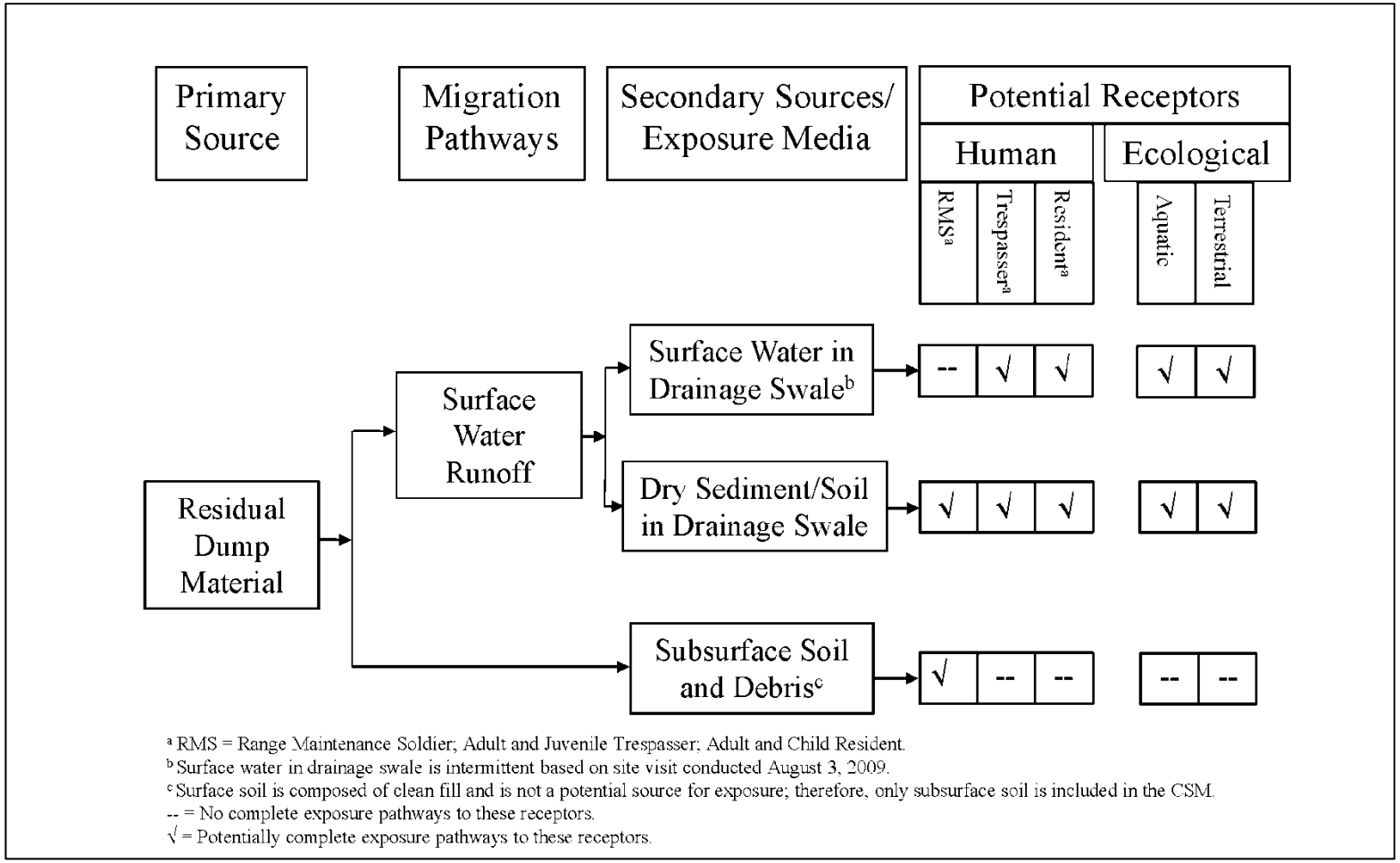



**Figure 4-1. Conceptual Site Exposure Model**

## 4.2 DATA EVALUATION FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

The purpose of this data evaluation is to develop a set of chemical data suitable for use in the HHRA and ERA. Data were evaluated to establish data aggregates and identify a list of SRCs.

Data collected at the Dump Along Paris-Windham Road were aggregated by environmental media (e.g., surface soil and surface water), exposure unit (EU), and sample type (i.e., discrete or ISM). A description of the media to which human and ecological receptors are potentially exposed follows.

### 4.2.1 Data Aggregate – Soil

Soil data at the Dump Along Paris-Windham Road include 10 discrete soil samples, 2 ISM soil samples, and 6 sediment samples collected in 2003. The dump area was divided into 10 equally sized grids (40 ft by 20 ft) to facilitate collection of discrete and ISM soil samples (Figure 3-1). One discrete soil sample was collected from each grid. One ISM sample was collected at Grid 9, and one ISM sample was collected to evaluate the extent of SVOC contamination over the entire AOC (i.e., across all 10 grids). All soil samples were collected from 0-1 ft bgs prior to AOC restoration. Six discrete sediment samples were collected from a drainage swale adjacent to the dump area. The 2003 limited "RD/RA" did not differentiate wet or dry sediment. Sampling logs indicate that sediment samples were collected from the 0 to 1 ft bgs interval. Surface water only occurs in the swale on an intermittent basis. For instance, during an August 2009 walkover, SAIC noted the sediment in the drainage swale had high moisture content, but no standing water was observed. However, during a November 2011 walkover following a rainfall event, water was observed. Based on the intermittent nature of surface water at the AOC and the sampling interval, the 2003 sediment samples are considered dry sediment. Evaluation of these samples as dry sediment/soil is a conservative approach because the Representative Receptor (Range Maintenance Soldier) is exposed to soil but is not exposed to wet sediment. Further discussion of characteristics and habitat within the drainage swale is presented in the ERA (Section 4.4).

Soil at the Dump Along Paris-Windham Road was evaluated as three EUs, based on the potential for exposure (i.e., exposed soil versus soil covered by fill) and sample coverage (i.e., AOC-wide ISM area). The three EUs are as follow:

- **Fill Area EU** – The middle of the dump area (characterized by discrete sample locations SS-005, SS-006, SS-007, SS-008, and SS-009 and ISM sample location PWss-CONT1) was excavated and covered with at least 2 ft of clean fill. These samples were collected from 0-1 ft bgs prior to restoration. This sampled soil is currently under at least 2 ft of clean fill; therefore, it represents subsurface soil.

- **Surface Area EU** – The northern and southern ends of the dump area (characterized by discrete sample locations SS-001, SS-002, SS-003, SS-004, and SS-010) and the drainage swale (characterized by samples SD-001, SD-002, SD-003, SD-004, SD-005, and SD-006) lay outside the limited "RD/RA" excavation area (Figure 3-1). Limited, if any, backfill/cover soil was placed

in these areas. Samples collected from 0-1 ft bgs in this area represent surface soil. Field duplicate samples PWsd-003-001-DUP and PWss-004-001-DUP were not excluded from the dataset.

- **AOC-Wide EU** – One ISM sample was collected across the entire soil grid (i.e., all 10 grid areas). As with the discrete samples, this sample was collected following excavation and prior to restoration to grade. Portions of the sampled area were subsequently filled. Therefore, this sample (PWss-CONT2) represents a combination of surface and subsurface conditions at the AOC.

Samples included in the risk assessment datasets for soil are listed in Table 4-1.

**Table 4-1. Risk Assessment Datasets for Soil**

| Station | Sample ID | Date | Depth (ft bgs) | |
|---|---|---|---|---|
| | | | At Time of Sampling | Following AOC Restoration |
| ***Fill Area EU: Discrete Subsurface Soil Samples*** | | | | |
| PWss-005 | PWss-005-0001-SO | 04/29/03 | 0-1 | >2 |
| PWss-006 | PWss-006-0001-SO | 04/29/03 | 0-1 | >2 |
| PWss-007 | PWss-007-0001-SO | 04/29/03 | 0-1 | >2 |
| PWss-008 | PWss-008-0001-SO | 04/29/03 | 0-1 | >2 |
| PWss-009 | PWss-009-0001-SO | 04/28/03 | 0-1 | >2 |
| ***Fill Area EU: ISM Subsurface Soil Sample*** | | | | |
| PWss-CONT1 | PWss-CONT1-0001-SO | 09/30/03 | 0-1 | >2 |
| ***Surface Area EU: Discrete Surface Soil Samples*** | | | | |
| PWsd-001 | PWsd-001-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWsd-002 | PWsd-002-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWsd-003 | PWsd-003-0001-DUP | 04/29/03 | 0-1 | 0-1 |
| PWsd-003 | PWsd-003-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWsd-004 | PWsd-004-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWsd-005 | PWsd-005-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWsd-006 | PWsd-006-0001-SD | 04/29/03 | 0-1 | 0-1 |
| PWss-001 | PWss-001-0001-SO | 04/28/03 | 0-1 | 0-1 |
| PWss-002 | PWss-002-0001-SO | 04/28/03 | 0-1 | 0-1 |
| PWss-003 | PWss-003-0001-SO | 04/28/03 | 0-1 | 0-1 |
| PWss-004 | PWss-004-0001-DUP | 04/28/03 | 0-1 | 0-1 |
| PWss-004 | PWss-004-0001-SO | 04/28/03 | 0-1 | 0-1 |
| PWss-010 | PWss-010-0001-SO | 04/28/03 | 0-1 | 0-1 |
| ***AOC-Wide EU: ISM Combined Surface and Subsurface Soil Sample*** | | | | |
| PWss-CONT2 | PWss-CONT2-0001-SO | 10/28/03 | 0-1 | 0 to >2 |

AOC = Area of Concern
bgs = below ground surface
EU = Exposure Unit
ISM = Incremental Sampling Method

### 4.2.2 Data Aggregate – Surface Water

Intermittent surface water at the Dump Along Paris-Windham Road is limited to a long, narrow drainage swale downslope of the excavated dump area. Clean backfill soil was not placed in the

drainage swale following the limited "RD/RA." The eastern edge of the drainage swale is estimated to be 15 ft wide by 400 ft long (approximately 0.14 acres). Sand Creek flows northward about 170 ft west of the south-central portion of the dump and flows as close as 30 ft at the northern end of the AOC. Six surface water samples were collected from the drainage swale at the base of the toe slope and within the neighboring floodplain in 2003. No data more recent than 2003 exists for surface water. The use of these samples in the HHRA and ERA is protective because the samples were collected prior to the placement of the soil and vegetation cover, and the potential for contaminant migration from the AOC and exposures was higher than following the completion of the limited "RD/RA."

Surface water at the Dump Along Paris-Windham Road was evaluated as a single EU (also referred to as the Surface Water EU in this SC/FFS). Samples included in the risk assessment dataset for surface water are listed in Table 4-2. Field duplicate sample PWsw-003-0001-F was not excluded from the dataset.

**Table 4-2. Risk Assessment Dataset for Surface Water**

| Station | Sample ID | Date |
|---|---|---|
| PWsw-001 | PWsw-001-0001-S | 04/29/03 |
| PWsw-002 | PWsw-002-0001-S | 04/29/03 |
| PWsw-003 | PWsw-003-0001-F | 04/29/03 |
| PWsw-003 | PWsw-003-0001-S | 04/29/03 |
| PWsw-004 | PWsw-004-0001-S | 04/29/03 |
| PWsw-005 | PWsw-005-0001-S | 04/29/03 |
| PWsw-006 | PWsw-006-0001-S | 04/29/03 |

## 4.3 HUMAN HEALTH RISK ASSESSMENT

As described in the SC/FFS WP (USACE 2010c), the HHRA conducted for this SC/FFS consists of the following three steps:

- Evaluate representative AOC-specific receptors and exposure media.
- Identify COCs using appropriate RVAAP risk-based values, FWCUGs, and background concentrations.
- Identify the specific FWCUGs that are applicable for this SC/FFS and evaluate the nature and extent of COCs.

Recently, the RVAAP project team adopted a streamlined approach for performing risk-based decision making at RVAAP, taking advantage of the experience gained through previously completed work. To aid in streamlined decision making, the FWCUG Report (USACE 2010a) was developed to support environmental remediation of the remaining AOCs at RVAAP to complete final transfer of the land to OHARNG. The FWCUG Report contains calculated FWCUGs and guidance for their application to accelerate the decision-making process for the remaining AOCs, taking advantage of

the fact that many of the risk assessment inputs and decisions for the facility have already been agreed to by stakeholders through the application of the CERCLA process over the past 10 years. Most of the agreed-to risk assessment methods have been documented in the FWHHRAM.

The streamlined approach to risk decision-making presented in the FWCUG Report (USACE 2010a) is as follows.

1. Using the risk assessment process presented in the FWHHRAM (and appended by information in the Final White Paper provided in Appendix B of the FWCUG Report), develop FWCUGs for all COPCs identified from the facility-wide dataset at RVAAP.

2. Perform RI characterization sampling and analysis to establish the baseline chemical concentrations within an AOC.

3. Perform data analysis and mapping to identify COPCs, determine EUs, and calculate exposure point concentrations (EPCs) for each COPC, following the requirements in the FWHHRAM and further clarified in the position paper developed by USACE, Louisville District provided in Appendix B of the FWCUG Report.

4. Compare EPCs to the FWCUGs to determine COCs.

5. Perform the FS, PP, and ROD to address any identified COCs.

Step 1 of this process (develop FWCUGs) has been completed in the FWCUG Report. The results of Step 2 (characterization sampling) and Step 3 (mapping and data analysis) are documented in the *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004) and summarized in Section 3.0 of this SC/FFS. The remainder of the process (Steps 4 and 5) is provided in the following subsections and follows the four steps for a streamlined risk assessment outlined in Figure 4-2: (1) identify media of concern (Section 4.3.1); (2) identify COPCs (Section 4.3.2); (3) determine the AOC land use and appropriate receptors (Section 4.3.3); and (4) compare to appropriate FWCUGs to identify COCs (Section 4.3.4). Section 4.3.5 identifies the specific FWCUGs that are applicable for this SC/FFS and provides an assessment of the nature and extent of COCs.

### 4.3.1 Identify Media of Concern

Media of concern at the Dump Along Paris-Windham Road are surface soil, subsurface soil, and surface water, as described in Section 4.2. As described in Section 1.1, groundwater will be addressed by the U.S. Army under a future decision for the RVAAP Facility-Wide Groundwater AOC (RVAAP-66).

### 4.3.2 Identify Chemicals of Potential Concern

Section 3.2 presents the screening criteria used to identify SRCs for the Dump Along Paris-Windham Road. Details of the SRC screening for each exposure medium and sample type are provided in Appendix Tables B-1 (discrete soil samples at the Fill Area EU), B-2 (discrete soil samples at the Surface Area EU), B-3 (ISM soil samples), and B-4 (surface water). COPCs were identified as a subset of SRCs present at concentrations that indicate potential impacts to human receptors. The COPC screen follows the approach specified in the FWCUG Report (USACE 2010a) and summarized here.

To determine COPCs, the MDCs of all SRCs were screened against the chemical-specific FWCUGs at a target cancer risk of 1E-06 and a non-carcinogenic target hazard quotient (HQ) of 0.1 for the Resident Farmer Adult, Resident Farmer Child, and National Guard Trainee. These are the most conservative FWCUGs available and are used for all AOCs at RVAAP regardless of the current or future land use. If no FWCUGs were developed for an SRC, the USEPA residential RSL [at a target risk (TR) of 1E-06 or an HQ of 0.1] was used for this screen. As part of the conservative screening approach for identifying COPCs, the FWCUG for hexavalent chromium (the more toxic of the two chromium types evaluated) was used at this stage.

Details of the COPC screening for each exposure medium are provided in Appendix Tables B-1 (soil in the Fill Area EU), B-2 (soil in the Surface Area EU), B-3 (ISM sampled soil), and B-4 (surface water). These tables include all carcinogenic and non-carcinogenic risk-based FWCUG or RSL values for each chemical. SRCs were identified as COPCs if the MDC exceeded the most protective (i.e., lowest) FWCUG. The COPCs identified for the media of concern at the Dump Along Paris-Windham Road are summarized in Table 4-3 and following sections.

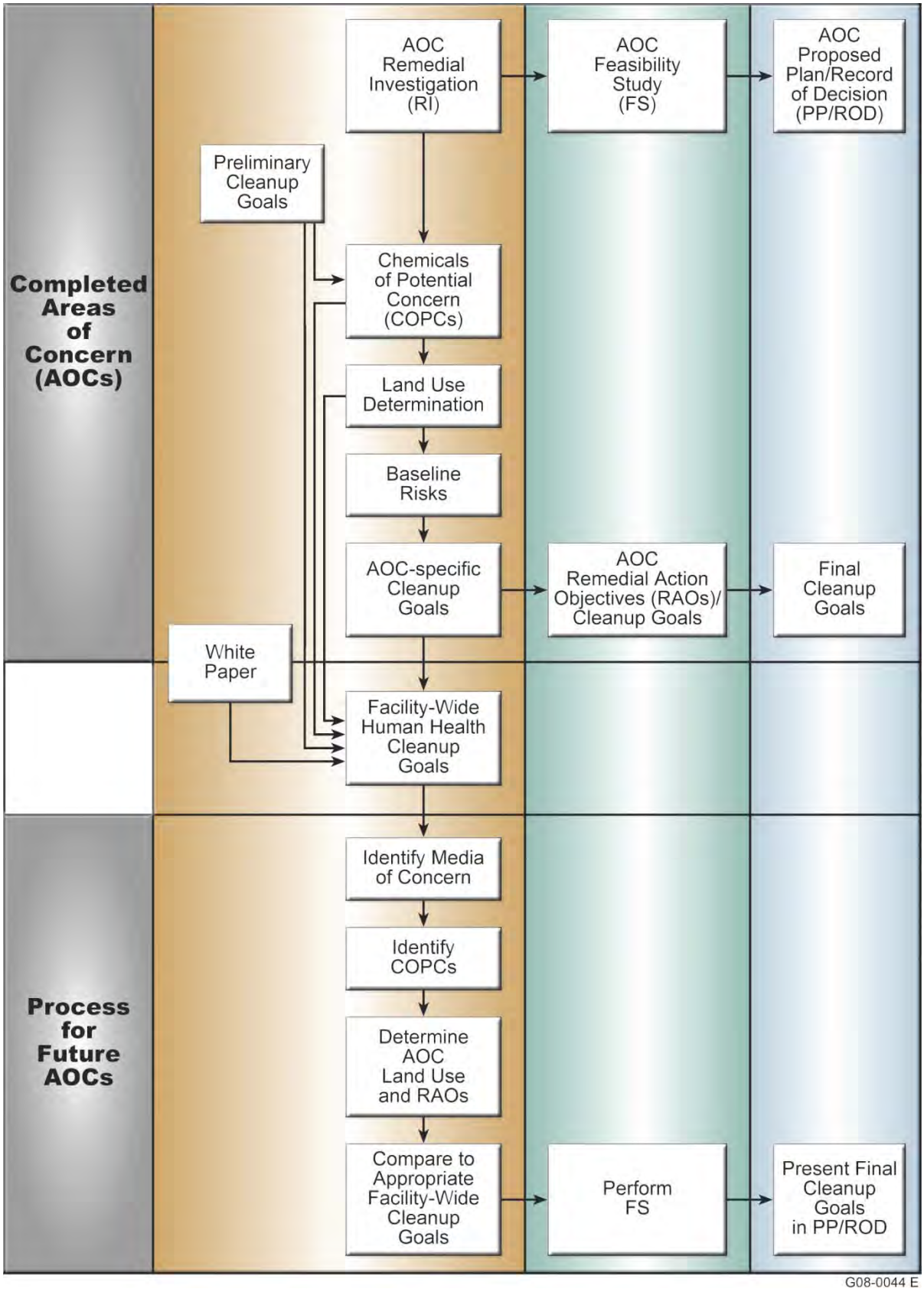



**Figure 4-2. Risk Assessment Input to Support Remediation Decisions**

#### 4.3.2.1 Chemicals of Potential Concern in the Fill Area Exposure Unit for Soil

Thirty-one chemicals were detected in discrete soil samples collected in the excavated area of the former dump prior to filling and grading during restoration. These samples currently represent subsurface soil because at least 2 ft of clean fill was added to this area after these samples were collected. Nineteen of these chemicals were identified as SRCs. Risk-based screening identified six COPCs in this soil: five SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] and one PCB (PCB-1254).

#### 4.3.2.2 Chemicals of Potential Concern in the Surface Area Exposure Unit for Soil

Thirty-one chemicals were detected in discrete soil samples collected in the area of the former dump not covered by fill during restoration. Twenty-one of these chemicals were identified as SRCs. Risk-based screening identified five COPCs in this soil: two inorganic chemicals (aluminum and manganese) and three SVOCs [benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene].

#### 4.3.2.3 Chemicals of Potential Concern in Incremental Sampling Method Soil Samples

Two ISM soil samples were collected from the same areas from which discrete samples had previously been collected. These ISM samples were analyzed for SVOCs only. Twenty-three SVOCs were detected, and all were identified as SRCs. Risk-based screening identified five COPCs in these samples: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

#### 4.3.2.4 Chemicals of Potential Concern in Surface Water

Sixteen chemicals were detected in surface water samples collected from the drainage swale at the base of the toe slope and within the neighboring floodplain; eight of these chemicals were identified as SRCs. Risk-based screening identified two inorganic chemicals as COPCs in surface water: arsenic and cobalt.

**Table 4-3. Summary of COPCs**

| Fill Area EU (Subsurface Soil) | Surface Area EU (Surface Soil) | ISM Samples (Surface and Subsurface Soil) | Surface Water |
|---|---|---|---|
| **SVOCs** | **Inorganic Chemicals** | **SVOCs** | **Inorganic Chemicals** |
| Benzo(a)anthracene | Aluminum | Benzo(a)anthracene | Arsenic |
| Benzo(a)pyrene | Manganese | Benzo(a)pyrene | Cobalt |
| Benzo(b)fluoranthene | | Benzo(b)fluoranthene | |
| Dibenz(a,h)anthracene | **SVOCs** | Dibenz(a,h)anthracene | |
| Indeno(1,2,3-cd)pyrene | Benzo(a)anthracene | Indeno(1,2,3-cd)pyrene | |
| | Benzo(a)pyrene | | |
| **Pesticides/PCBs** | Benzo(b)fluoranthene | | |
| PCB-1254 | | | |

COPC = Chemical of Potential Concern
EU = Exposure Unit
ISM = Incremental Sampling Method
PCB = Polychlorinated Biphenyl
SVOC = Semi-volatile Organic Compound

### 4.3.3 Determine Area of Concern Land Use and Appropriate Receptors

The Dump Along Paris-Windham Road is located in the east-central portion of RVAAP, along a steep embankment on the west side of Paris-Windham Road between the bridge over Sand Creek and the intersection of Paris-Windham Road with Remalia Road. Sand Creek is located to the west and north at distances ranging from approximately 30 ft (north end of the AOC) to 170 ft (south-central portion of the AOC). The following information was considered when identifying representative receptors for evaluation in this SC/FFS:

- No specific development project is currently identified by the OHARNG for this AOC.
- Any proposed utilities would be located on the east side of Paris-Windham Road due to the presence of transite on the west side of the road in this area.
- The area is not fenced and does not have any additional security measures beyond those in place for the entire facility.
- The dump area is small and located on a steep slope. It begins at the berm to the west of Paris-Windham Road, and there is a floodplain at the bottom.

Based on these considerations, the RAFLU for the AOC is as follows:

- Military Training.
- Representative Receptor – National Guard Range Maintenance Soldier

RVAAP is a controlled-access facility that is fenced and patrolled by security personnel. Full-time OHARNG, BRAC, and contractor staff work at the facility. Military training and operations are conducted at the facility. The AOC is located in the eastern-central portion of the facility. The AOC is not currently used for military training activities but may receive periodic foot traffic. The most representative receptor is the National Guard Range Maintenance Soldier. This anticipated future land use, in conjunction with the evaluation of agricultural-residential land uses and associated receptors, forms the basis for identifying COCs in this RI. Residential land use, specifically the Resident (adult and child) Farmer scenario, is included to evaluate COCs for unrestricted land use at the AOC as required by the CERCLA process and as outlined in the FWHHRAM (USACE 2005); however, the topography of the area (i.e., steep slope and floodplain) precludes Residential Land Use.

Because the AOC is located immediately adjacent to a primary road, trespassers may potentially visit the AOC; therefore, Adult and Juvenile Trespassers are also considered. The exposure assumptions for the Range Maintenance Soldier are also protective of the Adult and Child trespasser. Per guidelines in the FWCUG Report (USACE 2010a), the application of these receptor scenarios to the Dump Along Paris-Windham Road is described in more detail below.

- **Range Maintenance Soldier** – This receptor represents OHARNG personnel who may occasionally visit the AOC in connection with any adjacent range areas or for other routine or occasional monitoring of the area. This receptor is assumed to contact shallow surface soil, including dry sediment (0-1 ft bgs) and subsurface soil (>2 ft bgs). These two soil intervals represent the 0-4 ft deep surface soil interval as defined for the Range Maintenance Soldier in the FWCUG Report (USACE 2010a).

- **Adult and Juvenile Trespassers** – These receptors are assumed to contact shallow surface soil, including dry sediment (0-1 ft bgs) and surface water in the drainage swale at the base of the slope of the former dump. The Adult Trespasser is assumed to visit the AOC 75 days/year (USACE 2010a) and thus is also protective of "foot traffic" by National Guard Trainees.

- **Resident Farmer Adult and Child** – These receptors are generally assumed to contact shallow surface soil (0-1 ft bgs), subsurface soil, and surface water. This AOC is located on a steep embankment, is bordered by a floodplain and a road, and is not suitable for Residential Land Use (e.g., a house cannot be built directly on the AOC). However, for evaluation of Residential Land Use, a residence is assumed to be built across the road from the AOC with a yard that encompasses the road and hillside. Based on this scenario, the Resident Farmer is assumed to contact shallow surface soil, including dry sediment (0-1 ft bgs), and intermittent surface water in the drainage swale at the base of the toe slope of the former dump. Exposure to subsurface soil is not included because the foundation of a house would have to be located outside the AOC.

### 4.3.4 Compare to Appropriate Facility-Wide Cleanup Goals

The comparison to FWCUGs and determination of COCs follows guidance presented in Appendix B of the FWCUG Report (USACE 2010a). The screening process is as follows:

- Select the FWCUGs for the planned National Guard end-use Representative Receptor (Range Maintenance Soldier) and Adult and Juvenile Trespassers at the Dump Along Paris-Windham Road. Also select the FWCUGs for the Resident Farmer Adult and Child receptors to evaluate an unrestricted land use scenario corresponding to a TR of 1E-05 and target HQ of 1.0.

- Report all carcinogenic- and non-carcinogenic-based FWCUGs for each COPC for all appropriate receptors (i.e., Range Maintenance Soldier, Adult and Juvenile Trespassers, and Resident Farmer Adult and Child).

- Report critical effects and target organs for each of the non-carcinogenic-based FWCUGs.

- Complete a comparison of the selected FWCUG to the EPC, including a sum-of-ratios (SOR).
  - For non-carcinogens, compare the EPC to the target HQ FWCUG. Sum the ratios of the EPC/FWCUG for COPCs that affect similar target organs.
  - For carcinogens, compare the EPC to the TR FWCUG. Sum the ratios of the EPC/FWCUG for all carcinogens.

- The COPC is identified as a COC for a given receptor if
  - The EPC exceeds the more protective FWCUG for either the 1E-05 target cancer risk or the 1.0 target HQ; or
  - The SOR for all carcinogens or all non-carcinogens that may affect the same organ is greater than 1.0; chemicals contributing at least 10% to the SOR also were considered COCs.

The selection of FWCUGs, calculation of EPCs for comparison to the FWCUGs, and results of the identification of Dump Along Paris-Windham Road COCs are detailed in the following sections.

#### 4.3.4.1 Selection of Appropriate Facility-Wide Cleanup Goals for the Dump Along Paris-Windham Road

The basis for selecting the Range Maintenance Soldier as the receptor for the Dump Along Paris-Windham Road is that the area is not conducive for regular training (steep slope), there is residual asbestos at the AOC, and a safety danger zone (SDZ) for a proposed future range complex overlaps the AOC (OHARNG 2008b). The Adult and Juvenile Trespassers are also evaluated for this AOC. FWCUGs were identified for soil and surface water. In addition to this planned OHARNG land use, the Resident Farmer Adult and Child receptor FWCUGs were also used to evaluate a baseline scenario.

FWCUGs for these receptors from the FWCUG Report (USACE 2010a) are provided in Tables 4-4 and 4-5 (soil and surface water, respectively) for all COPCs. The critical effect or target organ associated with the toxicity values used to calculate the FWCUGs are also provided in these tables.

**Table 4-4. FWCUGs for COPCs in Soil**

| | | FWCUG (mg/kg) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Range Maintenance Soldier | | Trespasser[a] | | Resident Farmer[b] | |
| COPC | Target Organ | HQ = 1.0 | TR = 1E-05 | HQ = 1.0 | TR = 1E-05 | HQ = 1.0 | TR = 1E-05 |
| Aluminum | Reproductive[c] | 1,000,000 | NA | 1,000,000 | NA | 76,800 | NA |
| Manganese | CNS | 204,672 | NA | 220,293 | NA | 2,927 | NA |
| Benzo(a)anthracene | NA | NA | 26.2 | NA | 11.3 | NA | 2.21 |
| Benzo(a)pyrene | NA | NA | 2.62 | NA | 1.13 | NA | 0.221 |
| Benzo(b)fluoranthene | NA | NA | 26.2 | NA | 11.3 | NA | 2.21 |
| Dibenz(a,h)anthracene | NA | NA | 2.62 | NA | 1.13 | NA | 0.221 |
| Indeno(1,2,3-cd)pyrene | NA | NA | 26.2 | NA | 11.3 | NA | 2.21 |

[a]Trespasser FWCUGs are the smaller of the adult and juvenile values for each COPC.
[b]Resident Farmer FWCUGs are the smaller of the adult or child values for each COPC.
[c]Neurotoxicity in offspring
CNS = Central Nervous System
COPC = Chemical of Potential Concern
FWCUG = Facility-Wide Cleanup Goal
HQ = Hazard Quotient
NA = Not available
TR = Target Risk

**Table 4-5. FWCUGs for COPCs in Surface Water**

| COPC | Target Organ | FWCUG (mg/L) | | | |
|---|---|---|---|---|---|
| | | Trespasser[a] | | Resident Farmer[b] | |
| | | HQ = 1.0 | TR = 1E-05 | HQ = 1.0 | TR = 1E-05 |
| Arsenic | Skin | 0.705 | 0.0415 | 0.046 | 0.011 |
| Cobalt | Thyroid/Lung | NA | NA | NA | NA |

[a]Trespasser FWCUGs are the smaller of the adult and juvenile values for each COPC.
[b]Resident Farmer FWCUGs are the smaller of the adult and child values for each COPC.
COPC = Chemical of Potential Concern
FWCUG = Facility-Wide Cleanup Goal
HQ = Hazard Quotient
NA = Not available
TR = Target Risk

#### 4.3.4.2 Exposure Point Concentrations for Comparison to Facility-Wide Cleanup Goals

For discrete soil and surface water data, EPCs were calculated from the results of all of the discrete samples collected from each EU (listed in Tables 4-1 and 4-2), following the method and equations provided in the FWHHRAM (USACE 2005b). The EPC was either the 95% upper confidence limit ($UCL_{95}$) of the mean or the MDC, whichever value was lowest. If the $UCL_{95}$ could not be determined, the EPC was the MDC. For ISM soil data, the EPC was the detected concentration in each ISM sample.

#### 4.3.4.3 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Range Maintenance Soldier Scenario

The Range Maintenance Soldier is assumed to contact shallow surface soil (0-1 ft bgs at the Surface Area EU) and subsurface soil (> 2 ft bgs at the Fill Area EU). This receptor is not expected to contact surface water. COC screening for the Range Maintenance Soldier receptor is detailed in Appendix Tables B-5, B-6, and B-7 (Surface Area EU, Fill Area EU, and ISM soil samples, respectively) and summarized below.

No COCs were identified in the Surface Area EU, Fill Area EU, or in the ISM soil samples. The EPCs for all COPCs are below the FWCUGs for this receptor.

No COCs were identified based on the SOR analysis, as summarized below.

- None of the COPCs identified in soil have similar toxic endpoints; therefore, no non-cancer SOR was calculated.

- Five COPCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] in soil have FWCUGs for the cancer endpoint. An SOR was calculated for these potential carcinogens for the EPCs in the Surface Area EU and Fill Area EU, as well as for each of the ISM samples. All calculated SORs are $\leq 1$; therefore, no additional COCs were identified.

#### 4.3.4.4 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Trespasser Scenario

Trespassers are assumed to contact shallow surface soil and surface water in the drainage conveyance at the base of the slope of the former dump. COC screening for the Trespasser scenario is detailed in Appendix Tables B-8 (Surface Area EU), B-9 (AOC-wide ISM soil sample), and B-12 (surface water) and summarized below. The most conservative (smallest) FWCUGs for the Adult and Juvenile Trespassers were used in the COC screening.

Soil COCs for the Trespasser scenario are summarized below and in Table 4-6.

- No COCs were identified for the Trespasser scenario in the Surface Area EU. All EPCs are less than FWCUGs for the Adult and Juvenile Trespassers.

- No COCs were identified for the Trespasser scenario in the AOC-wide ISM sample. Benzo(a)pyrene was detected at a concentration of 1.4 mg/kg in PWss-CONT2. The detected concentration slightly exceeds the FWCUG for the Adult Trespasser (1.13 mg/kg) and is below the FWCUG for the Juvenile Trespasser (4.5 mg/kg). Sample PWss-CONT2 was collected from across all 10 soil sample grids prior to filling and grading of the AOC. Approximately one-half the sampled area was covered with at least 2 ft of clean fill after this sample was collected; therefore, this sample does not entirely represent surface conditions. Because the Trespasser is not exposed to subsurface soil, and considering the information presented above, benzo(a)pyrene is not identified as a COC for this receptor.

No additional COCs were identified based on the SOR analysis as summarized below.

- None of the COPCs identified in soil have similar toxic endpoints; therefore, no non-cancer SOR was calculated.

- Five COPCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] in soil have FWCUGs for the cancer endpoint. An SOR was calculated for these potential carcinogens for the EPCs in the Surface Area EU as well as for each ISM sample. All calculated SORs are $\leq$1; therefore, no additional COCs were identified.

No surface water COCs were identified for the Trespasser scenario. Two inorganic chemicals (arsenic and cobalt) were identified as COPCs for this medium. The EPC for arsenic (0.00685 mg/L) is less than the lowest FWCUG (0.0415 mg/L). No FWCUG is available for cobalt in surface water; however, the MDC (0.0015 mg/L) does not exceed the USEPA residential RSL (0.011 mg/L) for drinking water at an HQ of 1.0. Thus, cobalt is not a COC.

#### 4.3.4.5 Identification of Dump Along Paris-Windham Road Chemicals of Concern: Resident Farmer Scenario

The Resident Farmer is assumed to contact shallow surface soil and surface water. Exposure to subsurface soil is not included because the foundation of a house would have to be located outside the AOC. COC screening for the Resident Farmer is detailed in Appendix Tables B-10 (Surface Area EU), B-11 (AOC-wide ISM soil sample), and B-13 (surface water) and summarized below.

Soil COCs for the Resident Farmer scenario are summarized below and in Table 4-6.

- Benzo(a)pyrene was identified as a COC for the Resident Farmer scenario in the Surface Area EU. The EPC (0.33) exceeds the FWCUG for the Resident Farmer Adult (0.221 mg/kg).

- Benzo(a)pyrene and dibenz(a,h)anthracene were identified as COCs in ISM sample PWss-CONT2 collected from across all 10 soil sample grids. Approximately one-half of this area was covered with at least 2 ft of clean fill after this sample was collected. The detected concentrations of benzo(a)pyrene and dibenz(a,h)anthracene were 1.4 and 0.36 mg/kg, respectively. The FWCUG for the Resident Farmer Adult is 0.221 mg/kg for both of these chemicals.

No additional COCs were identified based on the SOR analysis as summarized below.

- None of the COPCs identified in soil have similar toxic endpoints; therefore, no non-cancer SOR was calculated.

- Five COPCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene] in soil have FWCUGs for the cancer endpoint. An SOR was calculated for these potential carcinogens for the EPCs in the Surface Area EU as well as for the AOC-wide ISM sample. All calculated SORs are $\leq$1; therefore, no additional COCs were identified.

No surface water COCs were identified for the Resident Farmer. Two inorganic chemicals (arsenic and cobalt) were identified as COPCs for this medium. The EPC for arsenic (0.00685 mg/L) is less than the lowest FWCUG (0.011 mg/L). No FWCUG is available for cobalt in surface water; however, the MDC (0.0015 mg/L) is less than the USEPA residential RSL (0.011 mg/L) for drinking water at an HQ of 1.0. Thus, cobalt is not a COC.

### 4.3.5 Uncertainty Assessment

The sources of uncertainty, as well as the potential bias they impart to the risk assessment (i.e., whether conservatism is increased or decreased), are briefly discussed below.

#### 4.3.5.1 Uncertainty in Estimating Potential Exposure

Sources of uncertainty in estimating potential human exposure include limitations of the sampling and analysis, comparison to background concentrations to identify SRCs, and estimation of EPCs.

**Sampling Limitations** – Uncertainties arise from limits on the media sampled, the total number and specific locations that can be sampled, and the parameters chosen for analysis to characterize the AOC. Sampling at the Dump Along Paris-Windham Road was targeted primarily at inorganic chemicals and asbestos. A subset of the total samples collected was analyzed for VOCs, SVOCs, pesticides, PCBs, explosives, and propellants. Soil has been characterized using both discrete and ISM sampling biased toward areas anticipated to have the highest level of potential contamination. Uncertainty is associated with exactly what sampled areas are currently covered by fill. A conservative estimate was made of the extent of excavation and fill. Some fill may extend onto areas included in the Surface Area EU, but its depth is assumed to be much less than that applied to the Fill Area EU.

**Analytical Limitations** – Uncertainty is associated with the contaminant concentrations detected and reported by the analytical laboratory. The quality of the analytical data used in the risk assessment was maximized and uncertainty minimized by implementing quality assurance/quality control (QA/QC) procedures that specify how samples are selected and handled; however, sampling errors, laboratory analysis errors, and data analysis errors can occur. Beyond the potential for errors, there is normal variability in analytical results. Some current analytical methods are limited in their ability to achieve detection limits at or below risk-based screening levels. Under these circumstances, it is uncertain whether the true concentration is above or below the screening levels that are protective of human health. When analytes have a mixture of detected and non-detected concentrations, EPC calculations may be affected by these detection limits. Risks may be overestimated as a result of some sample concentrations being reported as non-detected at the method detection limit (MDL) when the actual concentration may be much smaller than the MDL. Risks also may be underestimated if some analytes that were not detected in any sample were removed from the COPC list. If the concentrations of these analytes are below the MDL but above the screening level, the risk from these analytes would not be included in the risk assessment results.

**Identification of SRCs** – Uncertainty is associated with screening against background results from statistical limitations and natural variation in background concentrations. Because of this variation, metal concentrations below the background screening value are likely representative of background concentrations. Metal concentrations above the background screening level may be above background concentrations or may reflect natural variation. This is especially true for measured concentrations close to the background screening value.

**EPCs** – Soil was characterized using both discrete and ISM sampling techniques. ISM samples provide a physical average concentration across an exposure area. Use of ISM sampling reduces the uncertainty associated with estimating a statistical average exposure. Generally, the upper confidence limit on the arithmetic mean was adopted as the EPC for discrete sample results and was considered

to represent a conservative estimate of the average concentration. This imparts a small but intentional conservative bias to the risk assessment, provided the sampling captured the most highly contaminated areas. Representative EPCs for the EU were calculated from discrete data or measured with ISM data based on the assumption that samples collected from the EU were truly random samples. This assumption is not true for the Dump Along Paris-Windham Road. Sample locations were biased to identify the areas of highest contaminant concentrations. ISM sample PWss-CONT2 was collected from across the entire soil sampling grid. After this sample was collected, approximately one-half of the area sampled was covered with at least 2 ft of clean fill. Therefore, this sample is not representative of current surface soil conditions, but the area is also not completely covered by fill.

#### 4.3.5.2 Uncertainty in Use of Facility-Wide Cleanup Goals

Sources of uncertainty in the FWCUGs used to identify COCs include the selection of appropriate receptor scenarios and exposure parameters, exposure models, and toxicity values used in the calculation of FWCUGs.

**Selection of Representative Receptors –** The OHARNG will control future use of the property and implement any LUCs that may be required as a component of RAs. As discussed in Section 4.3.3, the RAFLU for the AOC is Military Training, with the Range Maintenance Soldier as the Representative Receptor. The basis for selecting the Range Maintenance Soldier as the receptor for the Dump Along Paris-Windham Road is that the area is not conducive for regular training (steep slope), there is residual asbestos at the AOC, and a safety danger zone (SDZ) for a proposed future range complex overlaps the AOC (OHARNG 2008b).. The AOC location and topographic conditions preclude Residential Land Use. A low degree of uncertainty exists with respect to the future OHARNG-controlled land use and the assumption that RVAAP will not be released for Residential Land Use; however, a Resident Farmer receptor is included to provide a baseline assessment. Because this area is located immediately adjacent to a primary road, trespassers may visit the AOC; therefore, Adult and Juvenile Trespassers were also evaluated. The Dump Along Paris-Windham Road is located in the eastern-central area of Camp Ravenna (well distant from the property boundary), and it is unlikely a trespasser will visit this small area 75 days/year for 30 years. Therefore, some uncertainty exists as to the exact number of hours or days a trespasser may be present. The exposure assumptions for the Range Maintenance Soldier are also protective of the Adult and Child trespasser.

**Exposure Parameters and Exposure Models –** For each primary exposure pathway included in the FWCUGs, assumptions are made concerning the exposure parameters (e.g., amount of contaminated media a receptor can be exposed to and intake rates for different routes of exposure) and the routes of exposure. Most exposure parameters have been selected so that errors occur on the side of conservatism. When several of these upper-bound values are combined in estimating exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and outside of the range that may be reasonably expected. Therefore, the consistent conservatism employed in the estimation of these parameters generally leads to overestimation of the potential risks.

**Toxicity Values –** The toxicity of chemicals is under constant study, and values change from time to time. The toxicity values used in the calculation of the FWCUGs were the most recent values available at the time of those calculations (September 2008). These values are designed to be conservative and provide an upper-bound estimate of risk.

#### 4.3.5.3 Uncertainty in the Identification of Chemicals of Concern

One of the two COPCs identified in surface water (cobalt) does not have FWCUGs. The MDC of cobalt (0.0015 mg/L) is less than the USEPA residential RSL (0.0011 mg/L) for drinking water at an HQ of 0.1. Thus, cobalt is not expected to contribute significantly to uncertainty in the results of the risk assessment.

### 4.3.6 Summary of Human Health Risk Assessment

This HHRA documents the COCs that may pose potential health risks to human receptors resulting from exposure to contamination at the Dump Along Paris-Windham Road. This HHRA was conducted as part of this SC/FFS and was based on the streamlined approach described in the FWCUG Report (USACE 2010a). The components of the risk assessment (receptors, exposure media, EPCs, and results) are summarized below.

**Receptors** – RVAAP is a controlled-access facility that is fenced and patrolled by security personnel. Full-time OHARNG, BRAC, and contractor staff work at the facility. Military training and operations are conducted at the facility. The AOC is not currently used for military training activities but may receive periodic foot traffic. The OHARNG projected future land use for the AOC is Military Training. The Representative Receptor at the AOC is the Range Maintenance Soldier. The basis for selecting the Range Maintenance Soldier as the receptor for the Dump Along Paris-Windham Road is that the area is not conducive for regular training (steep slope), there is residual asbestos at the AOC, and a safety danger zone (SDZ) for a proposed future range complex overlaps the AOC (OHARNG 2008b). This RAFLU (Military Training) forms the basis for identifying COCs. Because the AOC is located immediately adjacent to a primary road, trespassers may visit the AOC; therefore, Adult and Juvenile Trespassers were also evaluated. Topography (e.g., steep slopes and floodplain) and the presence of the covered dumpsite preclude unrestricted or Residential Land Use on the AOC. However, unrestricted or Residential Land Use could potentially occur adjacent to the AOC east of Paris-Windham Road. Therefore, an unrestricted scenario was evaluated in the HHRA as a comparative baseline, in accordance with CERCLA.

**Exposure Media –** Media of concern at the Dump Along Paris-Windham Road are surface soil, subsurface soil, and surface water. All soil samples were collected from 0-1 ft bgs. Some of these samples were subsequently covered with at least 2 ft of clean fill and now represent subsurface conditions.

**Estimation of EPCs –** For discrete soil and surface water, data EPCs were calculated from the results of all the discrete samples collected from each EU (listed in Tables 4-1 and 4-2). The EPC was either

the $UCL_{95}$ or the MDC, whichever value was lowest. If the $UCL_{95}$ could not be determined, the EPC was the MDC. For ISM soil data, the EPC was the detected concentration in each ISM sample.

**Results of HHRA –** No COCs were identified in surface water for any receptor scenario. No COCs were identified in soil for the Range Maintenance Soldier or Adult and Juvenile Trespassers. Two PAHs were identified as COCs in soil for the Resident Farmer. COCs and FWCUGs are summarized in Table 4-6.

**Table 4-6. Summary of COCs and FWCUGs**

| Exposure Unit | Chemicals of Concern (FWCUG) | | |
|---|---|---|---|
| | Range Maintenance Soldier | Trespasser[a] | Resident Farmer[b] |
| ***Soil*** | | | |
| Surface Area - Discrete Samples | None | None | Benzo(a)pyrene (0.221 mg/kg) |
| Fill Area - Discrete Samples | None | NA | NA |
| Fill Area ISM Sample (PWss-CONT1) | None | NA | NA |
| AOC-Wide ISM Sample (PWss-CONT2) | None | None | Benzo(a)pyrene (0.221 mg/kg)<br>Dibenz(a,h)anthracene (0.221 mg/kg) |
| ***Surface Water*** | | | |
| Surface Water - Discrete Samples | None | None | None |

[a]Both Adult and Juvenile Trespasser scenarios were evaluated.
[b]Both Resident Farmer Adult and Child scenarios were evaluated.
AOC = Area of Concern
COC = Chemical of Concern
FWCUG = Facility-Wide Cleanup Goal
ISM = Incremental Sampling Method
NA = Exposure medium not applicable to this receptor

## 4.4 ECOLOGICAL RISK ASSESSMENT

### 4.4.1 Introduction

The ERA presented in this SC/FFS follows a unified approach of methods integrating U.S. Army, Ohio EPA, and USEPA guidance. This ERA approach is consistent with the general approach by these agencies and primarily follows the Level I Scoping Level ERA, Level II Screening ERA, and Level III Baseline ERA outlined in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008), with specific application of components from the *RVAAP Facility-Wide Ecological Risk Work Plan* (USACE 2003c) (herein referred to as the FWERWP), *Risk Assessment Handbook Volume II: Environmental Evaluation* (USACE 2010b), and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA 1997). The process implemented in this SC/FFS combines these guidance documents to meet requirements of the Ohio EPA and U.S. Army, while following previously accepted methods established for RVAAP. This unified approach resulted from coordination between USACE and Ohio EPA during the summer of 2011.

### 4.4.2 Scope and Objective

The Dump Along Paris-Windham Road contains habitat that supports ecological receptors. The habitat has known chemical contamination (USACE 2003c). Habitat types and an assessment of the ecological resources found at the Dump Along Paris-Windham Road are presented in subsequent sections. Additionally, the limited "RD/RA" confirmatory sample results (MKM 2004) are provided to determine whether a qualitative ERA (Level I) is sufficient, based on the quality of the habitat and the presence of contamination, or whether a more rigorous ERA (Level II or Level III) should be conducted.

### 4.4.3 Level I: Scoping Level Ecological Risk Assessment

The ERA method for Level I follows guidance documents listed in Section 4.4.1. Level I is intended to evaluate if the AOC had past releases or the potential for current contamination, and if there are important ecological resources on or near the AOC.

The following two questions should be answered at the completion of the Level I ERA:

**1. Are current or past releases suspected at the AOC?** Current or past releases are determined by evidence that chemical contaminants or chemicals of potential ecological concern (COPECs) are present.

**2. Are important ecological resources present at or in the locality of the AOC?** Important ecological resources are defined in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008) and *Technical Document for Ecological Risk Assessment: Process for Developing Management Goals* (BTAG 2005).

If an AOC has contaminants but lacks important ecological resources, the ERA process can stop at Level I. Contamination and important ecological resources must both be present to proceed to a Level II Screening Level ERA.

#### 4.4.3.1 AOC Description and Land Use

The Dump Along Paris-Windham Road is approximately 30 ft wide by 400 ft long or about 0.25 acres in size. There are two small wetlands at the AOC. The primary habitat is forest and is not large enough to completely support cover and food for small birds and mammals that typically require approximately 1 acre (USEPA 1993). The habitat area at the Dump Along Paris-Windham Road represents 0.001% of the 21,683 acres at RVAAP.

Activity on the AOC will consist of occasional foot traffic associated with minor maintenance activities (e.g., mowing and vegetation control) and road maintenance (e.g., mowing along the road berm and road surface repairs/patching). Activities could also include foot traffic by range control (because the AOC is in the SDZ) and wildlife and natural resource management activities. The

Representative Receptor for the Dump Along Paris-Windham Road is the Range Maintenance Soldier. The Adult and Juvenile Trespassers and Adult and Child Resident are also evaluated in the HHRA. U.S. Army natural and ecological resource management activities may apply if habitat disturbance occurs.

#### 4.4.3.2 Evidence of Chemical Contamination

Previous investigative activities at the Dump Along Paris-Windham Road include an RRSE in 1998, environmental sampling conducted by USACE, Louisville District in 2001, confirmatory sampling performed during the April 2003 limited "RD/RA," and biological and water quality sampling conducted in June 2003 (USACE 2005a).

The RRSE summarized in the *Relative Risk Site Evaluation for Newly Added Sites* (USACHPPM 1998) identified potential ecological receptors for exposure to surface soil and sediment contamination and assumed complete exposure pathways due to the AOC's proximity to Sand Creek. As a result, the RRSE score for this AOC was "High." The "High" score was prior to the limited "RD/RA" in April 2003.

In 2003, USACE, Louisville District prepared a *Decision Document for a Removal Action at Paris-Windham Road Dumpsite (RVAAP-51)* (USACE 2003a). According to the DD, USACE, Louisville District collected soil samples in 2001 to further characterize the AOC. The DD reported the principal contaminants detected during the 2001 sampling with potential impact to ecological receptors were cadmium, PCBs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene.

The confirmatory sampling performed during the April 2003 limited "RD/RA" is summarized in Section 3.0 and the *Final Report for Remedial Design/Remedial Action Plan at Paris-Windham Road Dump* (MKM 2004). The limited "RD/RA" was conducted in accordance with CERCLA to mitigate risks related to potential contact with exposed waste material. The limited "RD/RA" removal activities consisted of removing all existing surface debris and limited removal of subsurface debris. Approximately 300 tons of surface and subsurface debris were removed from the AOC (see Section 3.1.3).

Ohio EPA and USACE, Louisville District investigated several streams at RVAAP using a network of various biological/water quality sampling stations (USACE 2005a). The purpose of this investigation was to document ecological effects of AOCs on stream or pond biota and conditions. The biological/water quality sampling was conducted between June and September 2003 after the limited "RD/RA" and the associated confirmatory sampling but prior to any site restoration conducted in November 2003. The site restoration consisted of returning the excavation area to grade using a combination of clean hard fill and soil backfill from an Ohio EPA-approved source. The area was then seeded and mulched (see Section 3.1.3).

The goal of this ERA is to identify COPECs for the Dump Along Paris-Windham Road using available analytical data from the 2003 limited "RD/RA" confirmatory sampling. The screening level approach to evaluate limited "RD/RA" confirmatory sample results followed instructions presented in the *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2003) and consisted of the first two of six steps listed in Figure III of the FWERWP (USACE 2003c). These two steps identify the evaluation procedures, which were used to determine AOC-related COPECs. Section 3.2 of this SC/FFS details chemical concentration data. The limited "RD/RA" confirmatory sampling included collection of discrete surface soil (0-1 ft bgs) samples and ISM surface soil (0-1 ft bgs) samples. Discrete soil samples are used in the COPEC screening. In addition, one ISM soil sample from Grid 9 that was analyzed for SVOCs was used in the COPEC screening. These samples were collected from 0-1 ft bgs after the removal action and prior to the placement of the soil and vegetation cover.

The 2003 limited "RD/RA" did not differentiate wet or dry sediment. Therefore, as part of this SC/FFS, SAIC scientists conducted a field survey to determine the sediment type (wet or dry per RVAAP guidelines as explained in Section 1.1). Surface water occurs in the drainage swale on only an intermittent basis. During an August 2009 walkover/assessment, SAIC scientists noted the sediment in the drainage swale had high moisture content, but no standing water was observed. By contrast, SAIC scientists did observe standing water in the drainage swale in November 2011, following a rainfall event (see photographs in Appendix A). Based on the conditions of the AOC, sediment in the drainage swale is considered dry sediment because of the intermittent surface water. It is not considered permanent habitat for aquatic organisms. Therefore, dry sediment (0-1 ft bgs) is addressed as surface soil in terms of contaminant nature and extent, fate and transport, and risk exposure models. This approach is consistent with the FWCUG Report. For surface water, discrete samples collected during the limited "RD/RA" were used to evaluate the drainage swale (i.e., former stream channel) located along the western border of the AOC. Duplicate samples were used in this assessment. This ERA uses updated ecological screening values (ESVs) that follow the revised *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008), as provided in Appendix Tables C-1 and C-2.

In the first step of the COPEC screening process, the MDC of each chemical is compared to its respective facility-wide background concentration. Chemicals are not considered site-related if the MDC is below the background concentration. For all chemicals detected above background concentrations, the MDC is compared to the chemical-specific ESV. The hierarchy of screening values was based on the guidance included in the FWERWP and *Guidance for Conducting Ecological Risk Assessments* (Ohio EPA 2008). In addition to the ESV comparison, it was determined if the chemical is a persistent, bioaccumulative, and toxic (PBT) compound. Chemicals are retained as COPECs if they exceed background concentrations and the ESV, if the chemical exceeds background concentrations and had no toxicity information, or if the chemical is considered a PBT compound. Ratios of MDC to ESV are used to determine the COPECs that result from the limited "RD/RA" dataset. A ratio greater than 1 suggests a possible environmental consequence. Any chemicals with ratios greater than 1 are identified as COPECs.

Groundwater was not included in the ERA. As explained in Section 3.2.2 of the FWERWP, groundwater is not considered an exposure medium to ecological receptors.

The ERA tables for soil and surface water are included in Appendix Tables C-3, C-4, and C-5 and contain the following:

- Frequency of detection;
- MDC;
- Average results;
- Background concentrations;
- SRC determination;
- ESVs used for COPEC determinations;
- Ratio of MDC to ESV;
- PBT compound identification;
- COPEC determination; and
- COPEC rationale.

As discussed in Section 4.2.1, the soil within the geographic area of the Dump Along Paris-Windham Road was subdivided into three spatial aggregates: the Fill Area EU, the Surface Area EU (Figure 4-3), and the AOC-Wide EU. The Fill Area EU is located in the middle of the dump area [characterized by discrete sample locations PWss-005, PWss-006, PWss-007, PWss-008, and PWss-009 and ISM sample location PWss-CONT1 (associated with Grid 9)] and was excavated and covered with approximately 2 ft of clean fill. The Surface Area EU is in the northern and southern ends of the dump area [characterized by discrete sample locations PWss-001, PWss-002, PWss-003, PWss-004 (including a duplicate sample), and PWss-010] and the drainage swale [characterized by samples PWsd-001, PWsd-002, PWsd-003 (including a duplicate sample), PWsd-004, PWsd-005, and PWsd-006] and is located outside the excavation area. The AOC-Wide EU was not evaluated in the ERA because it consisted of only a single ISM sample. Rather, the ERA focused on the other two soil EUs that had discrete samples.

Intermittent surface water at the Dump Along Paris-Windham Road is limited to a long, narrow drainage swale downslope of the excavated dump area. The Surface Water EU includes all samples collected in the drainage swale (i.e., former stream channel) located along the western border of the AOC. These surface water samples were co-located with sediment samples that were later classified as soil and included in the Surface Area EU.

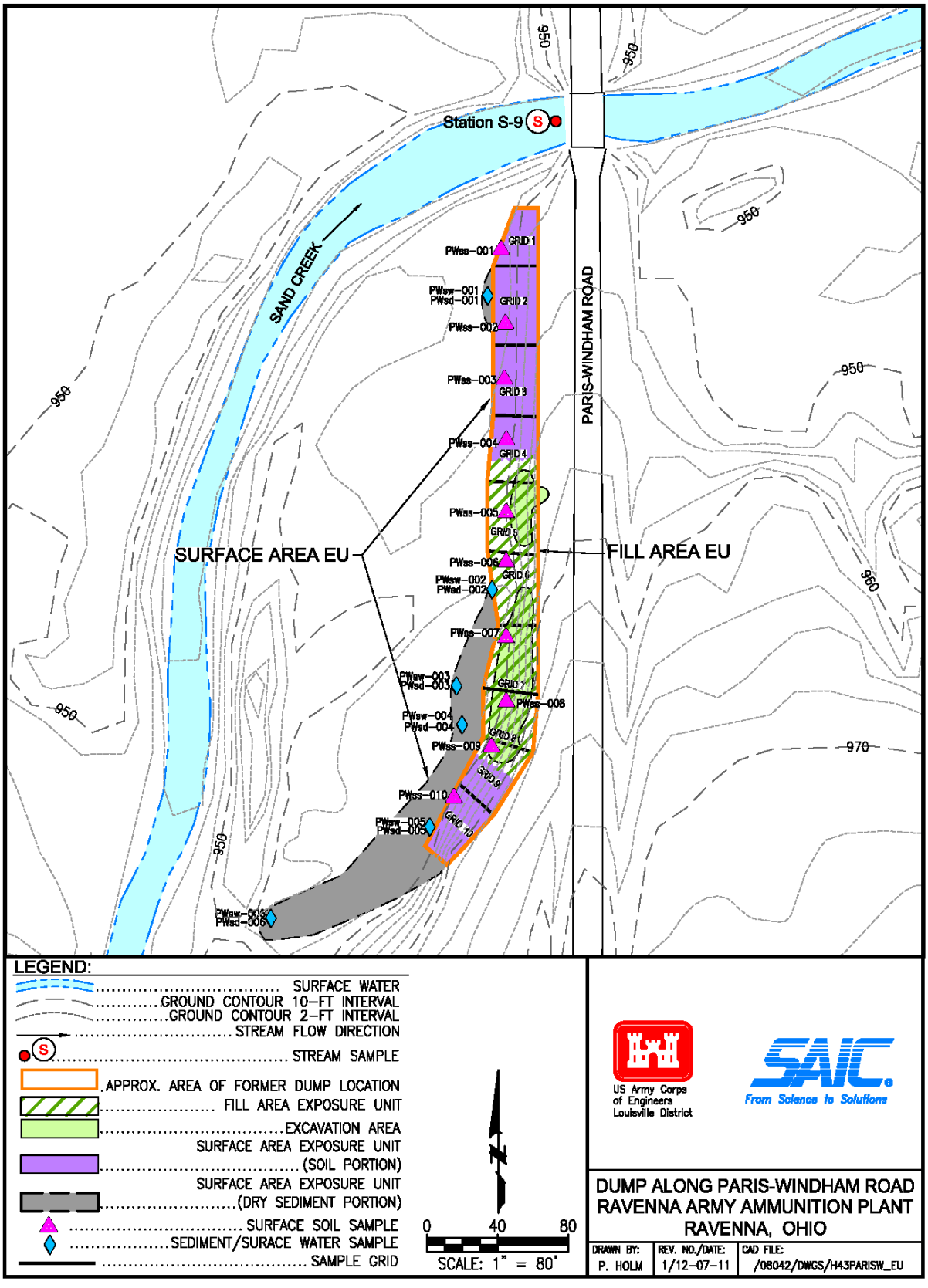



**Figure 4-3. Exposure Units at the Dump Along Paris-Windham Road**

**COPECs for Soil at the Fill Area EU.** Thirty-two chemicals were detected in surface soil at the Fill Area EU. Five chemicals (calcium, iron, magnesium, potassium, and sodium) were essential nutrients and were excluded as SRCs, as described in Section 3.2.1. Five inorganic chemicals and 14 organic chemicals were determined to be SRCs because they exceeded background concentrations, or they did not have an associated background concentration for comparison. Of the 19 SRCs, two inorganic chemicals (mercury and zinc) exceeded the ESVs and are identified as COPECs (Table 4-7). Mercury is also a PBT compound. Though it did not exceed its ESV, PCB-1254 was also identified as a COPEC because it is a PBT compound. The calculated ratio of MDC to ESV is shown in Table 4-7 for each COPEC. Appendix Table C-3 presents the details of the ESV comparisons for surface soil at the Fill Area EU.

**Table 4-7. Summary of COPECs for Surface Soil at the Fill Area EU**

| COPEC | MDC (mg/kg) | ESV (mg/kg) | Ratio of MDC to ESV | Comments |
|---|---|---|---|---|
| Mercury | 0.048 | 0.00051 | 94.1 | Highest ratio at 94x; PBT compound |
| Zinc | 100 | 46 | 2.2 | None |
| PCB-1254 | 0.23 | 0.371 | 0.62 | PBT compound |

Table excludes nutrients
-- = not applicable, no ESV is available for comparison
COPEC = Chemical of Potential Ecological Concern
ESV = Ecological Screening Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
PBT = Persistent, Bioaccumulative, and Toxic
PCB = Polychlorinated Biphenyl
x = multiplier

**COPECs for Soil at the Surface Area EU.** Thirty chemicals were detected in surface soil at the Surface Area EU. Five chemicals (calcium, iron, magnesium, potassium, and sodium) were essential nutrients and were excluded as SRCs, as described in Section 3.2.1. Eleven inorganic chemicals and 10 organic chemicals were determined to be SRCs because they either exceeded background concentrations or they did not have an associated background concentration for comparison. Of the 21 SRCs, six inorganic chemicals (aluminum, cadmium, lead, manganese, mercury, and zinc) exceeded the ESVs and are identified as COPECs (Table 4-8). Mercury is also a PBT compound. Though it did not exceed its ESV, PCB-1254 was also identified as a COPEC because it is a PBT compound. One organic chemical (nitrocellulose) was selected as a COPEC because it did not have an ESV. The calculated ratio of MDC to ESV is shown in Table 4-8 for each COPEC. Appendix Table C-4 presents the details of the ESV comparisons for surface soil at the Surface Area EU.

**Table 4-8. Summary of COPECs for Surface Soil at the Surface Area EU**

| COPEC | MDC (mg/kg) | ESV (mg/kg) | Ratio of MDC to ESV | Comments |
|---|---|---|---|---|
| Aluminum | 18,000 | 50 | 360 | Highest ratio at 360x |
| Cadmium | 0.59 | 0.36 | 1.6 | None |
| Lead | 29 | 11 | 2.6 | None |
| Manganese | 1,900 | 220 | 8.6 | None |
| Mercury | 0.08 | 0.00051 | 157 | Second highest ratio at 160x; PBT compound |
| Zinc | 120 | 46 | 2.6 | None |
| Nitrocellulose | 2 | No ESV | -- | None |
| PCB-1254 | 0.09 | 0.371 | 0.23 | PBT compound |

Table excludes nutrients
-- = not applicable, no ESV is available for comparison
COPEC = Chemical of Potential Ecological Concern
ESV = Ecological Screening Value
EU = Exposure Unit
MDC = Maximum Detected Concentration
PBT = Persistent, Bioaccumulative, and Toxic
PCB = Polychlorinated Biphenyl
x = multiplier

**COPECs for Sediment**. Sediment in the drainage swale is considered dry sediment because of the intermittent nature of the surface water. It is not considered permanent habitat for aquatic organisms. Therefore, dry sediment (0-1 ft bgs) is addressed as surface soil in the Surface Water EU.

**COPECs for Surface Water.** Seventeen chemicals were detected in surface water. Five chemicals (calcium, iron, magnesium, potassium, and sodium) were essential nutrients and were excluded as SRCs, as described in Section 3.2.1. Seven detected inorganic chemicals, and one organic chemical were determined to be SRCs because they either exceeded background concentrations or they did not have an associated background concentration for comparison. Of the nine SRCs, one inorganic chemical (manganese) exceeded its ESV and is identified as a COPEC (Table 4-9). In addition, nitrocellulose was selected as a COPEC because it does not have an ESV for comparison. Mercury did not exceed its ESV in surface water but is retained as a COPEC because it is a PBT compound. The calculated ratio of MDC to ESV is shown in Table 4-9 for each COPEC. Appendix Table C-5 presents the details of the ESV comparisons for surface water.

**Summary of ERA.** The ERA was performed using the limited "RD/RA" confirmatory sampling results to determine COPECs at the Dump Along Paris-Windham Road in surface soil and surface water. There are three surface soil COPECs identified in the ERA for the Fill Area EU: mercury, zinc, and PCB-1254. There are eight surface soil COPECs identified in the ERA for the Surface Area EU: aluminum, cadmium, lead, manganese, mercury, zinc, nitrocellulose, and PCB-1254. There are three surface water COPECs identified in the ERA: manganese, mercury, and nitrocellulose. Based on the identification of COPECs, ecological risk in surface soil and surface water was predicted.

**Table 4-9. Summary of COPECs for Surface Water**

| COPEC | MDC (mg/kg) | ESV (mg/kg) | Ratio of MDC to ESV | Comments |
|---|---|---|---|---|
| Manganese | 0.56 | 0.12 | 4.7 | Highest ratio at 5x |
| Mercury | 0.0001 | 0.0017 | 0.06 | PBT compound |
| Nitrocellulose | 0.094 | No ESV | -- | None |

Table excludes nutrients
-- = not applicable, no ESV is available for comparison
COPEC = Chemical of Potential Ecological Concern
ESV = Ecological Screening Value
MDC = Maximum Detected Concentration
PBT = Persistent, Bioaccumulative, and Toxic
x = multiplier

#### 4.4.3.3 Ecological Significance

Sources of data and information about the ecological resources at the Dump Along Paris-Windham Road include the *Integrated Natural Resource Management Plan* (INRMP) (OHARNG 2008a), *Facility-Wide Biological and Water Quality Study* (USACE 2005a), previous characterization work (USACHPPM 1998, USACE 2003a, and MKM 2004), and visits to the AOC conducted for the SC/FFS.

One of the two key questions to answer in the Level I Scoping Level ERA is whether there are ecologically important and especially ecologically significant resources at the Dump Along Paris-Windham Road. Ecological importance is defined as a place or resource that exhibits unique, special, or other attributes that makes it of great value. Ecological significance is defined as an important resource found at an AOC or in its vicinity that is subject to contaminant exposure. The underlying basis for this distinction can be found in *Ecological Significance and Selection of Candidate Assessment Endpoints* (USEPA 1996), stated as follows:

> "A critical element in the ERA process requires distinguishing important environmental responses to chemical releases from those that are inconsequential to the ecosystem in which the site resides: in other words, determining the ecological significance of past, current, or projected site-related effects."

Important places and resources identified by the U.S. Army and Ohio EPA (Appendix Table C-6) include wetlands, terrestrial areas used for breeding by large or dense aggregations of animals, habitat known to be used by threatened or endangered species, state land designated for wildlife or game management, locally important ecological places, and state parks. Both the U.S. Army and Ohio EPA recognize 17 important places and resources. The U.S. Army recognizes an additional 16 important places (BTAG 2005), and the Ohio EPA recognizes another 6 important places (Ohio EPA 2008). In total, there are 39 important places. Presence or absence of an ecologically important place can be determined by comparing environmental facts and characteristics of the Dump Along Paris-Windham Road with each of the important places and resources listed in Appendix Table C-6.

Ecological significance is defined as an important resource found at an AOC or in its vicinity that is subject to contaminant exposure. Thus, important places and resources listed in Appendix Table C-6 are elevated to ecologically significant when present on the AOC and there is exposure to contaminants. For all 39 important places and resources, it is relatively clear the ecological place or resource is present or absent on the AOC; therefore, the decision process is objective. If no important or significant resource is present at an AOC, the evaluation will not proceed to Level II regardless of the presence of contamination. Instead, the Level I Scoping Level ERA would acknowledge there are important ecological places but that those resources are not ecologically significant, and no further evaluation is required.

**Management Goals for the AOC.** Regardless of whether the evaluation is concluded at Level I or continues to Level II, there is another level of environmental protection for the Dump Along Paris-Windham Road through the natural resource management goals expressed in the INRMP (OHARNG 2008a). The U.S. Army is required to monitor ecological conditions to maintain or enhance the facility's natural resources and ecosystem. While the monitoring focuses on the potential adverse effects from training activities, degradation from contamination would be noticed as well.

Some Natural Resources Management Goals of OHARNG (listed in Appendix Table C-7) benefit the Dump Along Paris-Windham Road. For example, Goal 1 states natural resources need to be managed in a compatible way with the military mission, and Goal 5 requires the U.S. Army to sustain usable training lands and native natural resources by implementing a natural resource management plan which incorporates invasive species management and by utilizing native species mixes for revegetation after ground disturbance activities. These management goals help detect degradation (whether from training activities or historical contamination). While the applicability of the remaining nine management goals to the Dump Along Paris-Windham Road varies, all of the management goals are intended to monitor, maintain, or enhance the RVAAP natural resources and ecosystem. While these goals are for the management of all types of resources at and near the Dump Along Paris-Windham Road, they do not affect the decisions concerning the presence or absence of important or significant ecological places or resources there.

**Important Places and Resources**. Ecological importance means a place or resource that exhibits a unique, special, or other attribute that makes it of great value. Examples of important places and resources include wetlands, terrestrial areas used for breeding by large or dense aggregations of animals, and habitat of state-listed or federally-listed species. An important resource becomes significant when found on an AOC and there is contaminant exposure.

As noted in Appendix Table C-6, a small portion (0.04 acres) of wetlands is within the AOC. The wetland is an important ecological resource at the AOC. The wetlands are discussed in greater detail later in this section.

**Terrestrial Resources.** The Dump Along Paris-Windham Road is dominated by terrestrial resources.

***Habitat Descriptions and Species.*** The INRMP and AOC visits by SAIC scientists indicated the habitat in the immediate vicinity of the Dump Along Paris-Windham Road contains two types of vegetation (Figure 4-4). The dominant vegetation is a temporarily flooded forest alliance of green ash (*Fraxinus pennsylvanica),* American elm (*Ulmus americana)*, and hackberry *(Celtis occidentalis* and *laevigata)* (Photographs 4-1 and 4-2). One other forest alliance consisting of American beech (*Fagus grandifolia*), oak (*Quercus* Spp.), and maple (*Acer* spp.) is found along the southeast border of the AOC. This characterization was originally established by a vegetation study using aerial photography and field verification (USACE 1999) and was later used in the INRMP (OHARNG 2008a).

During a field survey conducted at the Dump Along Paris-Windham Road in August 2009, SAIC scientists confirmed the main habitat type: green ash (*Fraxinus pennsylvanica)*/American elm (*Ulmus americana)/*hackberry *(Celtis occidentalis* and *laevigata)* temporarily flooded forest alliance.

The green ash (*Fraxinus pennsylvanica)*/American elm (*Ulmus americana)/*hackberry *(Celtis occidentalis* and *laevigata)* temporarily flooded forest alliance and the American beech (*Fagus grandifolia*)/oak (*Quercus* Spp.)/maple (*Acer* spp.) forest alliance includes small open areas and understory that results in multi-story vegetation (Photographs 4-1 and 4-2), providing layers of vegetation for various foraging height preferences of birds, mammals, insects, and other organisms.

Based on August 2009 and November 2011 observations (Photographs 4-1 and 4-2 and Appendix A), SAIC scientists assessed the habitat at the Dump Along Paris-Windham Road to be healthy and functioning. Functional habitat was determined by noting the absence of large bare spots and dead vegetation or other obvious visual signs of an unhealthy ecosystem. Some vegetation was removed during the limited "RD/RA;" however, the AOC walkover conducted by SAIC scientists in August 2009 and November 2011 showed vegetative recovery has occurred since the limited "RD/RA" in 2003. Appendix A provides photographs of current conditions at the AOC and the state of vegetative recovery observed during the AOC walkovers.

***Threatened and Endangered and Other State-listed or Federally-listed Species.*** There are currently no federally-listed species or critical habitat on Camp Ravenna. The Dump Along Paris-Windham Road has not been previously surveyed for rare species; however, there have been no documented sightings of state-listed, federally-listed, threatened, or endangered species at the AOC (OHARNG 2008a).

***Other Terrestrial Resources.*** While there are no other known important terrestrial places and resources (Appendix Table C-6), there are other resources at or near the Dump Along Paris-Windham Road (e.g., vegetation, animals) that interact in their ecosystems and support nutrient cycling and energy flow. For example, wildlife such as wild turkey (*Meleagris gallopavo*) and white-tailed deer (*Odocoileus virginianus*) could use the area. Also, it is possible that burrowing animals could be exposed to soil at depths greater than 1 ft. The INRMP provides information about species and habitat surveys at RVAAP (e.g., timber and ecological succession) (OHARNG 2008a). There are no other reported surveys of habitats and wildlife at the Dump Along Paris-Windham Road beyond those summarized in the INRMP (OHARNG 2008a).

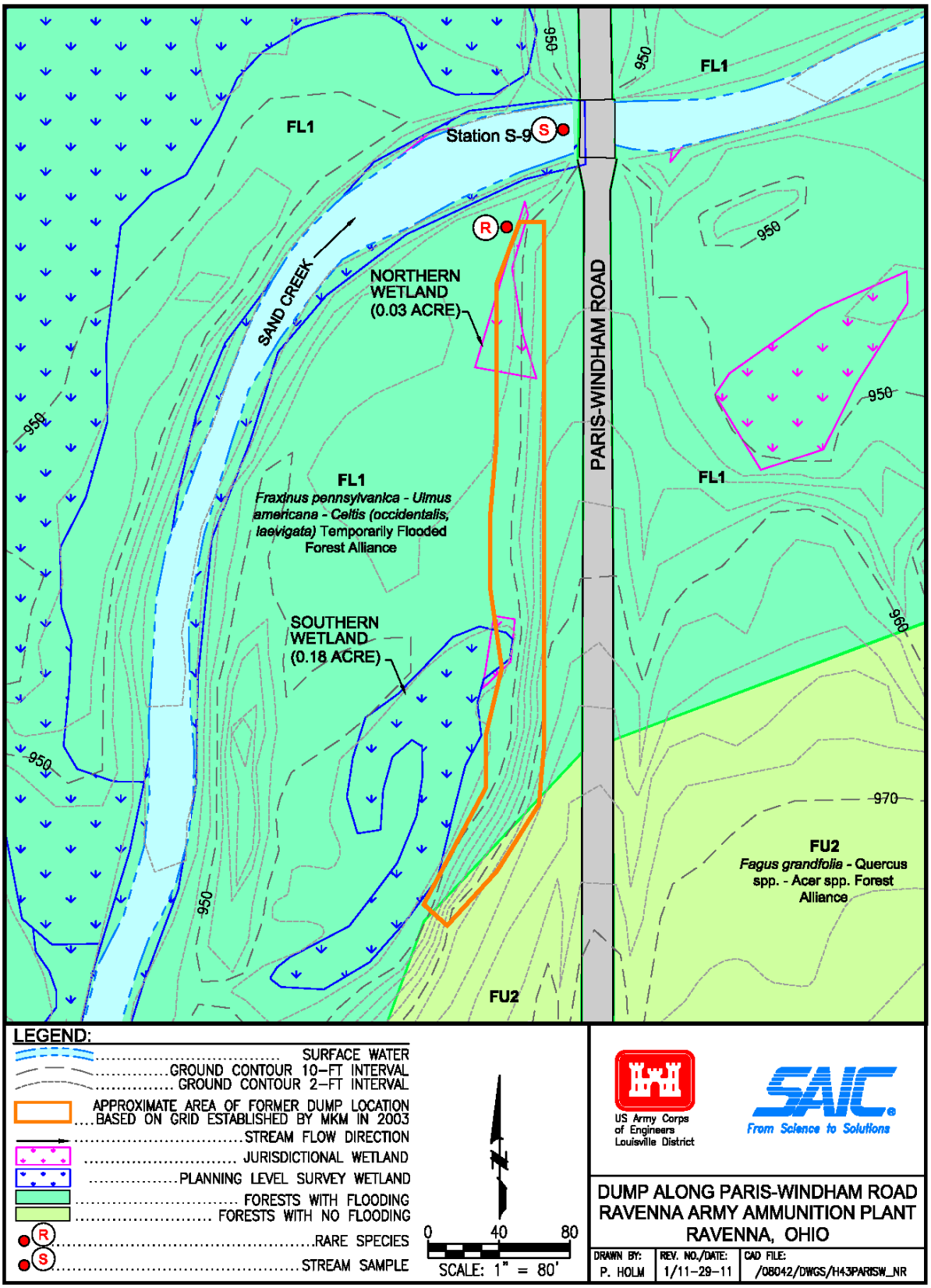



**Figure 4-4. Natural Resources (OHARNG 2008) Inside and Near Habitat Area at the Dump Along Paris-Windham Road**

**Photograph 4-1. Looking South along Paris-Windham Road; Green Ash, American Elm, and Hackberry Temporary Flooded Forest Alliance in Background (August 2009)**

**Photograph 4-2. Drainage Swale with no Standing Water Along the Northwest Portion of the AOC; Green Ash, American Elm, and Hackberry Temporary Flooded Forest Alliance in Background (August 2009)**

**Aquatic Resources**. The Dump Along Paris-Windham Road has one type of aquatic resource, as described below.

***Habitat Descriptions and Species.*** Wetlands exist in the small area in the northern portion of the AOC and within the drainage swale immediately adjacent to the southern portion of the AOC (Figure 4-4).

***Wetlands.*** Wetlands are important habitats with water-saturated soil or sediment whose plant life can survive saturation. Wetlands are home to many different species and are also chemical sinks that can serve as detoxifiers and natural water purifiers. It is expected that the wetlands/drainage swale at the Dump Along Paris-Windham Road (Figure 4-4) perform these and other related functions.

In November 2011, an SAIC Professional Wetland Scientist used the Ohio Rapid Assessment Method (ORAM) (Ohio EPA 2001) to assess the condition and ecological importance of the wetlands. The wetlands are located on the western side of the AOC, with one in the northern portion of the AOC and the other in the southern portion of the AOC. The wetlands at the Dump Along Paris-Windham Road consist of two small wetlands (designated northern and southern wetlands) and were evaluated together because they are within 140 ft of each other and part of the same landform. Using the ORAM, wetlands are classified into three categories:

- Category 1 wetlands are described as "limited quality waters." They are considered to be a resource that has been degraded, has limited potential for restoration, or is of such low functionality that lower standards for avoidance, minimization, and mitigation can be applied. Scores range from 1 to 29.

- Category 2 includes wetlands of moderate quality and wetlands that are degraded but exhibit reasonable potential for restoration. Scores range from 30 to 59.

- Category 3 includes wetlands of very high quality and wetlands of concern regionally and/or statewide, such as wetlands that provide habitat for species listed as threatened or endangered. Scores range from 60 to 100.

The field sheet detailing the ORAM is presented in Appendix Figure C-1. Figure 4-4 shows the location of the evaluated wetlands with jurisdictional and planning level survey wetlands [i.e., based on desktop surveys conducted for the OHARNG of wetlands data and resources (i.e., NWI maps, aerials)] within the vicinity. Based on the ORAM, the wetlands at the Dump Along Paris-Windham Road are classified as Category 2 (with a score of 37), indicating a moderate wetland quality with some degradation of wetland functions and conditions (Appendix Figure C-1).

Dominant vegetation near the wetlands is forest habitat that has developed since the modifications to Sand Creek and the dumping at the AOC. The northern wetland covers 0.03 acres and lies almost entirely within the AOC. The southern wetland covers 0.18 acres, with 0.01 acres of the wetland inside the AOC. The combined area of the northern and southern wetlands is 0.21 acres. The two

small wetlands associated with the Dump Along Paris-Windham Road appear to be relic floodplain features. The wetlands may be former overflow channels on the Sand Creek floodplain, or they may represent an original channel of Sand Creek prior to dredging and channelization by the U.S. Army. Both wetlands have been mostly disconnected from Sand Creek by a large berm on the right bank that was apparently created during channelization of the creek. Wetland hydrology is largely dependent on precipitation, with secondary inputs from high flows in Sand Creek.

Because there is contamination within the Dump Along Paris-Windham Road, further contaminant analysis was conducted to determine if the contamination is at a level of concern to ecological receptors in the wetlands.

Eight COPECs [six inorganic chemicals (aluminum, cadmium, lead, manganese, mercury, and zinc) and two organic chemicals (nitrocellulose and PCB-1254)] were identified at the Surface Area EU (Table 4-8), which included dry sediment samples in the wetland/drainage swale area (Section 4.4.3.2). Three COPECs (manganese, mercury, and nitrocellulose) were identified in surface water (Table 4-9). To determine if the dry sediment and surface water COPECs were impacting the wetlands, the concentrations of COPECs in the seven dry sediment and surface water samples (PWsd/sw-001, PWsd/sw-002, PWsd/sw-003, PWsd/sw-003(duplicate), PWsd/sw-004, PWsd/sw-005, and PWsd/sw-006) were assessed (Table 4-10).

The results are as follows:

- Manganese was detected below its ESV in the seven dry sediment samples. Although concentrations of manganese exceeded its ESV in all seven surface water samples collected in or around the wetlands, the ESV was below the RVAAP background concentration. Therefore, this ESV is judged to be conservative. When the average concentration of manganese (0.38 mg/L) from the seven surface water samples is compared to the RVAAP background concentration (0.391 mg/L), the average concentration of manganese is less than its background concentration. This suggests manganese is not present in dry sediment and surface water at concentrations of concern for ecological receptors in the wetlands.

- Although the maximum concentrations of aluminum (9,900 mg/kg) and lead (25 mg/kg) in dry sediment exceeded their ESVs (50 mg/kg and 11 mg/kg, respectively), aluminum and lead were not detected above their background concentrations (17,700 mg/kg and 26.1 mg/kg, respectively) in any of the dry sediment samples. As a result, these inorganic chemicals are not present at concentrations of concern for ecological receptors in the wetlands.

- Although cadmium (0.59 mg/kg) exceeded its ESV (0.36 mg/kg) in one of the seven dry sediment samples (PWsd-002), this concentration is slightly above its respective ESV. Cadmium was not detected in the remaining six dry sediment samples. In surface soil and surface water samples, cadmium is not detected above its ESV. As a result, cadmium is not present at concentrations of concern for ecological receptors in the wetlands.

- Although concentrations of mercury and zinc exceeded their ESVs in all seven dry sediment samples, the ESVs were below the RVAAP background concentrations. Therefore, these ESVs are judged to be conservative. When the average concentrations of mercury (0.066 mg/kg) and zinc (92 mg/kg) from the seven dry sediment samples are compared to the RVAAP background concentrations (0.036 mg/kg and 61.8 mg/kg, respectively), the average concentrations of these samples are similar to their background concentrations. This suggests these inorganic chemicals are not present at concentrations of concern for ecological receptors in the wetlands. Mercury is a COPEC for surface water because it is a PBT compound; however, is not likely a concern for ecological receptors in the wetlands because concentrations do not exceed the ESV, and bioaccumulation in higher trophic levels is assumed to be considered in development of the ESV per Ohio Administrative Code (OAC) 3745-1-37.

- Nitrocellulose in dry sediment and surface water is essentially non-toxic to wildlife (USEPA 1987) and is not a concern for ecological receptors.

- PCB-1254 was identified as a COPEC because it is a PBT compound. PCB-1254 was analyzed in only one dry sediment sample (PWsd-004) in the southern wetland and was detected at a concentration (0.086 mg/kg) below the ESV for total PCBs (0.371 mg/kg). PCB-1254 was analyzed in one surface soil sample (PWss-009) and was also detected at a concentration (0.23 mg/kg) below the ESV for total PCBs (0.371 mg/kg). While PCB-1254 is a PBT compound, it is not likely a concern for ecological receptors in the wetlands because concentrations do not exceed the ESV and bioaccumulation in higher trophic levels is considered in development of the ESV (DOE 1997).

In summary, although contamination is present in dry sediment and surface water samples, review of the data suggests that any migration of contamination from the AOC to the wetlands/drainage swale along the western boundary has not resulted in concentrations of concern to ecological receptors. As a result, although the wetlands are an important place, they are not ecologically significant with respect to the contamination at the Surface Area EU.

**Table 4-10. Summary of COPEC Concentrations for Dry Sediment and Surface Water at and in the Vicinity of the Dump Along Paris-Windham Road**

| COPEC | Units | Background Concentration | ESV | Sampling Stations | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PWsd/sw-001 | PWsd/sw-002 | PWsd/sw-003 | PWsd/sw-003 (Duplicate) | PWsd/sw-004 | PWsd/sw-005 | PWsd/sw-006 |
| ***Dry Sediment*** | | | | | | | | | | |
| Aluminum | mg/kg | 17,700 | 50 | 8,000 | 9,000 | 7,100 | 7,400 | 8,400 | 9,900 | 7,600 |
| Cadmium | mg/kg | 0 | 0.36 | ND | **0.59** | ND | ND | ND | ND | ND |
| Lead | mg/kg | 26.1 | 11 | 19 | 25 | 19 | 18 | 18 | 16 | 20 |
| Manganese | mg/kg | 1,450 | 220 | 99 | 150 | 97 | 95 | 120 | 100 | 150 |
| Mercury | mg/kg | 0.036 | 0.00051 | **0.059** | **0.08** | **0.058** | **0.069** | **0.073** | **0.077** | **0.05** |
| Zinc | mg/kg | 61.8 | 46 | **81** | **120** | **75** | **73** | **88** | **99** | **90** |
| Nitrocellulose | mg/kg | No BKG | No ESV | NR | NR | NR | NR | **2** | NR | NR |
| PCB-1254 | mg/kg | No BKG | No ESV | NR | NR | NR | NR | **0.086** | NR | NR |
| ***Surface Water*** | | | | | | | | | | |
| Manganese | mg/L | 0.391 | 0.12 | 0.32 | 0.27 | 0.26 | 0.26 | **0.51** | **0.47** | **0.56** |
| Mercury | mg/L | No BKG | 0.0017 | 0.0007 | 0.00009 | 0.00009 | 0.000091 | ND | 0.0001 | 0.00008 |
| Nitrocellulose | mg/L | No BKG | No ESV | NR | NR | NR | NR | **0.094** | NR | NR |

Background concentrations for surface soil (0-1 ft bgs) and surface water is from the final facility-wide background concentrations for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001b).
COPEC = Chemical of Potential Ecological Concern
ESV = Ecological Screening Value
ND = Not Detected
No BKG = A background concentration does not exist for the specified chemical
NR = Not reported
PCB = Polychlorinated Biphenyl
**Bold** = Concentration exceeds the background concentration and the ESV

***Threatened and Endangered and Other State-listed or Federally-listed Species.*** There are currently no federally listed species or critical habitat on Camp Ravenna. The Dump Along Paris-Windham Road has not been previously surveyed for rare species; however, there have been no documented sightings of rare, threatened or endangered species at the AOC (OHARNG 2008a).

***Other Aquatic Resources.*** There are no other known aquatic resources (Appendix Table C-6) at or near the Dump Along Paris-Windham Road (e.g., vegetation, animals). There are no other reported surveys of habitats and wildlife at the Dump Along Paris-Windham Road beyond those summarized in the INRMP (OHARNG 2008a). There are two nearby biological and water quality stations. The following subsections provide a summary of the biological and water quality stations in the vicinity of the Dump Along Paris-Windham Road.

***Biological/Water Quality Sampling Stations.*** Ohio EPA and USACE, Louisville District investigated several streams at RVAAP in a network of various biological/water quality sampling stations (USACE 2005a). The purpose of this investigation was to document ecological effects of AOCs on stream or pond biota and conditions. Two sampling stations were located in the vicinity of the Dump Along Paris-Windham Road. Station S-7 was located upstream of the AOC, and station S-9 was located downstream of the AOC. The upstream biological/water quality station (S-7) provides information regarding potential contamination from upstream AOCs and if upstream AOCs may be contributing to adverse biological, chemical, and physical measurements in the vicinity of the Dump Along Paris-Windham Road. The downstream sampling station (S-9) provides information about potential contamination from the Dump Along Paris-Windham Road and upstream AOCs. If the downstream sampling station has a positive rating (e.g., good, excellent, full attainment, and other positive terms reported in the study), it means that the Dump Along Paris-Windham Road and other upstream AOCs are not adversely impacting the quality of Sand Creek.

According to the *Facility-Wide Biological and Water Quality Study* (USACE 2005a), each sampling location included sediment sampling/assessment, surface water sampling/assessment, fish and macroinvertebrate community assessment, and habitat assessment. The sampling reach for stream sampling stations ranged 120-210 meters.

Sediment evaluations were conducted in June 2003 using guidelines established in *Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald et al. 2000), sediment reference values (SRVs) for inorganic chemicals (Ohio EPA 2003), and USEPA Region 5 Ecological Screening Levels (ESLs) (USEPA 2003). Sediment samples were analyzed for SVOCs, pesticides, PCBs, TAL metals, explosives, percent solids, cyanide, ammonia, nitrate, and phosphorus. Surface water grab samples collected in June and September 2003 were evaluated using Ohio Water Quality Standards (WQS) criteria, reference conditions, or the *Facility-wide Biological and Water Quality Study*. Surface water samples were analyzed for TAL metals, pesticides, PCBs, explosives, SVOCs, and several nutrients.

Fish and macroinvertebrate sampling and assessments occurred in August and September 2003. Fish were sampled using electrofishing methods. Macroinvertebrate communities were assessed using

artificial substrates (quantitative sampling), supplemented with a composite natural substrate (qualitative sampling). Both the fish and macroinvertebrate community assessments followed the methods in the *Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities* (Ohio EPA 1989).

The physical habitat assessment was conducted in June 2003 and used the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA (Rankin 1989, 1995). The types(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, riffle development and quality, and gradient are some of the habitat characteristics used to determine the QHEI score.

*Sampling Station Locations.* Station S-7 (RM 2.4) is located on Sand Creek approximately 1,900 ft upstream from the Dump Along Paris-Windham Road and provides the closest upstream reference point for the AOC. Station S-9 (RM 1.9) is located on Sand Creek at Paris-Windham Road. The station is immediately downstream from the Dump Along Paris-Windham Road and provides the closest downstream sampling point to the AOC.

*Summary of Sampling/Assessment Results.* Table 4-11 shows the ratings of the attributes for sampling stations S-7 and S-9. Review of the *Facility-Wide Biological and Water Quality Study* (USACE 2005a) data from the two stations showed many positive attribute ratings (e.g., good, excellent, full attainment) and little to no sign of aquatic impairment. Each station was rated at Full Use Attainment Status, which indicated all indices met the Ohio EPA biological criteria.

At S-7, all inorganic chemicals tested in sediment were below Ohio SRVs and threshold effects concentration (TEC) levels. All tested explosives, pesticides, and PCBs were not detected in sediment samples collected from S-7. The few SVOCs were measured at low levels, with all concentrations below TEC or ESL guidelines. Ammonia and total phosphorus levels were measured below screening guidelines. None of the surface water chemical concentrations at S-7 exceeded Ohio WQS aquatic life maximum or average water quality criteria, and none of the chemicals measured exceeded criteria protective of the Warm Water Habitat (WWH) aquatic life use (USACE 2005a). Overall, the sediment quality and water quality at S-7 was rated "excellent." The fish community at S-7 was rated "marginally good." The index of biotic integrity (IBI) score was 36, and 15 species were reported. The macroinvertebrate community at S-7 was rated "exceptional." Based on the fish and macroinvertebrate community assessment, no biological impairment associated with chemical contaminants was observed at S-7. The physical habitat was also evaluated at S-7, and the QHEI score was 70, indicating "good" stream habitat capable of supporting WWH biological communities.

At S-9, all inorganic chemicals tested in sediment were below Ohio SRVs and TEC levels. All tested explosives, pesticides, and PCBs were not detected in sediment samples collected from S-9. The few SVOCs were measured at low levels, with all concentrations below TEC or ESL guidelines. Ammonia and total phosphorus levels were measured below screening guidelines. None of the surface water chemical concentrations at S-9 exceeded Ohio WQS aquatic life maximum or average

water quality criteria, and none of the chemicals measured exceeded criteria protective of the WWH aquatic life use (USACE 2005a). Overall, the sediment quality and water quality at S-9 was rated "excellent." The fish community at S-9 was rated "good." The IBI score was 43, and 19 species were reported. The macroinvertebrate community at S-9 was rated "exceptional." Based on the assessment attributes, low body burdens to fish and macroinvertebrates would be expected, given the positive conditions in the fish and macroinvertebrate communities. High fecundity and other measures of reproductive success would also be expected. The physical habitat was also evaluated at S-9, and the QHEI score was 71.5, indicating "good" stream habitat capable of supporting WWH biological communities. These favorable sediment/water quality findings at S-9 support the observation that the Dump Along Paris-Windham Road is not contributing contamination to Sand Creek.

**Table 4-11. Comparison of Five Assessment Techniques at Sampling Stations Near the Dump Along Paris-Windham Road**

| Attributes | S-7 (RM 2.4) (upstream) | S-9 (RM 1.9) (downstream) | Comments |
|---|---|---|---|
| Sediment quality | Excellent | Excellent | Downstream station rating is equivalent to upstream station, suggesting no negative impacts from the AOC. |
| Water quality | Excellent | Excellent | Downstream station rating is equivalent to upstream station, suggesting no negative impacts from the AOC. |
| Fish community (IBI)[a] | Marginally Good | Good | Downstream station rating is slightly better to upstream station, suggesting no negative impacts from the AOC. |
| Macroinvertebrate community (ICI)[b] | Exceptional | Exceptional | Downstream station rating is equivalent to upstream station, suggesting no negative impacts from the AOC. |
| Habitat (QHEI)[c] | Good | Good | Downstream station rating is equivalent to upstream station, suggesting no negative impacts from the AOC. |
| Use Attainment Status[d] | Full | Full | Downstream station rating is equivalent to upstream station, suggesting no negative impacts from the AOC. |

[a]Fish communities range from 0-60, with <18 being "very poor," 18-27 being "poor," 28-35 being "fair," 36-39 being "marginally good,",40-45 being "good," 46-49 being "very good," and 50-60 being "excellent" (Ohio EPA 2009).
[b]Macroinvertebrate communities range from 0-60 with <2 being "very poor," 2-12 being "poor," 14-32 being "fair," 34-46 being "good," and 48-60 being "exceptional" (Ohio EPA 1988).
[c]Habitat ranges from 30 to <100 with <30 being "very poor," 30-44 being "poor," 45-59 being "fair," 60-74 being "good," and 75-100 being "excellent" (Ohio EPA 2009).
[d]Full-attainment means all of the applicable indices meet the Ohio EPA biocriteria (USACE 2005a).
AOC = Area of Concern
IBI = Index of Biotic Integrity
ICI = Invertebrate Community Index
Ohio EPA = Ohio Environmental Protection Agency
QHEI = Qualitative Habitat Evaluation Index
RM = River Mile

**Ecosystem and Landscape Roles and Relationships.** There are four spatial areas evaluated to assess the ecosystem and landscape roles and relationships: the AOC, the vicinity of the AOC, the

entire RVAAP, and the northeastern or ecoregion of Ohio. Information about the first spatial area (the AOC) was provided in the subsections above on terrestrial and aquatic resources.

***Vicinity of the AOC.*** Two vegetation communities border the Dump Along Paris-Windham Road (Figure 4-4): the green ash (*Fraxinus pennsylvanica)*/American elm (*Ulmus americana)*/hackberry *(Celtis occidentalis* and *laevigata)* temporary flooded forest alliance and the American beech (*Fagus grandifolia*)/oak (*Quercus* spp.)/and maple (*Acer* spp.) forest alliance. The AOCs bordering vegetation communities are similar to those observed at Dump Along Paris-Windham Road; there are no apparent differences in habitat quality of these plant communities inside or outside of the AOC. The types and qualities of habitat are not unique and can be found at many other areas at RVAAP. Figure 4-4 shows there are two wetlands along the western border of the AOC. Other wetlands are located to the west along the drainage swale (i.e., former stream channel), west along Sand Creek, and east of Paris-Windham Road. No perennial surface water features exist in the AOC boundary; however, Sand Creek is located 100-170 ft west of the AOC (Figure 4-4).

The closest recorded state-listed or federally-listed species [butternut (*Juglans cinerea*)] was located approximately 5 ft west of the northwestern border of the AOC (Table 4-12) (OHARNG 2008a); it is a state potentially threatened plant. The next closest recorded state-listed or federally-listed species [yellow-bellied sapsucker (*Sphyrapicus varius*)] was previously sighted about 500 ft southwest of the AOC; it is a state endangered species.

No beaver dams are in or near the AOC. There is a 100-year floodplain to Sand Creek located approximately 40 ft west of the AOC boundary, and there is a biological and water quality station (stream sampling station) within 60 ft of the AOC.

**Table 4-12. Survey of Proximity to the AOC of Various Ecological Resources**

| Natural Resource | Inside Habitat Area | Near the AOC | Distances to Nearest Resource[a] and Comments |
|---|---|---|---|
| Wetlands (Planning Level Survey and Jurisdictional) | Two small jurisdictional wetlands | West along the drainage swale, west along Sand Creek, and east of Paris-Windham Road | Others in vicinity (Figure 4-4) |
| State-listed or Federally-listed Species | No known sightings | Along western border | 5 ft west<br>500 ft southwest<br>See text for species names |
| Beaver dams | None | None | 1,600 ft north<br>1,700 ft north |
| 100-year floodplain | None | Sand Creek floodplain located 40 ft to the west | 100-year floodplain to Sand Creek located 40 ft west of the AOC |
| Stream sampling[b] | None | Sampling location (S-9) is located 60 ft north | An additional stream sampling location (S-7) is located approximately 1,900 ft upstream of the AOC |
| Pond sampling[b] | None | None | Nearest pond station at Cobbs Ponds about 2,000 ft south |

[a] Measurements of distance and direction are taken from the nearest boundary of the AOC to the resource being measured
[b] Stream and pond sampling refers to *Facility-Wide Biological and Water Quality Study 2003* (USACE 2005a)
AOC = Area of Concern

***The Entire RVAAP.*** The Dump Along Paris-Windham Road is approximately 0.25 acres in size, which represents 0.001% of the total area of RVAAP (21,683 acres). There are approximately 2,310 acres of forest type FL1 [temporarily flooded cold-deciduous forest alliance (e.g., green ash and American elm)] at RVAAP, based on the INRMP map (OHARNG 2008a); this represents 10.7% of the habitat at RVAAP. There are approximately 2,290 acres of forest type FU2 (American beech, oak, maple) (OHARNG 2008a), representing 10.6% of the habitat at RVAAP. There are approximately 1,990 acres of wetlands (jurisdictional and planning level survey) as defined in the INRMP (OHARNG 2008a), representing 9% of the habitat at RVAAP. These types of resources are abundant and are not unique to the Dump Along Paris-Windham Road at RVAAP.

***Ecoregion.*** In the area surrounding RVAAP, forests occupy a high percentage of the terrain. Ohio's forests cover approximately 8,000,000 acres or 30% of the state (USDA 2009). The Erie/Ontario Drift and Lake Plain ecoregion (USEPA 2011) is located in the northeastern part of Ohio, and both contain the communities of temporarily flooded, cold-deciduous forest alliance (e.g., green ash and American elm) and American beech/oak/maple forest alliance. The Erie/Ontario Drift and Lake Plain ecoregion exhibits rolling to level terrain formed by lacustrine and low lime drift deposits. Lakes, wetlands, and swampy streams occur where stream networks converge or where the land is flat and clayey (USEPA 2011). The United States Forest Service (USFS) has a Forest Inventory Data Online tool that was queried for the forest types in the surrounding counties in or near RVAAP (USFS 2011). In 2009, approximately 93,900 acres of forest type FL1 and 621,100 acres of forest type FU2 were found throughout northwestern Ohio in Cuyahoga, Geauga, Mahoning, Portage, Stark, Summit, and Trumbull counties that surround RVAAP (USFS 2011). Wetlands across the ecoregion make up 207,800 acres (USEPA 1999). The vegetation communities and wetlands at the Dump Along Paris-Windham Road are also found in the surrounding counties in the ecoregion of northeastern Ohio.

In summary, the current vegetation types of temporarily flooded, cold-deciduous forest alliance (e.g., green ash and American elm); the American beech/oak/maple forest alliance; and wetlands are found in the vicinity of the Dump Along Paris-Windham Road. The two forest types and wetlands are in abundance at RVAAP and the larger surrounding local ecoregion. There is no known unique resource at the Dump Along Paris-Windham Road that cannot be found in the immediate vicinity of the AOC, RVAAP, and in the large part of the ecoregion of northeastern Ohio.

#### 4.4.3.4 Evaluation of Chemical Contamination and Ecological Significance

There are three surface soil COPECs identified in the ERA for the Fill Area EU: mercury, zinc, and PCB-1254. There are eight surface soil COPECs identified in the ERA for the Surface Area EU: aluminum, cadmium, lead, manganese, mercury, zinc, nitrocellulose, and PCB-1254. There are three surface water COPECs identified in the ERA: manganese, mercury, and nitrocellulose (Section 4.4.3.2).

Section 4.4.3.3 provides information about presence of important ecological resources and the lack of significant ecological resources at the AOC. Approximately 0.25 acres of forest habitat exists within the boundaries of the Dump Along Paris-Windham Road. The current forest community consists

primarily of green ash, American elm, and hackberry. Small wetlands are found at the western boundary of the AOC along a drainage swale. The entire extent of the wetlands is 0.21 acres; however, only 0.04 acres of the wetlands lie within the AOC boundary. Although the wetlands are an important resource, they are not a significant resource, as dry sediment and surface water sampling results in and around the wetlands (discussed in Section 4.4.3.3) do not indicate exposure to elevated concentrations of contaminants would occur within the wetlands/drainage swale (i.e., former stream channel). As a result, there are no significant ecological resources. Also, the downstream biological and water quality sampling station shows no impairment, indicating contaminants are not migrating from the landfill to Sand Creek.

#### 4.4.3.5 Summary and Recommendations of Scoping Level Ecological Risk Assessment

While a removal action occurred in the Fill Area EU, the limited "RD/RA" confirmatory sample results indicate there are three surface soil COPECs for the Fill Area EU, eight surface soil COPECs for the Surface Area EU, and three surface water COPECs identified in the Surface Water EU at the Dump Along Paris-Windham Road. These COPECs consist of inorganic chemicals, PCBs, and propellants. There are no sediment COPECs at the AOC.

The information in Section 4.4.3.3 regarding ecological resources at the AOC was compared to the list of important ecological places and resources (Appendix Table C-6). One of the 39 important places (wetlands) was present. Although the wetlands are an important resource, the wetlands are not a significant resource, as dry sediment and surface water sampling results (Section 4.4.3.2) do not indicate chemicals are present at concentrations of concern for ecological receptors in the wetlands/drainage swale. Environmental management goals and objectives of OHARNG are applicable to the AOC, as presented in Appendix Table C-6. Some of the management goals benefit the AOC, including Goal 1 that requires management of natural resources to be compatible with the military mission, and Goal 5 that requires the U.S. Army to sustain usable training lands and native natural resources by implementing a natural resource management plan which incorporates invasive species management and by utilizing native species mixes for revegetation after ground disturbance activities.

The Dump Along Paris-Windham Road is approximately 0.25 acres and is vegetated with: (1) green ash/American elm/hackberry temporary flooded forest alliance; (2) American beech/oak/maple forest alliance; and (3) small wetlands. These same types of habitats are found adjacent to the AOC and elsewhere at RVAAP (OHARNG 2008a). The habitats are also found in the larger, local ecoregion that surrounds RVAAP (USFS 2011). There is no known unique resource at the AOC.

Although there is contamination at the AOC and an important ecological resource is present, the AOC has no known significant ecological places or resources. Also, the downstream biological and water quality sampling station shows no impairment, suggesting contaminants have not migrated from the landfill to Sand Creek. Consequently, the ERA for the Dump Along Paris-Windham Road can conclude with a Level I Scoping Level ERA and the recommendation of NFA from the ecological risk perspective.

### 4.4.4 Conclusions

There is chemical contamination present at the Dump Along Paris-Windham Road. While a removal action occurred in the Fill Area EU, the limited "RD/RA" confirmatory sample results indicate there are three surface soil COPECs at the Fill Area EU, eight surface soil COPECs at the Surface Area EU, and four surface water COPECs at the Surface Water EU. Although the wetlands are an important resource, they are not a significant resource because dry sediment and surface water sampling results do not indicate chemicals are present at concentrations of concern for ecological receptors in the wetlands/drainage swale. Thus, there are no significant ecological resources at the AOC. Also, the downstream biological and water quality sampling station shows no impairment, suggesting contaminants are not migrating from the landfill to Sand Creek. Further, the vegetation types are found elsewhere near the AOC, at RVAAP, and in the ecoregion. Based on the results of the ERA, there is sufficient justification to recommend NFA for the Dump Along Paris-Windham Road from the ecological perspective.

# 5.0 REMEDIAL ACTION OBJECTIVE

## 5.1 REMEDIAL ACTION OBJECTIVE

RAOs specify the requirements remedial alternatives must fulfill to protect human health and the environment from COCs at the Dump Along Paris-Windham Road. Media-specific objectives that identify major contaminants and associated media-specific cleanup goals (CUGs) are developed to provide this protection. These objectives specify COCs, exposure routes and receptors, and acceptable constituent concentrations for long-term protection of receptors.

In accordance with CERCLA, a residential receptor (Resident Farmer Adult and Child) was addressed in the risk assessment (see Section 4.3) as a comparative baseline. However, a remedial alternative based on Unrestricted (Residential) Land Use is not evaluated in this FFS. The Representative Receptor for the Dump Along Paris-Windham Road is the Range Maintenance Soldier. The Adult and Juvenile Trespassers were also evaluated in the HHRA. No COCs are identified in soil and surface water for these receptors; however, COCs were identified in shallow surface soil for the Resident Farmer receptor. LUCs and awareness training are necessary as part of the final remedy due to future Camp Ravenna training missions, AOC characteristics, the presence of shallow surface soil COCs for a Resident Farmer receptor, and the presence of residual transite, all of which make unrestricted use of the AOC impractical. The HHRA identified no surface water COCs for any receptor; therefore, RAs are not required for surface water. The ERA recommended NFA for protection of ecological resources. As noted earlier, RAs for groundwater are not included in the alternatives evaluated in this FFS; groundwater will be addressed under a future decision by the U.S. Army.

Based upon the SC results, the RAO at the Dump Along Paris-Windham Road is to prevent exposure of the Resident Farmer to shallow surface soil (0-1 ft bgs) with COC levels exceeding the TR of 1E-05 and an HQ of 1.0.

## 5.2 REASONABLE AND ANTICIPATED FUTURE LAND USE

The RAFLU for the AOC is Military Training. The Range Maintenance Soldier was selected as the Representative Receptor for this AOC. The basis for selecting the Range Maintenance Soldier, rather than the National Guard Trainee, as the receptor for the Dump Along Paris-Windham Road is that the area is not conducive for regular training (steep slope), there is residual asbestos at the AOC, and a safety danger zone (SDZ) for a proposed future range complex overlaps the AOC (OHARNG 2008b). No range construction activities are proposed to be conducted within the AOC. The presence of the former dump and residual transite preclude placement of utilities along the west side of Paris-Windham Road in the vicinity of this AOC. The Range Maintenance Soldier is the Representative Receptor for this land use, because maintenance of the road is the primary activity that is practical in this area.

Activities could also include foot traffic by range control (due to the fact the AOC is in the SDZ) and wildlife and natural resource management activities. Because this area does not have elevated security measures, trespassers may visit the AOC; therefore, Adult and Juvenile Trespassers were also evaluated. The National Guard Trainee is not considered a likely receptor for this area, because the AOC is a small area on a steep road embankment and is not suitable for training use. However, the exposure assumptions for the Adult Trespasser are protective of foot traffic by the National Guard Trainee. Characteristics of the AOC (e.g., proximity to the road, steep slope, and floodplain at the bottom) preclude Residential Land Use. These considerations determined the selection of the representative receptors denoted in Section 4.3.3 for the most likely foreseeable land use.

## 5.3 FACILITY-WIDE CLEANUP GOALS

FWCUGs have been established in the FWCUG Report (USACE 2010a). These FWCUGs are the remediation levels for the designated user for any COCs at the Dump Along Paris-Windham Road, unless there are additive effects to be considered.

The COCs identified at the Dump Along Paris-Windham Road are listed in Table 5-1. No COCs were identified in soil or surface water for the Range Maintenance Soldier or Adult and Juvenile Trespassers.

**Table 5-1. Chemicals of Concern and Cleanup Goals by Media and Receptor**

| Media | COC | FWCUG (mg/kg) |
|---|---|---|
| ***Range Maintenance Solder*** | | |
| Surface Soil (0-4 ft bgs) | None | NA |
| Wet Sediment | None[a] | NA |
| Surface Water | None[b] | NA |
| ***Adult and Juvenile Trespasser*** | | |
| Shallow Surface Soil (0-1 ft bgs) | None | NA |
| Subsurface Soil (1-13 ft bgs) | None[b] | NA |
| Wet Sediment | None[a] | NA |
| Surface Water | None | NA |
| ***Resident Farmer*** | | |
| Shallow Surface Soil (0-1 ft bgs) | Benzo(a)pyrene<br>Dibenz(a,h)anthracene | 0.211 mg/kg<br>0.211 mg/kg |
| Subsurface Soil (1-13 ft bgs) | None | NA |
| Wet Sediment | None[a] | NA |
| Surface Water | None | NA |

[a]Wet sediment does not exist within the boundaries of the area of concern. Dry sediment is addressed the same as surface soil in terms of contaminant nature and extent, fate and transport, and risk exposure models and is consistent with the FWCUG Report (USACE 2010a).
[b]A complete exposure pathway does not exist for the specified receptor and media.
bgs = Below ground surface
COC = Chemical of Concern
FWCUG = Facility-Wide Cleanup Goal
NA = Not applicable

# 6.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Agencies responsible for RAs under CERCLA must ensure selected remedies meet ARARs. This section describes the proposed ARARs for the Dump Along Paris-Windham Road.

## 6.1 INTRODUCTION

CERCLA Sections 121(d)(1) and (2) provide that RAs selected for an AOC must attain a degree of cleanup of hazardous substances, pollutants, and contaminants that: (1) assures protection of human health and the environment; and (2) complies with ARARs. ARARs are developed in accordance with the statutory and regulatory provisions set forth in CERCLA and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP).

An RA will comply with ARARs if the RA attains the standard established in the ARAR for a particular hazardous substance. When a hazardous substance, pollutant, or contaminant will remain on-site at the completion of an RA, that substance must meet any limit or standard set forth in any legal ARAR, criteria, or limitation under a federal environmental law. These standards apply unless such standard, requirement, criteria, or limitation is waived in accordance with CERCLA Section 121(d)(4). Any promulgated standard, requirement, criteria, or limitation under a state environmental or facility citing law that is more stringent than any federal standard, requirement, criteria, or limitation, and that has been identified by the state in a timely manner, can be an ARAR as well.

Regulatory language interpreting and implementing the statutory directive is found in the NCP. One provision, 40 *Code of Federal Regulations (CFR)* Section 300.400(g), provides that the lead agency (U.S. Army) and support agency (Ohio EPA) shall identify applicable requirements based on an objective determination of whether the requirement specifically addresses a hazardous substance, pollutant, contaminant, RA, location, or other circumstance found at a CERCLA site. Under 40 *CFR* Section 300.430(e), the lead agency has the ultimate authority to decide what requirements are ARARs for the potential remedial activities.

Identifying ARARs involves determining whether a requirement is legally applicable, and (if it is not legally applicable) whether a requirement is relevant and appropriate. Individual ARARs for each AOC must be identified on a site-specific basis. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance found at a CERCLA site (40 *CFR* Section 300.5).

If a requirement is determined to not be legally applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. Determining whether a rule is relevant and appropriate is a two-step process that involves determining whether the rule is relevant, and appropriate. A requirement is relevant if it addresses problems or situations sufficiently similar

to the circumstances of the RA contemplated. It is appropriate if its use is well suited to the AOC. In addition to ARARs, the lead and support agencies may identify other advisories, criteria, or guidance to be considered for a particular release. The "to be considered" category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies. "To be considered" will be regarded as guidance or justification for a standard used in the remediation if no other standard is available for a situation to help determine the necessary level of cleanup for protection of health or the environment.

While on-site actions must comply with both applicable and relevant and appropriate requirements, off-site actions taken outside of the CERCLA site must fully comply with the regulations in their entirety, including any administrative requirements. Also, a determination of relevance and appropriateness may be applied to specific portions of a requirement so that only parts of a requirement need be complied with; whereas, a determination of applicability is made for the requirement as a whole so that the entire requirement must be complied with.

CERCLA provides for a permit waiver for RAs that are conducted on-site and in accordance with NCP. Although the administrative requirement of permits has been waived by the statute, substantive requirements of rules that would otherwise be enforced through permits are still applicable. The Ohio EPA Division of Emergency and Remedial Response (DERR) has addressed this issue in two policies, one in final form and one in draft form. The policy in final form, Final Policy Number DERR-00-RR-001, "ARARs," July 30, 1998, states "cleanup projects will not be subject to the administrative requirements of permits, including permit applications, public notice, etc. " particularly when the cleanup project is governed by an enforcement order. The policy in draft form, Draft Policy Number DERR-00-RR-034, "Use of ARARs in the Ohio EPA Remedial Response Program," September 2, 2003, states "it has been DERR's policy to require responsible parties to acquire and comply with all necessary permits, including all substantive and administrative requirements." Permit waivers are specifically addressed in Section VII, General Provisions (Paragraph No. 12e) of the DFFO:

> "It is Ohio EPA's position that if state law related to a remedial or removal action requires a permit, then a permit must be acquired in accordance with CERCLA Section 120(a)(4). It is the Respondent's position that these Orders implement a CERCLA-based remediation program and that a permit is not required in accordance with CERCLA Section 121(e). The Parties agree that the remedial or removal actions anticipated at RVAAP are not of the type that routinely requires a permit under state law. If Ohio EPA determines that a permit is required for a particular remedial or removal action at RVAAP, the Parties will meet and attempt in good faith to resolve to [sic] this issue."

Any remedial response action at RVAAP must be conducted in accordance with the DFFOs, which provide that, irrespective of ARARs, "all activities undertaken…pursuant to these Orders shall be performed in accordance with the requirements of CERCLA, the NCP, and all other applicable federal and state laws and regulations."

## 6.2 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

USEPA classifies ARARs as chemical-specific, action-specific, and location-specific to provide guidance for identifying and complying with ARARs (USEPA 1988).

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, allow numerical values to be established. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Action-specific ARARs are rules, such as performance or design or other activity-based rules, that place requirements or limitations on actions.

- Location-specific ARARs are rules that place restrictions on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations.

As explained in the following paragraph, rules from each of these categories are ARARs only to the extent they relate to the degree of cleanup.

CERCLA Section 121 governs cleanup standards at CERCLA sites. ARARs originate in the subsection of CERCLA that specifies the degree of cleanup at each AOC, CERCLA Section 121(d). In Section 121(d)(2), CERCLA expressly directs that ARARs are to address specific COCs at each AOC, specifying the level of protection to be attained by any chemicals remaining at the AOC. CERCLA Section 121(d)(2) provides that, with respect to hazardous substances, pollutants, or contaminants remaining on-site at the completion of an RA, an ARAR is:

> "any standard, requirement, criteria, or limitation under any Federal environmental law…or any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation."

CERCLA Section 121(d)(2) further provides that the RA attain a level of control established in rules determined to be ARARs.

In some cases, most ARARs will be chemical-specific, depending on the identified COCs and (in some cases) the media that have been contaminated from the release of these contaminants (e.g., MCLs for groundwater contamination). Action- or location-specific requirements will be ARARs to the extent they establish standards addressing COCs that will remain at the AOC. In addition, CERCLA Section 121(d)(1) directs that RAs taken to achieve a degree of cleanup that is protective of human health and the environment are to be relevant and appropriate under the circumstances presented by the release. Accordingly, any chemical-, action-, or location-specific requirements will

be ARARs to the extent that they ensure that the degree of cleanup will be protective of human health and the environment under the circumstances presented by the release.

In summary, chemical-, action-, or location-specific requirements will be ARARs to the extent: (1) they establish standards protective of human health and the environment for chemicals that will remain on-site after the RA; and (2) to the extent they ensure a degree of cleanup that is protective of human health and the environment under the circumstances presented by the release.

## 6.3 POTENTIAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The actions evaluated within this FFS address the potential risk from contaminated soil at the Dump Along Paris-Windham Road. A review of regulations governing the remediation of soil did identify the requirements of 40 *CFR* 761 governing PCBs as a potential ARAR. However, these standards were found to not be applicable or relevant and appropriate, as the highest concentration of PCBs found within the soil was 0.23 mg/kg, and the guidance documents from USEPA concerning the Toxic Substances Control Act (TSCA) requirements state that triggering of these requirements is based on a finding of unacceptable risk during the risk assessment. As no such finding was made, the TSCA requirements for PCBs at 40 *CFR* Part 761 were deemed not to be an ARAR (chemical- or action-specific). Due to the nature of the AOC, the identified COCs, and the media of concern, no chemical-specific ARARs were identified.

## 6.4 POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The proposed actions at the Dump Along Paris-Windham Road include No Action and LUC alternatives. Neither of these activities would result in the excavation or generation of contaminated soil. By leaving the soil in place, no potential waste treatment or disposal requirement is triggered; therefore, the Resource Conservation and Recovery Act (RCRA) and TSCA requirements would not be considered ARARs for either of these actions.

Although passive in nature, the potential presence of transite (an ACM) would trigger certain provisions within the OAC for inactive asbestos disposal sites. Even though sampling has not indicated that asbestos was present, past operating knowledge indicates such material is in the landfill that would result in these rules being considered (at minimum) relevant and appropriate. The requirements of OAC 3745-20-07 are considered ARARs for both the No Action and the LUC alternatives (see Table 6-1). These regulations require that a former asbestos waste disposal site must be covered and posted in accordance with the specific requirements. Because all visible surface debris was removed and the subsurface transite excavation areas were backfilled and covered with clean soil and vegetated (Section 3.1.3), the cover requirements have been achieved in compliance with this ARAR. In addition to the cover requirements, these rules specify the AOC must be posted as a former asbestos disposal site. The No Action alternative would not comply with this

requirement. However, such posting is anticipated to be conducted under the LUC alternative and would comply with the posting requirements of this ARAR.

As previously discussed, the Dump Along Paris-Windham Road historically was used as a waste disposal site. Under the evaluated alternatives, the disposed waste will remain in place. Based on the majority of the material observed within the AOC and the accompanying analytical data, the dumpsite is believed to have been used primarily for the disposal of debris from C&D activities during its operation. Because the exact historical dates of operation are unknown but thought to have been as late as the 1970s, the solid waste landfill closure requirements (OAC 3745-27-11) have not been identified as ARARs for this facility. Although the closure requirements have not been identified as ARARs, the requirements of OAC 3745-27-14 (landfill post-closure for existing facilities) are considered an applicable requirement and an ARAR (see Table 6-1). The No Action alternative would not include provisions such as quarterly inspections [OAC 3745-27-14(c)(4)]. Based on available information and observations noted above, the material disposed of consisted of debris that would not result in the generation of methane or leachate; therefore, this subparagraph is the only provision within this rule identified as an ARAR.

**Table 6-1. Potential Action ARARs for Disposal of RCRA Hazardous Waste**

| Media and Citation | Description of Requirement | Potential ARAR Status | Standard |
|---|---|---|---|
| Standard for Inactive Asbestos Waste Disposal Sites OAC 3745-20-07 | These rules require that inactive asbestos disposal sites be covered and posted to ensure access to ACM is controlled. In addition, these rules require that no visible emissions be allowed from the AOC | If ACM is present within the AOC, these rules are potentially applicable | An inactive asbestos disposal site must be covered by 6 inches of compacted soil with a vegetated cover or 2 ft of compacted soil. In addition, the AOC must be posted as having ACM present and must have access control to ensure exposure to asbestos does not occur |
| Post-Closure Care for Sanitary Landfill Facilities OAC 3745-27-14 | These rules specify the required post-closure care activities required for solid waste facilities, including existing facilities | Because material that would be considered solid waste is disposed at the AOC, these requirements are considered relevant and appropriate | Required inspection and maintenance of the cover. Additional provisions are not considered ARARs, as the debris disposed at the AOC does not generate methane gas or leachate |

ACM = Asbestos-containing Material
AOC = Area of Concern
ARAR = Applicable or Relevant and Appropriate Requirement
OAC = Ohio Administrative Code
RCRA = Resource Conservation and Recovery Act

## 6.5 POTENTIAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Location requirements include those established for potential remedial activities conducted within wetlands or a floodplain area or with respect to threatened and endangered (T&E) species. Generally, for wetlands and floodplains, rules require alternatives to remedial activity within the sensitive area

be pursued. If that is not feasible, then adverse effects from any actions taken within the sensitive area must be mitigated to the extent possible. These requirements do not relate to specific chemicals nor do they further the degree of cleanup in the sense of protecting human health or the environment from the effects of harmful substances. Rather, their purpose is to protect the sensitive areas to the extent possible. Under CERCLA Section 121(d), relevance and appropriateness are related to the circumstances presented by the release of a hazardous substance, with the goal of attaining a degree of cleanup and control of further releases that ensures protection of human health and the environment.

Rules ensuring protection of sensitive resources do not represent requirements that are relevant and appropriate to circumstances presented by the release of a hazardous substance, with a goal of attaining a degree of cleanup and control of further releases that ensure protection of human health and the environment. Location requirements for wetlands and floodplains do not relate to the degree of cleanup as much as they relate to the protection of these sensitive areas from the effects of remedial activities. This purpose does not address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular AOC as an ARAR; that is, the rule requirements are not sufficiently relevant and appropriate under CERCLA Section 121(d) as related to the circumstances of the release, degree of cleanup, or protectiveness of RA, to include these requirements as ARARs.

The Endangered Species Act (ESA) exists to protect the habitat or body of flora and fauna that are T&E. Once again, these rules do not relate to specific chemicals nor do they further the degree of cleanup in the sense of protecting human health or the environment from the effects of harmful substances. The purpose of these rules is to protect sensitive areas and plant and animal life to the degree possible. This purpose does not address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular AOC as an ARAR; that is, the rule requirements are not sufficiently relevant and appropriate under CERCLA Section 121(d) as related to the circumstances of the release, degree of cleanup, or protectiveness of RA to include these requirements as ARARs.

Having determined these requirements are not ARARs, any action taken by the Federal Government must be conducted in accordance with requirements established under the National Environmental Policy Act, National Historic Preservation Act, ESA, and federal and state wetlands and floodplains construction and placement of material considerations, even though these laws and rules do not establish standards, requirements, limitations, or criteria relating to the degree of cleanup for chemicals remaining on-site at the close of the response action. As the No Action or LUC alternatives would not result in impacts upon endangered species or their habitats, these ARARs would be complied with.

# 7.0 TECHNOLOGY TYPES AND PROCESS OPTIONS

This section describes the general response actions (GRAs) and remedial technologies that are potentially applicable at the Dump Along Paris-Windham Road. GRAs are actions that will satisfy the RAO (Section 5.1) for shallow surface soil. Given no COCs were identified for the Representative Receptor (Range Maintenance Soldier) or the Adult and Juvenile Trespassers, and NFA has been recommended for ecological receptors, the appropriate GRAs for this FFS are No Action (as required by the NCP) and LUCs (to prevent exposure to human receptors). The residential receptor (Resident Farmer) has two PAHs identified as COCs, thus preventing unrestricted land use.

## 7.1 NO ACTION

In this GRA, no action would be undertaken to reduce any hazard to human health or the environment. Any current actions, restrictions, or monitoring would be discontinued. This action complies with the CERCLA requirement to provide an appropriate option (or component of a remedial alternative if no unacceptable risks are present) and to provide a baseline against which other alternatives can be compared.

## 7.2 LAND USE CONTROLS

Generally, LUCs reduce the potential for exposure to contaminants but do not reduce contaminant volume or toxicity. These controls are utilized to supplement and affect the engineering component(s) of a remedy (e.g., treatment and removal) during short- and long-term implementation. The primary goal of LUCs is to restrict the use of, or limit access to, real property using physical, legal, and/or administrative mechanisms to ensure protectiveness of the remedy. Particular LUCs under consideration at the Dump Along Paris-Windham Road include measures that will restrict land use changes over the long term, such as governmental controls and enforcement tools. Governmental controls could include a Property Management Plan (PMP) and facility-specific regulations to manage property and enforce management strategies, while enforcement tools may involve administrative orders or consent decrees.

# 8.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section describes the remedial alternatives assembled for impacted shallow surface soil at the Dump Along Paris-Windham Road. Remedial alternatives should assure adequate protection of human health and the environment; achieve the RAO; meet ARARs; and permanently and significantly reduce the volume, toxicity, and/or mobility of COCs. The remedial alternatives are listed below.

- Alternative 1: No Action; and
- Alternative 2: LUCs.

Alternative 1 is the No Action response required under the NCP. Alternative 2 relies on LUCs. No source control or removal actions are implemented under Alternative 2.

## 8.1 NO ACTION

Under Alternative 1, no actions regarding access or LUCs would be implemented. Alternative 1 provides no additional protection to human health and the environment. This remedial alternative is required under the NCP as a no action baseline against which other remedial alternatives can be compared. Any current legal and administrative LUC mechanisms at the AOC would be discontinued. No future legal, administrative, or physical LUC mechanisms would be employed at the AOC. Environmental monitoring would not be performed. In addition, no restrictions on land use would be pursued.

## 8.2 LAND USE CONTROLS

For Alternative 2, LUCs would be implemented for the Dump Along Paris-Windham Road. This alternative relies on LUCs to limit access to the AOC and prevent exposure by possible receptors (e.g., Resident Farmer) to COCs in shallow surface soil. Unrestricted land use of the AOC is hindered by concentrations of benzo(a)pyrene and dibenz(a,h)anthracene in shallow surface soil, which exceed FWCUGs for the Resident Farmer. However, no COCs were identified for the Range Maintenance Soldier (the Representative Receptor at the AOC as determined by the RAFLU) or the possible Adult and Juvenile Trespassers. Alternative 2 would leave impacted media in place and implement no active remedial measures. Instead, long-term management to ensure land use remains protective of potential receptors would be implemented. Awareness training and signs (posted every 300 ft or less along the AOC perimeter) would be employed to alert persons having a need to access the AOC that the location was formerly used to dispose of ACM. Controls on digging within the AOC would be incorporated due to the potential presence of ACM and to maintain integrity of restored sections of the dump. Because: (1) surface debris was removed; (2) subsurface transite was excavated to the extent possible without undermining and compromising the integrity of Paris-Windham Road; (3) soil confirmation samples did not indicate the presence of asbestos in soil, dry sediment, or surface water; and (4) the AOC is heavily vegetated, potential exposures to asbestos are

currently controlled, and physical access controls other than warning signs (e.g., fencing/gates) are not proposed as part of Alternative 2. Prior to implementation of Alternative 2, an RD detailing the 5-year review requirements and any supplemental access restrictions to address chemical contamination of soil would be developed.

An RD would be developed to address specific maintenance activities, monitoring requirements (i.e., 5-year reviews), and LUCs. The RD would incorporate existing access restrictions. A more detailed discussion of the LUCs would be developed as part of the RD, including notification requirements for changes in land use. The RVAAP PMP would capture all LUCs prescribed by the approved RD and serve as a formal tool to help manage and set forth procedures for the established LUCs. Coordination with any planned OHARNG AOC improvement and environmental monitoring activities would be necessary to ensure consistency with the Dump Along Paris-Windham Road's designated land use and RAO. Pursuant to CERCLA, a review would be conducted every 5 years, as COCs would remain on-site above unrestricted (i.e., residential) land use CUGs. Five-year reviews permit evaluation of all remedy components, including LUCs, to assess the presence and behavior of the remaining COCs. Continued surveillance would ensure any land use changes or disturbances of impacted areas are identified.

# 9.0 ANALYSIS OF REMEDIAL ALTERNATIVES

## 9.1 INTRODUCTION

This section presents a detailed analysis of the two remedial alternatives for the Dump Along Paris-Windham Road. Under the CERCLA remedy selection process, the preferred remedial alternative will be suggested in the PP and set forth in final form in the ROD. A detailed evaluation of each alternative is performed in this section to provide the basis and rationale for identifying a preferred remedy and preparing the PP.

To ensure the analysis of alternatives provides information of sufficient quality and quantity to justify the selection of a remedy, it is helpful to understand the requirements of the remedy selection process. This process is driven by the requirements set forth in CERCLA Section 121. In accordance with these requirements (USEPA 1988), RAs must:

- Be protective of human health and the environment;
- Attain ARARs;
- Be cost effective;
- Use permanent solutions and alternative treatment technologies to the maximum extent practicable; and
- Satisfy the preference for treatment that, as a principle element, reduces volume, toxicity, or mobility.

CERCLA emphasizes long-term effectiveness and related considerations for each remedial alternative. These statutory considerations are as follows:

- Long-term uncertainties associated with land disposal;
- The goals, objectives, and requirements of the Solid Waste Disposal Act;
- The persistence, toxicity, and mobility of hazardous substances and their propensity to bio-accumulate;
- Short- and long-term potential for adverse health effects from human exposure;
- Long-term maintenance costs;
- The potential for future RA costs if the remedial alternative in question was to fail; and

- The potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment.

These statutory requirements are implemented through the use of nine evaluation criteria presented in the NCP. These nine criteria are grouped into threshold criteria, balancing criteria, and modifying criteria, as described below. A detailed analysis of each alternative against the evaluation criteria is presented in the following sections. The detailed analysis provides further definition of each alternative (if necessary), compares the alternatives against one another, and presents considerations common to alternatives.

### 9.1.1 Threshold Criteria

Two of the NCP evaluation criteria relate directly to statutory findings that must be made in the ROD. These criteria are considered to be threshold criteria that must be met by any remedy selected. The criteria are:

1. Overall protection of human health and the environment; and
2. Compliance with ARARs.

Each alternative must be evaluated to determine how it achieves and maintains protection of human health and the environment. Similarly, each remedial alternative must be assessed to determine how it complies with ARARs or, if a waiver is required, an explanation of why a waiver is justified. An alternative is considered to be protective of human health and the environment if it complies with CUGs.

### 9.1.2 Balancing Criteria

The five balancing criteria represent the primary criteria upon which the detailed analysis of alternatives and the comparison of alternatives are based. They are:

1. Long-term effectiveness and permanence;
2. Reduction of toxicity, mobility, or volume through treatment;
3. Short-term effectiveness;
4. Implementability; and
5. Cost.

*Long-term effectiveness and permanence* is an evaluation of the magnitude of residual risk (risk remaining after implementation of the alternative) and the adequacy and reliability of controls used to manage the remaining waste (untreated waste and treatment residuals) over the long term. Alternatives that provide the highest degree of long-term effectiveness and permanence leave little or no untreated waste at the AOC, make long-term maintenance and monitoring unnecessary, and minimize the need for LUCs.

*Reduction of toxicity, mobility, or volume through treatment* is an evaluation of the ability of the alternative to reduce the toxicity, mobility, or volume of the waste. The irreversibility of the treatment process and the type and quantity of residuals remaining after treatment are also assessed.

*Short-term effectiveness* addresses the protection of workers and the community during the RA, the environmental effects of implementing the action, and the time required to achieve CUGs.

*Implementability* addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and material required during implementation. Technical feasibility assesses the ability to construct and operate a technology, the reliability of the technology, the ease in undertaking additional RAs, and the ability to monitor the effectiveness of the alternative. Administrative feasibility is addressed in terms of the ability to obtain approval from federal, state, and local agencies.

*Cost* analyses provide an estimate of the dollar cost of each alternative. The cost estimates in this report are based on estimating reference manuals, historical costs, vendor quotes, and engineering estimates. Costs are reported in base year 2010 dollars. The present value analysis is a method to evaluate expenditures, either capital or operation and maintenance (O&M), which occur over different time periods. Present value calculations allow for cost comparisons of different remedial alternatives on the basis of a single cost figure. The cost estimates are for guidance in project evaluation and implementation and are believed to be accurate within a range of -30 to +50%, in accordance with USEPA guidance (USEPA 1988). Actual costs could be higher than estimated due to unexpected conditions or potential delays. Details and assumptions used in developing cost estimates for Alternative 2 are provided in Appendix D.

### 9.1.3 Modifying Criteria

The two modifying criteria below will be evaluated as part of the ROD after the public has had an opportunity to comment on the PP. They are:

1. State acceptance; and
2. Community acceptance.

*State acceptance* considers comments received from agencies of the state of Ohio. The primary state agency supporting this investigation is Ohio EPA. Comments will be obtained from state agencies on the SC/FFS and the preferred remedy presented in the PP. This criterion will be addressed in the responsiveness summary of the ROD.

*Community acceptance* considers comments made by the community, including stakeholders, on the alternatives being considered. Input has been encouraged during the ongoing investigation process to ensure the remedy ultimately selected for the Dump Along Paris-Windham Road is acceptable to the public. Comments will be accepted from the community on the preferred remedy presented in the PP. This criterion will be addressed in the responsiveness summary of the ROD. Because the actions

above have not yet taken place, the detailed analysis of alternatives presented below cannot account for these criteria at this time. Therefore, the detailed analysis is carried out only for the first seven of the nine criteria.

## 9.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

Detailed analyses of the retained remedial alternatives for the Dump Along Paris-Windham Road are presented below. Each relevant alternative is described and evaluated against the criteria outlined in Section 9.1.

### 9.2.1 Alternative 1: No Action

Under this alternative, contaminated shallow surface soil would remain in place. Existing access restrictions (e.g., the RVAAP perimeter fence) would not be continued. No restrictions on land use would be pursued.

#### 9.2.1.1 Overall Protection of Human Health and the Environment

Under Alternative 1, the Representative Receptor (Range Maintenance Soldier) and possible Adult and Juvenile Trespassers would not be exposed to unacceptable risk due to contaminants in shallow surface and subsurface soil at the AOC. However, the AOC has COC concentrations above CUGs for the Resident Farmer. Consequently, a No Action alternative would not be protective, as LUCs would be required to prevent Residential Land Use of the AOC while the COC concentrations exceed Resident Farmer COCs. Alternative 1 is not considered protective for human health.

The ERA concluded there is chemical contamination and possible risk but no significant ecological resources at the AOC, and the recommendation is NFA for protection of ecological receptors. Under Alternative 1, current risk is not reduced and the ecological resources at the AOC remain unchanged. Current land use and RAFLU allows for sustainability of terrestrial habitat for ecological receptors.

#### 9.2.1.2 Compliance with ARARs

Potential ARARs for the final remedy of shallow surface soil at the Dump Along Paris-Windham Road are presented in Section 6.0. There are no identified chemical- or location-specific ARARs for Alternative 1.

OAC 3745-20-07 requires that a former asbestos waste disposal site must be covered and posted in accordance with the specific requirements. Because all visible surface debris was removed and the excavation areas covered with clean soil and vegetated, the cover requirements have been achieved in compliance with this ARAR. However, in addition to the cover requirements, these rules specify the AOC must be posted as a former asbestos disposal site. The No Action alternative would not comply with this requirement, as no signs would be posted at the AOC.

#### 9.2.1.3 Long-Term Effectiveness and Permanence

Alternative 1 includes no long-term management measures to prevent exposures to, or the spread of, contamination. This alternative does not have controls in place outside the existing cover over portions excavated during the limited "RD/RA" and does not provide any additional new controls in the future.

#### 9.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not reduce contaminant toxicity, mobility, or volume because no treatment process is proposed.

#### 9.2.1.5 Short-Term Effectiveness

There are no significant short-term human health risks associated with Alternative 1. No additional short-term health risks to the community would occur because no RAs would be implemented. There would be no transportation risks nor would workers be exposed to any additional health risks. Alternative 1 would not directly cause adverse impacts to soil, air quality, water resources, or biotic resources.

#### 9.2.1.6 Implementability

No RAs would be implemented under this alternative.

#### 9.2.1.7 Cost

The present value cost to complete Alternative 1 is $0. No capital costs are associated with this alternative.

### 9.2.2 Alternative 2: Land Use Controls

Alternative 2 maintains the current status of the Dump Along Paris-Windham Road and includes LUCs and annual inspections to identify potential exposures and/or changes in the nature or extent of AOC contamination. LUCs would be implemented in accordance with an approved RD and PMP. In addition, signs would be posted at the AOC stating that the area was a former ACM disposal location.

Pursuant to CERCLA, a review would be conducted every 5 years, as contaminants remain on-site above unlimited use and unrestricted exposure FWCUGs. These 5-year reviews will evaluate the effectiveness of LUCs and ensure any land use changes are identified.

#### 9.2.2.1 Overall Protection of Human Health and the Environment

Under Alternative 2, the Representative Receptor (Range Maintenance Soldier) and possible Adult and Juvenile Trespassers are not exposed to unacceptable risk due to contaminants in shallow surface or subsurface soil at the AOC. Implementation of LUCs prevents exposure to the Resident Farmer. Alternative 2 is considered protective for human receptors.

The ERA concluded there is chemical contamination and possible risk but no significant ecological resources at the Dump Along Paris-Windham Road, and the recommendation is NFA for protection of ecological receptors. Under Alternative 2, current risk is not reduced and the ecological resources at the AOC remain unchanged. Current land use and RAFLU allow for sustainability of terrestrial habitat for ecological receptors.

#### 9.2.2.2 Compliance with ARARs

Potential ARARs for the final remedy of shallow surface soil at the Dump Along Paris-Windham Road are presented in Section 6.0. These enforceable standards would be protective of representative receptors under the Range Maintenance Soldier and Trespasser scenario. There are no identified chemical- or location-specific ARARs for Alternative 2.

OAC 3745-20-07 requires that a former asbestos waste disposal site must be covered and posted in accordance with the specific requirements. Because all visible surface debris was removed and the excavation areas covered with clean soil and vegetated, the cover requirements have been achieved in compliance with this ARAR. In addition to the cover requirements, these rules specify that the AOC must be posted as a former asbestos disposal site. Alternative 2 would comply with this posting requirement.

#### 9.2.2.3 Long-Term Effectiveness and Permanence

Alternative 2 is protective in the long term. It relies on LUCs to eliminate or reduce exposures to contaminants. The effectiveness of this approach is related to the adequacy and reliability of the LUCs. However, with appropriate documentation and procedures, LUCs can reasonably be expected to be effective in protecting human health and the environment while preserving the RAFLU anticipated for the Dump Along Paris-Windham Road.

Because contaminants would remain on-site above Resident Farmer CUGs, reviews would need to be conducted every 5 years, pursuant to CERCLA requirements. The purpose of these reviews is to ensure that land use and engineering controls are retaining effectiveness.

#### 9.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 does not involve reduction in contaminant toxicity, mobility, or volume because no treatment is proposed.

#### 9.2.2.5 Short-Term Effectiveness

There are no significant short-term human health risks associated with Alternative 2. No additional short-term health risks to the community would occur because no RAs would be implemented. Alternative 2 would not directly cause adverse impacts on soil, air quality, water resources, or biotic resources. The alternative's remedial measures would require less than 1 year to complete and would include an O&M period (30 years assumed for cost-estimating purposes).

#### 9.2.2.6 Implementability

LUCs are technically implementable. No technical difficulties are anticipated in establishing or maintaining monitoring programs, signs, or access restrictions. There are currently access restrictions implemented facility-wide at RVAAP. Implementing proposed LUCs would supplement and support restrictions already in place at the Dump Along Paris-Windham Road.

#### 9.2.2.7 Cost

The present value (discounted) cost to complete Alternative 2 is approximately $93,384 (in base year 2010 dollars). O&M and monitoring costs are estimated for a 30-year period. The development of a RD, including LUCs and CERCLA 5-year reviews, is included in this cost. A detailed description of Alternative 2 costs is contained in Appendix D.

### 9.3 COMPARATIVE ANALYSIS

A comparison of the two alternatives for the Dump Along Paris-Windham Road is presented in Table 9-1.

**Table 9-1. Comparison of Alternatives by Evaluation Criteria**

| NCP Evaluation Criteria | Alternative 1:No Action | Alternative 2: LUCs |
|---|---|---|
| 1. Overall Protectiveness for Human Health and the Environment | Somewhat protective | Protective |
| 2. Compliance with ARARs | Not compliant | Compliant |
| 3. Long-Term Effectiveness and Permanence | Low | High |
| 4. Reduction of Toxicity, Mobility, or Volume through Treatment | Low | Low |
| 5. Short-Term Effectiveness | High | Medium |
| 6. Implementability | High | Medium |
| 7. Cost | High | Medium |

"High" = highly favorable
"Medium" = moderately favorable
"Low" = not favorable
ARAR = Applicable or relevant and appropriate requirement
LUC = Land Use Control
NCP = National Oil and Hazardous Substances Pollution Contingency Plan

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# 10.0 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

The U.S. Army is the lead agency under the Defense Environmental Restoration Program responsible for achieving remedy of the Dump Along Paris-Windham Road. This section reviews actions that have been conducted and that are planned in the future to ensure regulatory agencies and the public have been provided with appropriate opportunities to stay informed of progress of the AOC's remediation and to provide meaningful input on the planning effort and final selection of a remedy.

As described in Section 9.0, two of the nine NCP evaluation criteria are known as "modifying criteria." These are state acceptance and community acceptance. These criteria provide a framework for obtaining the necessary agency coordination and public involvement in the remedy selection process.

## 10.1 STATE ACCEPTANCE

State acceptance considers comments received from agencies of the state of Ohio on the remedial alternatives being considered. For the process supporting remedy of the Dump Along Paris-Windham Road, Ohio EPA is the lead regulatory agency, and this SC/FFS has been prepared in consultation with Ohio EPA. Ohio EPA has provided input during the ongoing investigation and report development process to ensure the remedy selected for this AOC meets the needs of the state of Ohio and fulfills the requirements of the DFFO (Ohio EPA 2004). Comments will be solicited from Ohio EPA on this SC/FFS and on the PP. The U.S. Army will obtain Ohio EPA concurrence prior to selecting the final remedy for the Dump Along Paris-Windham Road.

## 10.2 COMMUNITY ACCEPTANCE

Community acceptance considers comments provided by the community on the remedial alternatives being considered. CERCLA 42 U.S. Code 9617(a) emphasizes early, constant, and responsive community relations. The U.S. Army has prepared a *Community Relations Plan* (USACE 2003b) for RVAAP to ensure the public has convenient access to information regarding project progress. The community relations program interacts with the public through news releases; public meetings; and Restoration Advisory Board meetings with local officials, interest groups, and the general public.

The public also is provided the opportunity to comment on draft documents submitted to the Administrative Record that support remedy of the Dump Along Paris-Windham Road.

CERCLA 42 U.S. Code 9617(a) requires that an Administrative Record be established "at or near the facility at issue." Relevant documents regarding RVAAP have been made available to the public for review and comment. The Administrative Record for this project is available at the following location:

**Ravenna Army Ammunition Plant**
Building 1037 Conference Room
8451 State Route 5
Ravenna, Ohio 44266-9297

Access to RVAAP is restricted but can be obtained by contacting facility management at (330) 358-7311. In addition, an Information Repository of current information and final documents is available to any interested reader at the following libraries:

**Reed Memorial Library**
167 East Main Street
Ravenna, Ohio 44266

**Newton Falls Public Library**
204 South Canal Street
Newton Falls, Ohio 44444-1694

Also, RVAAP has an online resource for restoration news and information. This website is available at: <www.rvaap.org>.

Similar to state agencies, comments will be received from the community upon issuance of this FFS and the PP. The U.S. Army will request public comments on the PP for the Dump Along Paris-Windham Road, as required by the CERCLA regulatory process and the RVAAP *Community Relations Plan*. These comments will be considered in the final selection of a remedy for the Dump Along Paris-Windham Road. Responses to these comments will be addressed in the responsiveness summary of the ROD.

# 11.0 CONCLUSIONS

## 11.1 CONCLUSIONS

The primary purpose of this SC/FFS is to: (1) evaluate the nature and extent of contamination at the Dump Along Paris-Windham Road following the limited "RD/RA" using data collected during previous investigations; (2) determine the potential risk to appropriate human and ecological receptors; and (3) develop, screen, and evaluate remedial alternatives in compliance with the CERCLA process. This SC/FFS examined the history of the Dump Along Paris-Windham Road, summarized previous investigations, outlined CUGs and RAO for the AOC, and identified alternatives potentially applicable for meeting these CUGs.

The RAFLU for the Dump Along Paris-Windham Road is Military Training. Chemical-specific CUGs were identified for the Representative Receptor (Range Maintenance Soldier), Adult and Juvenile Trespassers, and Resident Farmer. CUGs were identified for a Resident Farmer to provide a baseline for evaluating whether this AOC may be eligible for unrestricted land use.

This SC/FFS establishes the RAO for the Dump Along Paris-Windham Road and evaluates RAs to reduce risks to the environment to obtain a final remedy with respect to shallow surface soil. The RAO analysis identified COCs in impacted shallow surface soil at the Dump Along Paris-Windham Road that require further evaluation of potential remedial alternatives for Residential Land Use. The RAO analysis indicates the Representative Receptor (Range Maintenance Soldier) and Adult and Juvenile Trespassers do not have COCs in media at the AOC, and the RAFLU is protective with respect to impacted shallow surface soil. NFA is recommended for the protection of ecological resources within the AOC. However, COCs were identified for the Resident Farmer; therefore, the following potential remedial alternatives were developed:

- Alternative 1: No Action; and
- Alternative 2: LUCs.

These alternatives were assessed and compared against one another to provide information of sufficient quality and quantity to justify the selection of a remedy.

## 11.2 RECOMMENDED ALTERNATIVE

The recommended alternative for the final remedy of the Dump Along Paris-Windham Road is Alternative 2: LUCs. COCs do not exist for the Representative Receptor for the RAFLU (Range Maintenance Soldier) and Adult and Juvenile Trespassers. However, COCs exist within shallow surface soil for the Resident Farmer; therefore, LUCs are required to ensure protection of this receptor. ACM is also known to be present within the subsurface. Alternative 2 fully complies with ARARs by including signs alerting persons of the presence of ACM and offers long-term effectiveness and permanence when implemented and maintained. Alternative 2 is easily

implementable in a relatively short time frame and is expected to have a discounted cost of approximately $93,384.

The next step in the CERCLA process is to prepare a PP to solicit public input regarding the remedial alternatives. The PP will present alternatives evaluated in the FFS together with the preferred alternative for the Dump Along Paris-Windham Road.

The ROD will document the remedy for the Dump Along Paris-Windham Road. Comments on the PP received from state and federal agencies and the public will be considered in drafting the ROD for the AOC. The ROD will provide a brief summary of the history, characteristics, risks, and selected remedy. The ROD also will include a responsiveness summary, which addresses comments received on the PP.

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# APPENDIX A

## Photographs

# SAIC Site Photographs
# August 2009

**Photograph 1. View from Paris-Windham Road Bridge over Sand Creek (sample location S-9 on left side of creek)**

**Photograph 2. Looking South Along Paris-Windham Road (AOC on right)**

**Photograph 3. Dense Growth at North End of AOC**

**Photograph 4. Dense Growth Downgradient of Former Dump Site**

**Photograph 5. Drainage Swale Facing East with No Standing Water (sheen from high moisture content of sediment)**

**Photograph 6. Drainage Swale Facing Southeast with No Standing Water (sheen from high moisture content of sediment)**

**Photograph 7. View of Floodplain Located West of Drainage Swale**

**Photograph 8. Toe of Slope in Vicinity of Grid 5**

# SAIC Site Photographs
# November 2011

**Photograph 9. View to West of Northern Wetland from Paris-Windham Road (Grid 2)**

**Photograph 10. View to West of Sand Creek Floodplain from Paris-Windham Road (Grid 4)**

**Photograph 11. View to Southwest of Southern Wetland from Paris-Windham Road (Grid 6)**

**Photograph 12. View to Southwest of Southern Wetland from Paris-Windham Road (excavation and fill area in Grids 8-9 in foreground; Grid 10 in background left)**

**Photograph 13. View to Northeast of Northern Wetland from Sand Creek Floodplain (Grids 1-3 and Paris-Windham Road in background)**

**Photograph 14. View to North of Sand Creek Floodplain between Northern and Southern Wetlands (Grids 1-5 on right)**

**Photograph 15. View to East of Grid 4 from Sand Creek Floodplain (Paris-Windham Road in background)**

**Photograph 16. View to Southeast of Southern Wetland from Sand Creek Floodplain (excavation and fill area in Grids 6-8 in background)**

**Photograph 17. View to Southeast of Southern Wetland from Sand Creek Floodplain (Grids 9 and 10 in background)**

**Photograph 18. View to Southeast of Southern Wetland from Sand Creek Floodplain (Grids 7-10 on left)**

# APPENDIX B

# Human Health Risk Assessment Supporting Data

# List of Tables

**SRC and COPC Screening**


Table B-1. SRC and COPC Screening for Subsurface Soil (> 2 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Fill Area EU ..... 1
Table B-2. SRC and COPC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU ..... 2
Table B-3. SRC and COPC Screening for Soil (ISM Samples) at Paris-Windham Dump AOC ..... 3
Table B-4. SRC and COPC Screening for Surface Water at Paris-Windham Dump AOC ..... 4


**COC Screening: Soil – Range Maintenance Soldier**


Table B-5. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU
Representative Receptor: Range Maintenance Soldier ..... 5
Table B-6. COC Screening for Subsurface Soil (>2 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Fill Area EU
Representative Receptor: Range Maintenance Soldier ..... 6
Table B-7. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples
Representative Receptor: Range Maintenance Soldier ..... 7


**COC Screening: Soil – Trespasser**


Table B-8. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU
Representative Receptor: Trespasser ..... 8
Table B-9. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples
Representative Receptor: Trespasser ..... 9


**COC Screening: Soil – Resident Farmer**


Table B-10. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU
Baseline Receptor: Resident Farmer ..... 10
Table B-11. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples
Baseline Receptor: Resident Farmer ..... 11


**COC Screening: Surface Water – Trespasser**


Table B-12. COC Screening for Surface Water at Paris-Windham Dump AOC
Representative Receptor: Trespasser ..... 12


**COC Screening: Surface Water – Resident Farmer**


Table B-13. COC Screening for Surface Water at Paris-Windham Dump AOC
Baseline Receptor: Resident Farmer ..... 13

**Table B-1. SRC and COPC Screening for Subsurface Soil (> 2 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Fill Area EU**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | SRC? (yes/no) | SRC Justification | Screening FWCUG[b] (HQ= 0.1 or Risk=1E-6) RFA | RFC | NGT | Risk Screening Level | Screening Level Source[c] | COPC? (yes/no) | COPC Justification | Station at Max Detect | Date Collected at Max Detect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 5/ 5 | 6500 | 11000 | 8240 | 17700 | No | Below background | 52923 | 7380 | 3496 | 3496 | NGT | No | Below background | PWss-005 | 4/29/2003 |
| Arsenic | 7440-38-2 | 5/ 5 | 9.2 | 13 | 11.2 | 15.4 | No | Below background | 0.425 | 0.524 | 2.78 | 0.425 | RFA | No | Below background | PWss-008 | 4/29/2003 |
| Barium | 7440-39-3 | 5/ 5 | 47 | 180 | 76.6 | 88.4 | Yes | Exceeds background | 8966 | 1413 | 351 | 351 | NGT | No | Below risk screening criteria | PWss-005 | 4/29/2003 |
| Beryllium | 7440-41-7 | 5/ 5 | 0.34 | 1.2 | 0.576 | 0.88 | Yes | Exceeds background | -- | -- | -- | 16 | RSL | No | Below risk screening criteria | PWss-005 | 4/29/2003 |
| Calcium | 7440-70-2 | 5/ 5 | 1500 | 39000 | 9860 | 15800 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-005 | 4/29/2003 |
| Chromium[d] | 7440-47-3 | 5/ 5 | 8.3 | 11 | 9.96 | 17.4 | No | Below background | 90.4 | 19.9 | 1.64 | 1.64 | NGT | No | Below background | PWss-008 | 4/29/2003 |
| Cobalt | 7440-48-4 | 5/ 5 | 4.3 | 7.1 | 5.98 | 10.4 | No | Below background | 803 | 131 | 7.03 | 7.03 | NGT | No | Below background | PWss-009 | 4/28/2003 |
| Copper | 7440-50-8 | 5/ 5 | 9.3 | 19 | 14 | 17.7 | Yes | Exceeds background | 2714 | 311 | 25368 | 311 | RFC | No | Below risk screening criteria | PWss-005 | 4/29/2003 |
| Iron | 7439-89-6 | 5/ 5 | 14000 | 22000 | 18000 | 23100 | No | Essential Nutrient | 19010 | 2313 | 184370 | 180000 | RDA | No | Essential Nutrient | PWss-005 | 4/29/2003 |
| Lead | 7439-92-1 | 5/ 5 | 14 | 19 | 16.2 | 26.1 | No | Below background | -- | -- | -- | 400 | RSL | No | Below background | PWss-005 | 4/29/2003 |
| Magnesium | 7439-95-4 | 5/ 5 | 1500 | 6100 | 2580 | 3030 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-005 | 4/29/2003 |
| Manganese | 7439-96-5 | 5/ 5 | 390 | 880 | 540 | 1450 | No | Below background | 1482 | 293 | 35.1 | 35.1 | NGT | No | Below background | PWss-005 | 4/29/2003 |
| Mercury | 7439-97-6 | 5/ 5 | 0.025 | 0.048 | 0.036 | 0.036 | Yes | Exceeds background | 16.5 | 2.27 | 172 | 2.27 | RFC | No | Below risk screening criteria | PWss-006 | 4/29/2003 |
| Nickel | 7440-02-0 | 5/ 5 | 10 | 21 | 14.2 | 21.1 | No | Below background | 1346 | 155 | 12639 | 155 | RFC | No | Below background | PWss-009 | 4/28/2003 |
| Potassium | 7440-09-7 | 5/ 5 | 740 | 1100 | 892 | 927 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-005 | 4/29/2003 |
| Sodium | 7440-23-5 | 5/ 5 | 130 | 380 | 202 | 123 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-005 | 4/29/2003 |
| Vanadium | 7440-62-2 | 5/ 5 | 10 | 15 | 12.2 | 31.1 | No | Below background | 156 | 44.9 | 2304 | 44.9 | RFC | No | Below background | PWss-008 | 4/29/2003 |
| Zinc | 7440-66-6 | 5/ 5 | 50 | 100 | 66.8 | 61.8 | Yes | Exceeds background | 19659 | 2321 | 187269 | 2321 | RFC | No | Below risk screening criteria | PWss-005 | 4/29/2003 |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | | | | |
| Acenaphthylene | 208-96-8 | 1/ 1 | 0.13 | 0.13 | 0.13 | -- | Yes | Detected organic | -- | -- | -- | 340 | RSL | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| Anthracene | 120-12-7 | 1/ 1 | 0.12 | 0.12 | 0.12 | -- | Yes | Detected organic | -- | -- | -- | 1700 | RSL | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| **Benz(a)anthracene** | **56-55-3** | **1/ 1** | **1** | **1** | **1** | -- | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |
| **Benzo(a)pyrene** | **50-32-8** | **1/ 1** | **1.3** | **1.3** | **1.3** | -- | **Yes** | **Detected organic** | **0.022** | **0.065** | **0.477** | **0.022** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |
| **Benzo(b)fluoranthene** | **205-99-2** | **1/ 1** | **1.2** | **1.2** | **1.2** | -- | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |
| Benzo(ghi)perylene | 191-24-2 | 1/ 1 | 0.75 | 0.75 | 0.75 | -- | Yes | Detected organic | -- | -- | -- | 1.5 | RSL | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| Benzo(k)fluoranthene | 207-08-9 | 1/ 1 | 1.4 | 1.4 | 1.4 | -- | Yes | Detected organic | 2.21 | 6.5 | 47.7 | 2.21 | RFA | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| Chrysene | 218-01-9 | 1/ 1 | 1.1 | 1.1 | 1.1 | -- | Yes | Detected organic | 22.1 | 65 | 477 | 22.1 | RFA | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| **Dibenz(a,h)anthracene** | **53-70-3** | **1/ 1** | **0.24** | **0.24** | **0.24** | -- | **Yes** | **Detected organic** | **0.022** | **0.065** | **0.477** | **0.022** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |
| Fluoranthene | 206-44-0 | 1/ 1 | 1.7 | 1.7 | 1.7 | -- | Yes | Detected organic | 276 | 163 | 5087 | 163 | RFC | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| **Indeno(1,2,3-cd)pyrene** | **193-39-5** | **1/ 1** | **0.75** | **0.75** | **0.75** | -- | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |
| Phenanthrene | 85-01-8 | 1/ 1 | 0.32 | 0.32 | 0.32 | -- | Yes | Detected organic | -- | -- | -- | 170 | RSL | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| Pyrene | 129-00-0 | 1/ 1 | 1.4 | 1.4 | 1.4 | -- | Yes | Detected organic | 207 | 122 | 3815 | 122 | RFC | No | Below risk screening criteria | PWss-009 | 4/28/2003 |
| ***Pesticides/PCBs*** | | | | | | | | | | | | | | | | | |
| **PCB-1254** | **11097-69-1** | **1/ 1** | **0.23** | **0.23** | **0.23** | -- | **Yes** | **Detected organic** | **0.203** | **0.12** | **3.46** | **0.12** | **RFC** | **Yes** | **Exceeds screening level** | **PWss-009** | **4/28/2003** |

[a]Background criteria for soil >1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[b]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA), Resident Farmer Child (RFC), and National Guard Trainee (NGT) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[c]Screening Level Source:

NGT = FWCUG for National Guard Trainee
RDA = Concentration associated with recommended daily allowance of essential nutrient
RFA = FWCUG for Resident Farmer Adult
RFC = FWCUG for Resident Farmer Child
RSL = United States Environmental Protection Agency Residential Regional Screening Level

[d]FWCUG is the most conservative (smallest) of the FWCUGs for hexavalent and trivalent chromium.

AOC = Area of Concern
bgs = Below ground surface
CAS = Chemical Abstract Service
COPC = Chemical of Potential Concern
EU = Exposure Unit
HQ = Hazard Quotient
PCB = Polychlorinated Biphenyl
SRC = Site-related Contaminant
-- = no value available
**Bold** = chemical is a COPC

**Table B-2. SRC and COPC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | SRC? (yes/no) | SRC Justification | Screening FWCUG[b] (HQ= 0.1 or Risk=1E-6) RFA | RFC | NGT | Risk Screening Level | Screening Level Source[c] | COPC? (yes/no) | COPC Justification | Station at Max Detect | Date Collected at Max Detect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | | | |
| **Aluminum** | **7429-90-5** | **13/ 13** | **5300** | **18000** | **8350** | **17700** | **Yes** | **Exceeds background** | **52923** | **7380** | **3496** | **3496** | **NGT** | **Yes** | **Exceeds screening level** | **PWss-002** | **4/28/2003** |
| Antimony | 7440-36-0 | 2/ 13 | 0.49 | 0.6 | 0.31 | 0.96 | No | Below background | 13.6 | 2.82 | 175 | 2.82 | RFC | No | Below background | PWss-001 | 4/28/2003 |
| Arsenic | 7440-38-2 | 13/ 13 | 2.6 | 13 | 7.53 | 15.4 | No | Below background | 0.425 | 0.524 | 2.78 | 0.425 | RFA | No | Below background | PWss-010 | 4/28/2003 |
| Barium | 7440-39-3 | 13/ 13 | 40 | 150 | 74.8 | 88.4 | Yes | Exceeds background | 8966 | 1413 | 351 | 351 | NGT | No | Below risk screening criteria | PWss-002 | 4/28/2003 |
| Beryllium | 7440-41-7 | 13/ 13 | 0.33 | 1.9 | 0.566 | 0.88 | Yes | Exceeds background | -- | -- | -- | 16 | RSL | No | Below risk screening criteria | PWss-002 | 4/28/2003 |
| Cadmium | 7440-43-9 | 13 | 0.1 | 0.59 | 0.204 | 0 | Yes | Exceeds background | 22.3 | 6.41 | 10.9 | 6.41 | RFC | No | Below risk screening criteria | PWsd-002 | 4/29/2003 |
| Calcium | 7440-70-2 | 4/ 13/ 13 | 1700 | 55000 | 6650 | 15800 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-002 | 4/28/2003 |
| Chromium[d] | 7440-47-3 | 13/ 13 | 7.9 | 17 | 12.4 | 17.4 | No | Below background | 90.4 | 19.9 | 1.64 | 1.64 | NGT | No | Below background | PWsd-006 | 4/29/2003 |
| Cobalt | 7440-48-4 | 13/ 13 | 4.7 | 7.5 | 5.85 | 10.4 | No | Below background | 803 | 131 | 7.03 | 7.03 | NGT | No | Below background | PWss-010 | 4/28/2003 |
| Copper | 7440-50-8 | 13/ 13 | 9.4 | 27 | 18.5 | 17.7 | Yes | Exceeds background | 2714 | 311 | 25368 | 311 | RFC | No | Below risk screening criteria | PWsd-005 | 4/29/2003 |
| Iron | 7439-89-6 | 13/ 13 | 12000 | 18000 | 14800 | 23100 | No | Essential Nutrient | 19010 | 2313 | 184370 | 180000 | RDA | No | Essential Nutrient | PWsd-003 | 4/29/2003 |
| Lead | 7439-92-1 | 13/ 13 | 15 | 29 | 19.5 | 26.1 | Yes | Exceeds background | -- | -- | -- | 400 | RSL | No | Below risk screening criteria | PWss-002 | 4/28/2003 |
| Magnesium | 7439-95-4 | 13/ 13 | 1300 | 10000 | 2700 | 3030 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-002 | 4/28/2003 |
| **Manganese** | **7439-96-5** | **13/ 13** | **95** | **1900** | **386** | **1450** | **Yes** | **Exceeds background** | **1482** | **293** | **35.1** | **35.1** | **NGT** | **Yes** | **Exceeds screening level** | **PWss-002** | **4/28/2003** |
| Mercury | 7439-97-6 | 13/ 13 | 0.045 | 0.08 | 0.0631 | 0.036 | Yes | Exceeds background | 16.5 | 2.27 | 172 | 2.27 | RFC | No | Below risk screening criteria | PWsd-002 | 4/29/2003 |
| Nickel | 7440-02-0 | 13/ 13 | 9.9 | 37 | 19.1 | 21.1 | Yes | Exceeds background | 1346 | 155 | 12639 | 155 | RFC | No | Below risk screening criteria | PWsd-005 | 4/29/2003 |
| Potassium | 7440-09-7 | 13/ 13 | 730 | 1900 | 1180 | 927 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWsd-006 | 4/29/2003 |
| Silver | 7440-22-4 | 1/ 13 | 0.39 | 0.39 | 0.396 | 0 | Yes | Exceeds background | 324 | 38.6 | 3105 | 38.6 | RFC | No | Below risk screening criteria | PWss-001 | 4/28/2003 |
| Sodium | 7440-23-5 | 11/ 13 | 120 | 480 | 185 | 123 | No | Essential Nutrient | -- | -- | -- | 1000000 | RDA | No | Essential Nutrient | PWss-002 | 4/28/2003 |
| Vanadium | 7440-62-2 | 13/ 13 | 9.3 | 18 | 13 | 31.1 | No | Below background | 156 | 44.9 | 2304 | 44.9 | RFC | No | Below background | PWsd-005 | 4/29/2003 |
| Zinc | 7440-66-6 | 13/ 13 | 51 | 120 | 81.7 | 61.8 | Yes | Exceeds background | 19659 | 2321 | 187269 | 2321 | RFC | No | Below risk screening criteria | PWsd-002 | 4/29/2003 |
| ***Explosives*** | | | | | | | | | | | | | | | | | |
| Nitrocellulose | 9004-70-0 | 1/ 1 | 2 | 2 | 2 | -- | Yes | Detected organic | -- | -- | -- | 23000000 | RSL | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | | | | |
| **Benz(a)anthracene** | **56-55-3** | **1/ 1** | **0.25** | **0.25** | **0.25** | -- | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWsd-004** | **4/29/2003** |
| **Benzo(a)pyrene** | **50-32-8** | **1/ 1** | **0.33** | **0.33** | **0.33** | -- | **Yes** | **Detected organic** | **0.022** | **0.065** | **0.477** | **0.022** | **RFA** | **Yes** | **Exceeds screening level** | **PWsd-004** | **4/29/2003** |
| **Benzo(b)fluoranthene** | **205-99-2** | **1/ 1** | **0.39** | **0.39** | **0.39** | -- | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWsd-004** | **4/29/2003** |
| Benzo(k)fluoranthene | 207-08-9 | 1/ 1 | 0.33 | 0.33 | 0.33 | -- | Yes | Detected organic | 2.21 | 6.5 | 47.7 | 2.21 | RFA | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| Chrysene | 218-01-9 | 1/ 1 | 0.33 | 0.33 | 0.33 | -- | Yes | Detected organic | 22.1 | 65 | 477 | 22.1 | RFA | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| Fluoranthene | 206-44-0 | 1/ 1 | 0.44 | 0.44 | 0.44 | -- | Yes | Detected organic | 276 | 163 | 5087 | 163 | RFC | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| Pyrene | 129-00-0 | 1/ 1 | 0.44 | 0.44 | 0.44 | -- | Yes | Detected organic | 207 | 122 | 3815 | 122 | RFC | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| ***Pesticides/PCBs*** | | | | | | | | | | | | | | | | | |
| PCB-1254 | 11097-69-1 | 1/ 1 | 0.086 | 0.086 | 0.086 | -- | Yes | Detected organic | 0.203 | 0.12 | 3.46 | 0.12 | RFC | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |
| ***Volatile Organic Compounds*** | | | | | | | | | | | | | | | | | |
| Acetone | 67-64-1 | 1/ 1 | 0.041 | 0.041 | 0.041 | -- | Yes | Detected organic | -- | -- | -- | 6100 | RSL | No | Below risk screening criteria | PWsd-004 | 4/29/2003 |

[a]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[b]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA), Resident Farmer Child (RFC), and National Guard Trainee (NGT) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[c]Screening Level Source:

NGT = FWCUG for National Guard Trainee
RDA = Concentration associated with recommended daily allowance of essential nutrient
RFA = FWCUG for Resident Farmer Adult
RFC = FWCUG for Resident Farmer Child
RSL = United States Environmental Protection Agency Residential Regional Screening Level

[d]FWCUG is the most conservative (smallest) of the FWCUGs for hexavalent and trivalent chromium.

AOC = Area of Concern
bgs = Below ground surface
CAS = Chemical Abstract Service
COPC = Chemical of Potential Concern
EU = Exposure Unit
HQ = Hazard Quotient
PCB = Polychlorinated Biphenyl
SRC = Site-related Contaminant
-- = no value available
**Bold** = chemical is a COPC

**Table B-3. SRC and COPC Screening for Soil (ISM Samples) at Paris-Windham Dump AOC**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | SRC? (yes/no) | SRC Justification | Screening FWCUG[b] (HQ= 0.1 or Risk=1E-6) RFA | RFC | NGT | Risk Screening Level | Screening Level Source[c] | COPC? (yes/no) | COPC Justification | Station at Max Detect | Date Collected at Max Detect | Sample ID at Max Detect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | | | | | |
| 1,4-Dichlorobenzene | 106-46-7 | 1/ 2 | 0.23 | 0.23 | 0.16 | -- | Yes | Detected organic | -- | -- | -- | 2.4 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| 2-Methylnaphthalene | 91-57-6 | 2/ 2 | 0.0055 | 0.064 | 0.0348 | -- | Yes | Detected organic | 238 | 30.6 | 2384 | 30.6 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Acenaphthene | 83-32-9 | 1/ 2 | 0.12 | 0.12 | 0.0688 | -- | Yes | Detected organic | -- | -- | -- | 340 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Acenaphthylene | 208-96-8 | 2/ 2 | 0.056 | 0.12 | 0.088 | -- | Yes | Detected organic | -- | -- | -- | 340 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Anthracene | 120-12-7 | 2/ 2 | 0.041 | 0.22 | 0.131 | -- | Yes | Detected organic | -- | -- | -- | 1700 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| **Benz(a)anthracene** | **56-55-3** | **2/ 2** | **0.36** | **1** | **0.68** | **--** | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-CONT2** | **10/28/2003** | **PWss-CONT2-0001-SO** |
| **Benzo(a)pyrene** | **50-32-8** | **2/ 2** | **0.46** | **1.4** | **0.93** | **--** | **Yes** | **Detected organic** | **0.022** | **0.065** | **0.477** | **0.022** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-CONT2** | **10/28/2003** | **PWss-CONT2-0001-SO** |
| **Benzo(b)fluoranthene** | **205-99-2** | **2/ 2** | **0.5** | **1.4** | **0.95** | **--** | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-CONT2** | **10/28/2003** | **PWss-CONT2-0001-SO** |
| Benzo(ghi)perylene | 191-24-2 | 2/ 2 | 0.3 | 0.79 | 0.545 | -- | Yes | Detected organic | -- | -- | -- | 1.5 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Benzo(k)fluoranthene | 207-08-9 | 2/ 2 | 0.45 | 1.4 | 0.925 | -- | Yes | Detected organic | 2.21 | 6.5 | 47.7 | 2.21 | RFA | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Bis(2-ethylhexyl)phthalate | 117-81-7 | 1/ 2 | 0.025 | 0.025 | 0.0575 | -- | Yes | Detected organic | -- | -- | -- | 35 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Carbazole | 86-74-8 | 1/ 2 | 0.19 | 0.19 | 0.14 | -- | Yes | Detected organic | 69.4 | 44.6 | 835 | 44.6 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Chrysene | 218-01-9 | 2/ 2 | 0.41 | 1.2 | 0.805 | -- | Yes | Detected organic | 22.1 | 65 | 477 | 22.1 | RFA | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| **Dibenz(a,h)anthracene** | **53-70-3** | **2/ 2** | **0.14** | **0.36** | **0.25** | **--** | **Yes** | **Detected organic** | **0.022** | **0.065** | **0.477** | **0.022** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-CONT2** | **10/28/2003** | **PWss-CONT2-0001-SO** |
| Dibenzofuran | 132-64-9 | 2/ 2 | 0.0064 | 0.051 | 0.0287 | -- | Yes | Detected organic | 119 | 15.3 | 1192 | 15.3 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Diethyl phthalate | 84-66-2 | 1/ 2 | 0.0093 | 0.0093 | 0.0214 | -- | Yes | Detected organic | -- | -- | -- | 4900 | RSL | No | Below risk screening criteria | PWss-CONT1 | 9/30/2003 | PWss-CONT1-0001-SO |
| Di-n-butyl phthalate | 84-74-2 | 1/ 2 | 0.041 | 0.041 | 0.0655 | -- | Yes | Detected organic | -- | -- | -- | 610 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Fluoranthene | 206-44-0 | 2/ 2 | 0.67 | 2.9 | 1.79 | -- | Yes | Detected organic | 276 | 163 | 5087 | 163 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Fluorene | 86-73-7 | 2/ 2 | 0.011 | 0.1 | 0.0555 | -- | Yes | Detected organic | 737 | 243 | 11458 | 243 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| **Indeno(1,2,3-cd)pyrene** | **193-39-5** | **2/ 2** | **0.31** | **0.7** | **0.505** | **--** | **Yes** | **Detected organic** | **0.221** | **0.65** | **4.77** | **0.221** | **RFA** | **Yes** | **Exceeds screening level** | **PWss-CONT2** | **10/28/2003** | **PWss-CONT2-0001-SO** |
| Naphthalene | 91-20-3 | 1/ 2 | 0.039 | 0.039 | 0.0283 | -- | Yes | Detected organic | 368 | 122 | 1541 | 122 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Phenanthrene | 85-01-8 | 2/ 2 | 0.16 | 1.1 | 0.63 | -- | Yes | Detected organic | -- | -- | -- | 170 | RSL | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |
| Pyrene | 129-00-0 | 2/ 2 | 0.62 | 2 | 1.31 | -- | Yes | Detected organic | 207 | 122 | 3815 | 122 | RFC | No | Below risk screening criteria | PWss-CONT2 | 10/28/2003 | PWss-CONT2-0001-SO |

[a]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[b]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA), Resident Farmer Child (RFC), and National Guard Trainee (NGT) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[c]Screening Level Source:

NGT = FWCUG for National Guard Trainee
RDA = Concentration associated with recommended daily allowance of essential nutrient
RFA = FWCUG for Resident Farmer Adult
RFC = FWCUG for Resident Farmer Child
RSL = United States Environmental Protection Agency Residential Regional Screening Level

AOC = Area of Concern
bgs = Below ground surface
CAS = Chemical Abstract Service
COPC = Chemical of Potential Concern
HQ = Hazard Quotient
ISM = Incremental Sampling Method
PCB = Polychlorinated Biphenyl
SRC = Site-related Contaminant
-- = no value available
**Bold** = chemical is a COPC

**Table B-4. SRC and COPC Screening for Surface Water at Paris-Windham Dump AOC**

| Analyte (mg/L) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | SRC? (yes/no) | SRC Justification | Screening FWCUG[b] (HQ= 0.1 or Risk=1E-6) RFA | RFC | NGT | Risk Screening Level | Screening Level Source[c] | COPC? (yes/no) | COPC Justification | Station at Max Detect | Date Collected at Max Detect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 7 | 0.042 | 0.28 | 0.104 | 3.37 | No | Below background | 63.895 | 14.827 | 73.445 | 14.827 | RFC | No | Below background | PWsw-004 | 04/29/03 |
| **Arsenic** | **7440-38-2** | **7/ 7** | **0.0028** | **0.0082** | **0.00549** | **0.0032** | **Yes** | **Exceeds background** | **0.0011** | **0.0012** | **0.0042** | **0.0011** | **RFA** | **Yes** | **Exceeds screening level** | **PWsw-005** | **04/29/03** |
| Barium | 7440-39-3 | 7/ 7 | 0.035 | 0.12 | 0.066 | 0.0475 | Yes | Exceeds background | 12.131 | 2.901 | 10.64 | 2.901 | RFC | No | Below risk screening criteria | PWsw-004 | 04/29/03 |
| Calcium | 7440-70-2 | 7/ 7 | 23 | 60 | 41.4 | 41.4 | No | Essential Nutrient | -- | -- | -- | 500 | RDA | No | Essential Nutrient | PWsw-001 | 04/29/03 |
| **Cobalt** | **7440-48-4** | **7/ 7** | **0.001** | **0.0015** | **0.00177** | **0** | **Yes** | **Exceeds background** | -- | -- | -- | **0.0011** | **RSL** | **Yes** | **Exceeds screening level** | **PWsw-006** | **04/29/03** |
| Copper | 7440-50-8 | 4/ 7 | 0.0022 | 0.0039 | 0.0025 | 0.0079 | No | Below background | 2.788 | 0.614 | 7.199 | 0.614 | RFC | No | Below background | PWsw-004 | 04/29/03 |
| Iron | 7439-89-6 | 7/ 7 | 3.6 | 9.4 | 5.04 | 2.56 | No | Essential Nutrient | 20 | 4.527 | 31.296 | 18 | RDA | No | Essential Nutrient | PWsw-005 | 04/29/03 |
| Lead | 7439-92-1 | 2/ 7 | 0.0019 | 0.0027 | 0.00137 | 0 | Yes | Exceeds background | -- | -- | -- | 0.015 | RSL | No | Below risk screening criteria | PWsw-004 | 04/29/03 |
| Magnesium | 7439-95-4 | 7/ 7 | 6 | 12 | 9.4 | 10.8 | No | Essential Nutrient | -- | -- | -- | 200 | RDA | No | Essential Nutrient | PWsw-004 | 04/29/03 |
| Manganese | 7439-96-5 | 7/ 7 | 0.26 | 0.56 | 0.379 | 0.391 | Yes | Exceeds background | 2.476 | 0.633 | 1.449 | 0.633 | RFC | No | Below risk screening criteria | PWsw-006 | 04/29/03 |
| Mercury | 7439-97-6 | 6/ 7 | 0.000072 | 0.0001 | 0.0000896 | 0 | Yes | Exceeds background | 0.0182 | 0.0044 | 0.016 | 0.00435 | RFC | No | Below risk screening criteria | PWsw-005 | 04/29/03 |
| Nickel | 7440-02-0 | 4/ 7 | 0.002 | 0.0075 | 0.00487 | 0 | Yes | Exceeds background | 1.445 | 0.312 | 8.258 | 0.312 | RFC | No | Below risk screening criteria | PWsw-006 | 04/29/03 |
| Potassium | 7440-09-7 | 7/ 7 | 1.7 | 5.4 | 4.17 | 3.17 | No | Essential Nutrient | -- | -- | -- | 1750 | RDA | No | Essential Nutrient | PWsw-004 | 04/29/03 |
| Sodium | 7440-23-5 | 7/ 7 | 4.2 | 9.9 | 7.76 | 21.3 | No | Essential Nutrient | -- | -- | -- | 1200 | RDA | No | Essential Nutrient | PWsw-004 | 04/29/03 |
| Zinc | 7440-66-6 | 4/ 7 | 0.013 | 0.024 | 0.0149 | 0.042 | No | Below background | 21.002 | 4.617 | 58.216 | 4.617 | RFC | No | Below background | PWsw-004 | 04/29/03 |
| ***Explosives*** | | | | | | | | | | | | | | | | | |
| Nitrocellulose | 9004-70-0 | 1/ 1 | 0.094 | 0.094 | 0.094 | -- | Yes | Exceeds background | -- | -- | -- | 11000 | RSL | No | Below risk screening criteria | PWsw-004 | 04/29/03 |

[a]Background criteria for surface water from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[b]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA), Resident Farmer Child (RFC), and National Guard Trainee (NGT) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[c]Screening Level Source:

NGT = FWCUG for National Guard Trainee
RDA = Concentration associated with recommended daily allowance of essential nutrient
RFA = FWCUG for Resident Farmer Adult
RFC = FWCUG for Resident Farmer Child
RSL = United States Environmental Protection Agency Residential Regional Screening Level
AOC = Area of Concern
CAS = Chemical Abstract Service
COPC = Chemical of Potential Concern
HQ = Hazard Quotient
SRC = Site-related Contaminant
-- = no value available
**Bold** = chemical is a COPC

**Table B-5. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU**
**Representative Receptor: Range Maintenance Soldier**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Range Maintenance Soldier FWCUG[a] | | Background Criteria[b] | COC? (yes/no) | COC Justification | Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | HQ=1 | Risk=1E-5 | | | | |
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 13/ 13 | 5300 | 18000 | 8350 | 9900 | X | 9900 | 1000000 | -- | 17700 | No | EPC below FWCUG | NA |
| Manganese | 7439-96-5 | 13/ 13 | 95 | 1900 | 386 | 807 | L | 807 | 204672 | -- | 1450 | No | EPC below FWCUG | NA |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | |
| Benz(a)anthracene | 56-55-3 | 1/ 1 | 0.25 | 0.25 | 0.25 | -- | D | 0.25 | -- | 26.2 | -- | No | EPC below FWCUG | 1.E-02 |
| Benzo(a)pyrene | 50-32-8 | 1/ 1 | 0.33 | 0.33 | 0.33 | -- | D | 0.33 | -- | 2.62 | -- | No | EPC below FWCUG | 1.E-01 |
| Benzo(b)fluoranthene | 205-99-2 | 1/ 1 | 0.39 | 0.39 | 0.39 | -- | D | 0.39 | -- | 26.2 | -- | No | EPC below FWCUG | 1.E-02 |
| **Sum-of-Ratios for Carcinogens** | | 1/ | | | | | | | | | | | | 2.E-01 |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Range Maintenance Soldier from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[b]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

UCL 95 = 95% upper confidence limit of the mean

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation

L = Lognormal distribution, Land statistic used for UCL 95 calculation

X = Distribution neither normal nor lognormal, t statistic used for UCL 95 calculation

AOC = Area of Concern

bgs = below ground surface

CAS = Chemical Abstract Service

COC = Chemical of Concern

EPC = Exposure Point Concentration

EU = Exposure Unit

HQ = Hazard Quotient

-- = no value available

**Table B-6. COC Screening for Subsurface Soil (>2 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Fill Area EU**
**Representative Receptor: Range Maintenance Soldier**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Range Maintenance Soldier FWCUG[b] | | Background Criteria[a] | COC? (yes/no) | COC Justification | Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | HQ=1 | Risk=1E-5 | | | | |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | |
| Benz(a)anthracene | 56-55-3 | 1 | 1 | 1 | 1 | -- | D | 1 | -- | 26.2 | -- | Yes | EPC below FWCUG | 4E-02 |
| Benzo(a)pyrene | 50-32-8 | 1 1/ | 1.3 | 1.3 | 1.3 | -- | D | 1.3 | -- | 2.62 | -- | Yes | EPC below FWCUG | 5E-01 |
| Benzo(b)fluoranthene | 205-99-2 | 1 1/ | 1.2 | 1.2 | 1.2 | -- | D | 1.2 | -- | 26.2 | -- | Yes | EPC below FWCUG | 5E-02 |
| Dibenz(a,h)anthracene | 53-70-3 | 1 1/ | 0.24 | 0.24 | 0.24 | -- | D | 0.24 | -- | 2.62 | -- | Yes | EPC below FWCUG | 9E-02 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 1 1/ | 0.75 | 0.75 | 0.75 | -- | D | 0.75 | -- | 26.2 | -- | Yes | EPC below FWCUG | 3E-02 |
| ***Pesticides/PCBs*** | | | | | | | | | | | | | | |
| PCB-1254 | 11097-69-1 | 1 1/ | 0.23 | 0.23 | 0.23 | -- | D | 0.23 | 36.7 | 25.7 | -- | Yes | EPC below FWCUG | 9E-03 |
| **Sum-of-Ratios for Carcinogens** | | | | | | | | | | | | | | 7E-01 |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Range Maintenance Soldier from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[b]Background criteria for soil >1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

UCL 95 = 95% upper confidence limit of the mean

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation

L = Lognormal distribution, Land statistic used for UCL 95 calculation

X = Distribution neither normal nor lognormal, t statistic used for UCL 95 calculation

AOC = Area of Concern

bgs = below ground surface

CAS = Chemical Abstract Service

COC = Chemical of Concern

EPC = Exposure Point Concentration

EU = Exposure Unit

HQ = Hazard Quotient

PCB = Polychlorinated Biphenyl

-- = no value available

**Table B-7. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples**
**Representative Receptor: Range Maintenance Soldier**

| | | Analyte (mg/kg) | Benz(a)anthracene | | Benzo(a)pyrene | | Benzo(b)fluoranthene | | Dibenz(a,h)anthracene | | Indeno(1,2,3-cd)pyrene | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CAS Number | 56-55-3 | | 50-32-8 | | 205-99-2 | | 53-70-3 | | 193-39-5 | | |
| | | Range Maintenance Soldier FWCUG[a]: | | | | | | | | | | | |
| | | HQ=1 | -- | | -- | | -- | | -- | | -- | | |
| | | Risk=1E-5 | 26.2 | | 2.62 | | 26.2 | | 2.62 | | 26.2 | | |
| | | Background Criteria[b] | -- | | -- | | -- | | -- | | -- | | |
| Sample ID | Date | Station | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | SOR |
| PWss-CONT1-0001-SO | 9/30/2003 | PWss-CONT1 | No | 1E-02 | No | 2E-01 | No | 2E-02 | No | 5E-02 | No | 1E-02 | 3E-01 |
| PWss-CONT2-0001-SO | 10/28/2003 | PWss-CONT2 | 0.36 No | 4E-02 | 0.46 No | 5E-01 | 0.5 No | 5E-02 | 0.14 No | 1E-01 | 0.31 No | 3E-02 | 8E-01 |
| | | | 1 | | 1.4 | | 1.4 | | 0.36 | | 0.7 | | |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Range Maintenance Soldier from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[b]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

Ratio = Sample concentration/FWCUG
AOC = Area of Concern
bgs = below ground surface
CAS = Chemical Abstract Service
COC = Chemical of Concern
HQ = Hazard Quotient
ISM = Incremental Sampling Method
SOR = Sum-of-Ratios
-- = no value available

**Table B-8. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU**
**Representative Receptor: Trespasser**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Trespasser FWCUG[a] | | | | Background Criteria[b] | COC? (yes/no) | COC Justification | Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | HQ=1 | Source | Risk=1E-5 | Source | | | | |
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 13/ 13 | 5300 | 18000 | 8350 | 9900 | X | 9900 | 1000000 | TJ/TA | -- | -- | 17700 | No | EPC below FWCUG | NA |
| Manganese | 7439-96-5 | 13/ 13 | 95 | 1900 | 386 | 807 | L | 807 | 220293 | TA | -- | -- | 1450 | No | EPC below FWCUG | NA |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | | | |
| Benz(a)anthracene | 56-55-3 | 1/ 1 | 0.25 | 0.25 | 0.25 | -- | D | 0.25 | -- | -- | 11.3 | TA | -- | No | EPC below FWCUG | 2.E-02 |
| Benzo(a)pyrene | 50-32-8 | 1/ 1 | 0.33 | 0.33 | 0.33 | -- | D | 0.33 | -- | -- | 1.13 | TA | -- | No | EPC below FWCUG | 3.E-01 |
| Benzo(b)fluoranthene | 205-99-2 | 1/ 1 | 0.39 | 0.39 | 0.39 | -- | D | 0.39 | -- | -- | 11.3 | TA | -- | No | EPC below FWCUG | 3.E-02 |
| **Sum-of-Ratios for Carcinogens** | | | | | | | | | | | | | | | | 3.E-01 |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Adult Trespasser (TA) and Juvenile Trespasser (TJ) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010). FWCUG presented is the most conservative (smallest) of the Adult and Juvenile value.

[b]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

UCL 95 = 95% upper confidence limit of the mean

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation

L = Lognormal distribution, Land statistic used for UCL 95 calculation

X = Distribution neither normal nor lognormal, t statistic used for UCL 95 calculation

AOC = Area of Concern

bgs = below ground surface

CAS = Chemical Abstract Service

COC = Chemical of Concern

EPC = Exposure Point Concentration

EU = Exposure Unit

HQ = Hazard Quotient

-- = no value available

**Table B-9. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples**
**Representative Receptor: Trespasser**

| | | Analyte (mg/kg) | Benz(a)anthracene | | Benzo(a)pyrene | | Benzo(b)fluoranthene | | Dibenz(a,h)anthracene | | Indeno(1,2,3-cd)pyrene | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CAS Number | 56-55-3 | | 50-32-8 | | 205-99-2 | | 53-70-3 | | 193-39-5 | | |
| | | Trespasser FWCUG[a]: | | | | | | | | | | | |
| | | HQ=1 | -- | | -- | | -- | | -- | | -- | | |
| | | Risk=1E-5 | 11.3 TA | | 1.13 TA | | 11.3 TA | | 1.13 TA | | 11.3 TA | | |
| | | Background Criteria[b] | -- | | -- | | -- | | -- | | -- | | |
| Sample ID | Date | Station | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | Result/COC? | Ratio | SOR |
| PWss-CONT2-0001-SO | 10/28/2003 | PWss-CONT2 | No | 9.E-02 | **Yes** | **NA** | No | 1.E-01 | No | 3.E-01 | No | 6.E-02 | 6.E-01 |
| | | | 1 | | **1.4** | | 1.4 | | 0.36 | | 0.7 | | |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Adult Trespasser (TA) and Juvenile Trespasser (TJ) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010). FWCUG presented is the most conservative (smallest) of the Adult and Juvenile value.

[b]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

Ratio = Sample concentration/FWCUG
AOC = Area of Concern
bgs = below ground surface
CAS = Chemical Abstract Service
COC = Chemical of Concern
HQ = Hazard Quotient
ISM = Incremental Sampling Method
NA = Not applicable, sample concentration exceeds FWCUG; therefore, not included in SOR for identifying additional COCs with concentrations below FWCUGs.
SOR = Sum-of-ratios
TA = Lowest FWCUG is for the Adult Trespasser
-- = no value available
**Bold** = Concentration exceeds FWCUG

**Table B-10. COC Screening for Surface Soil (0-1 ft bgs Discrete Samples) at Paris-Windham Dump AOC: Surface Area EU**
**Baseline Receptor: Resident Farmer**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Resident Farmer FWCUG[a] HQ=1 | Source | Risk=1E-5 | Source | Background Criteria[b] | COC? (yes/no) | COC Justification | Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 13/ 13 | 5300 | 18000 | 8350 | 9900 | X | 9900 | 73798 | RFC | -- | -- | 17700 | No | EPC below FWCUG | NA |
| Manganese | 7439-96-5 | 13/ 13 | 95 | 1900 | 386 | 807 | L | 807 | 2927 | RFC | -- | -- | 1450 | No | EPC below FWCUG | NA |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | | | |
| Benz(a)anthracene | 56-55-3 | 1/ 1 | 0.25 | 0.25 | 0.25 | -- | D | 0.25 | -- | -- | 2.21 | RFA | -- | No | EPC below FWCUG | 1.E-01 |
| **Benzo(a)pyrene** | **50-32-8** | **1/ 1** | **0.33** | **0.33** | **0.33** | **--** | **D** | **0.33** | **--** | **--** | **0.221** | **RFA** | **--** | **Yes** | **EPC exceeds FWCUG** | **NA** |
| Benzo(b)fluoranthene | 205-99-2 | 1/ 1 | 0.39 | 0.39 | 0.39 | -- | D | 0.39 | -- | -- | 2.21 | RFA | -- | No | EPC below FWCUG | 2.E-01 |
| **Sum-of-Ratios for Carcinogens** | | | | | | | | | | | | | | | | 3.E-01 |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA) and Resident Farmer Child (RFC) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[b]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

UCL 95 = 95% upper confidence limit of the mean

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation

L = Lognormal distribution, Land statistic used for UCL 95 calculation

X = Distribution neither normal nor lognormal, t statistic used for UCL 95 calculation

AOC = Area of Concern

bgs = below ground

CAS = Chemical Abstract Service

COC = Chemical of Concern

EPC = Exposure Point Concentration

EU = Exposure Unit

HQ = Hazard Quotient

NA = Not applicable, sample concentration exceeds FWCUG; therefore, not included in SOR for identifying additional COCs with concentrations below FWCUGs.

SOR = Sum-of-ratios

-- = no value available

**Bold** = EPC exceeds FWCUG

**Table B-11. COC Screening for Soil at Paris-Windham Dump AOC: ISM Samples**
**Baseline Receptor: Resident Farmer**

| | | Analyte (mg/kg) | Benz(a)anthracene | | Benzo(a)pyrene | | Benzo(b)fluoranthene | | Dibenz(a,h)anthracene | | Indeno(1,2,3-cd)pyrene | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CAS Number | 56-55-3 | | 50-32-8 | | 205-99-2 | | 53-70-3 | | 193-39-5 | | |
| | | Resident Farmer FWCUG[a]: | | | | | | | | | | | |
| | | HQ=1 | -- | | -- | | -- | | -- | | -- | | |
| | | Risk=1E-5 | 2.21 RFA | | 0.221 RFA | | 2.21 RFA | | 0.221 RFA | | 2.21 RFA | | |
| | | Background Criteria[b] | -- | | -- | | -- | | -- | | -- | | |
| **Sample ID** | **Date** | **Station** | **Result/COC?** | **Ratio** | **Result/COC?** | **Ratio** | **Result/COC?** | **Ratio** | **Result/COC?** | **Ratio** | **Result/COC?** | **Ratio** | **SOR** |
| PWss-CONT2-0001-SO | 10/28/2003 | PWss-CONT2 | No | 5.E-01 | **1.4 Yes** | NA | 1.4 No | 6.E-01 | **0.36 Yes** | NA | 0.7 No | 3.E-01 | 1.E+00 |

1

[a]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA) and Resident Farmer Child (RFC) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).
[b]Background criteria are for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).
Ratio = Sample concentration/FWCUG
AOC = Area of Concern
bgs = below ground surface
CAS = Chemical Abstract Service
COC = Chemical of Concern
HQ = Hazard Quotient
ISM = Incremental Sampling Method
NA = Not applicable, sample concentration exceeds FWCUG; therefore, not included in SOR for identifying additional COCs with concentrations below FWCUGs.
SOR = Sum-of-ratios
RFA = Lowest FWCUG is for the Adult Resident Farmer
-- = no value available

**Table B-12. COC Screening for Surface Water at Paris-Windham Dump AOC**
**Representative Receptor: Trespasser**

| Analyte (mg/L) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Trespasser FWCUG[a] | | | | Background Criteria[b] | COC? (yes/no) | COC Justification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | HQ=1 | Source | Risk=1E-5 | Source | | | |
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | |
| Arsenic | 7440-38-2 | 7/7 | 0.0028 | 0.0082 | 0.00549 | 0.0069 | N | 0.00685 | 0.705 | TJ | 0.0415 | TA | 0.0032 | No | EPC below FWCUG |
| Cobalt | 7440-48-4 | 7/7 | 0.001 | 0.0015 | 0.00177 | 0.0027 | L | 0.0015 | -- | -- | -- | -- | 0 | No[c] | No FWCUG available |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Adult Trespasser (TA) and Juvenile Trespasser (TJ) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010). FWCUG presented is the most conservative (smallest) of the Adult and Juvenile value.

[b]Background criteria for surface water from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[c]No FWCUG is available for cobalt in surface water. Maximum detected concentration (0.0015 mg/L) barely exceeds the United States Environmental Protection Agency residential Regional Screening Level (0.0011 mg/L) at an HQ of 0.

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation
L = Lognormal distribution, Land statistic used for UCL 95 calculation
N = Normal distribution, t statistic used for UCL 95 calculation
UCL 95 = 95% upper confidence limit of the mean
AOC = Area of Concern
CAS = Chemical Abstract Service
COC = Chemical of Concern
EPC = Exposure Point Concentration
HQ = Hazard Quotient
-- = no value available

**Table B-13. COC Screening for Surface Water at Paris-Windham Dump AOC**
**Baseline Receptor: Resident Farmer**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | UCL 95 | Dist. | EPC | Resident Farmer FWCUG[a] | | | | Background Criteria[b] | COC? (yes/no) | COC Justification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | HQ=1 | Source | Risk=1E-5 | Source | | | |
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | | |
| Arsenic | 7440-38-2 | 7/7 | 0.0028 | 0.0082 | 0.00549 | 0.0069 | N | 0.00685 | 0.0463 | RFC | 0.011 | RFA | 0.0032 | No | EPC below FWCUG |
| Cobalt | 7440-48-4 | 4/7 | 0.001 | 0.0015 | 0.00177 | 0.0027 | L | 0.0015 | -- | -- | -- | -- | 0 | No[c] | No FWCUG available |

[a]Facility-Wide Cleanup Goals (FWCUGs) for Resident Farmer Adult (RFA) and Resident Farmer Child (RFC) from *Facility-Wide Human Health Cleanup Goals for the Ravenna Army Ammunition Plant* (USACE 2010).

[b]Background criteria for surface water from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).

[c]No FWCUG is available for cobalt in surface water. Maximum detected concentration (0.0015 mg/L) barely exceeds the United States Environmental Protection Agency residential Regional Screening Level (0.0011 mg/L) at an HQ of 0.1.

Distribution Code:

D = Fewer than 5 or 50% detects, t statistic used for UCL 95 calculation

L = Lognormal distribution, Land statistic used for UCL 95 calculation

X = Distribution neither normal nor lognormal, t statistic used for UCL 95 calculation

UCL 95 − 95% upper confidence limit of the mean

AOC = Area of Concern

CAS = Chemical Abstract Service

COC = Chemical of Concern

EPC = Exposure Point Concentration

HQ = Hazard Quotient

-- = no value available

# APPENDIX C

# Ecological Risk Assessment Information and Data

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# TABLE OF CONTENTS

## FIGURE

Figure C-1. Ohio Rapid Assessment Method Worksheet ..... 1

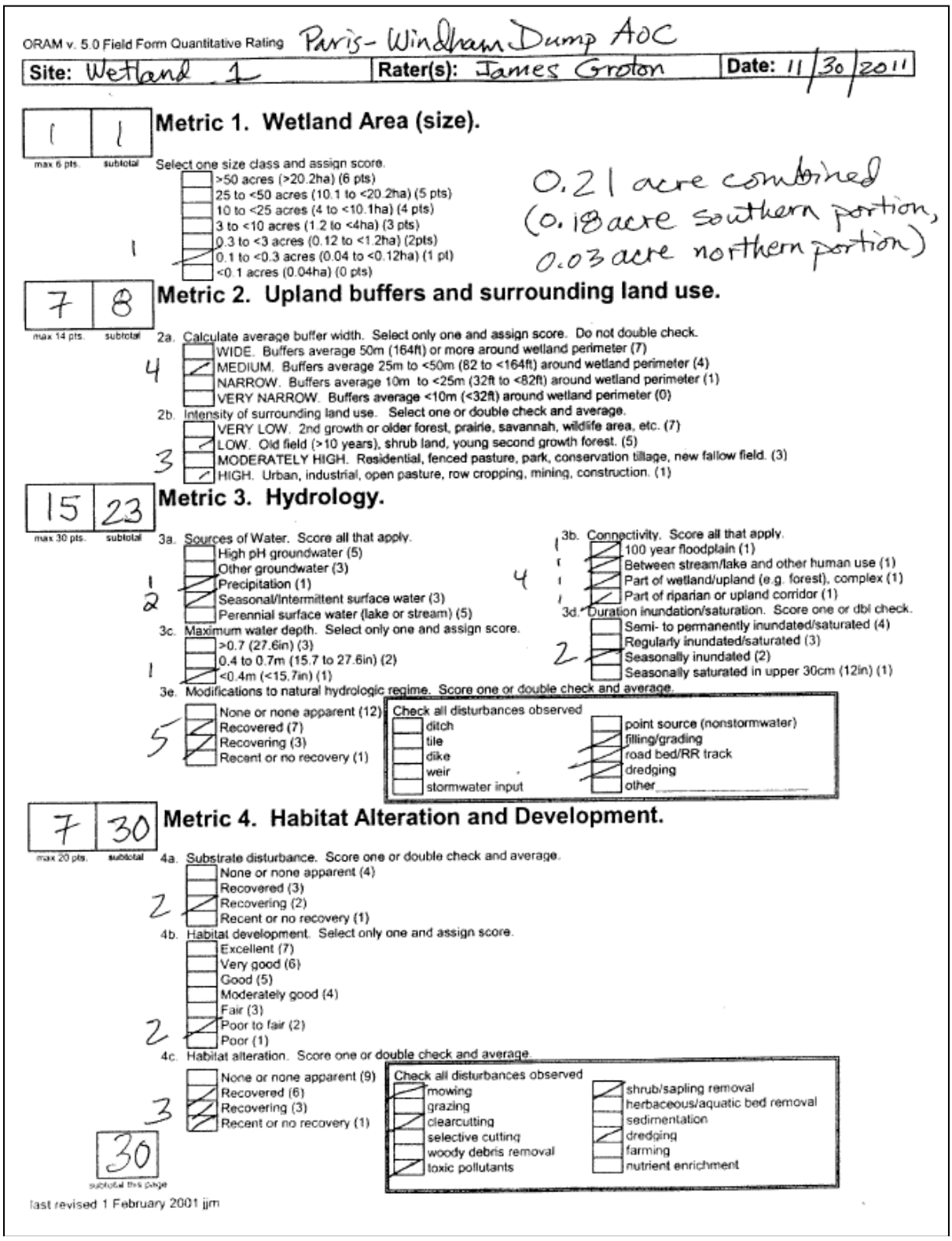
## LIST OF TABLES

Table C-1. Ecological Screening Values for Chemical Analytes in Soil ..... 3
Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water ..... 21
Table C-3. SRC and COPEC Screening with Maximum Ratio for Shallow Surface Soil (0-1 ft bgs Discrete Samples) at Dump Along Paris-Windham Road: Fill Area EU ..... 28
Table C-4. SRC and COPEC Screening with Maximum Ratio for Shallow Surface Soil (0-1 ft bgs Discrete Samples) at Dump Along Paris-Windham Road: Surface Area EU ..... 29
Table C-5. SRC and COPEC Screening for Surface Water at Dump Along Paris-Windham Road ..... 30
Table C-6. Checklist of Important Ecological Places and Resources at Dump Along Paris-Windham Road ..... 31
Table C-7. Natural Resources Management Goals (OHARNG 2008) ..... 33

REFERENCES ..... 37

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AOC | Area of Concern |
| BRAC | Base Realignment and Closure |
| CAS | Chemical Abstract Service |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| COPC | Chemical of Potential Concern |
| COPEC | Chemical of Potential Ecological Concern |
| DOE | United States Department of Energy |
| DOW | Department of Wildlife |
| EcoSSL | Ecological Soil Screening Level |
| EDQL | Ecological Data Quality Levels |
| ESL | Ecological Screening Level |
| ESV | Ecological Screening Value |
| EU | Exposure Unit |
| GIS | Geographic Information System |
| GLI | Great Lakes Initiative |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| INRMP | Integrated Natural Resources Management Plan |
| NAWQC | National Ambient Water Quality Criteria |
| OAC | Ohio Administrative Code |
| ODNR | Ohio Department of Natural Resources |
| OHARNG | Ohio Army National Guard |
| Ohio EPA | Ohio Environmental Protection Agency |
| OMZM | Outside Mixing Zone Maximum |
| PBT | Persistent, Bioaccumulative, and Toxic |
| PCB | Polychlorinated Biphenyl |
| PLS | Planning Level Survey |
| PRG | Preliminary Remediation Goal |
| Reg | Region |
| RVAAP | Ravenna Army Ammunition Plant |
| SRC | Site-related Contaminant |
| T&E | Threatened and Endangered Species |
| USACE | United States Army Corps of Engineers |
| USEPA | United States Environmental Protection Agency |



ORAM v. 5.0 Field Form Quantitative Rating Paris-Windham Dump AOC

Site: Wetland 1 | Rater(s): James Groton | Date: 11/30/2011

**Metric 1. Wetland Area (size).** 1 / 1 (max 6 pts. / subtotal)

Select one size class and assign score.

- [ ] >50 acres (>20.2ha) (6 pts)
- [ ] 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- [ ] 10 to <25 acres (4 to <10.1ha) (4 pts)
- [ ] 3 to <10 acres (1.2 to <4ha) (3 pts)
- [ ] 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- [x] 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt) — 1
- [ ] <0.1 acres (0.04ha) (0 pts)

0.21 acre combined (0.18 acre southern portion, 0.03 acre northern portion)

**Metric 2. Upland buffers and surrounding land use.** 7 / 8 (max 14 pts. / subtotal)

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- [ ] WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- [x] MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4) — 4
- [ ] NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- [ ] VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- [ ] VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- [x] LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- [ ] MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3) — 3
- [x] HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

**Metric 3. Hydrology.** 15 / 23 (max 30 pts. / subtotal)

3a. Sources of Water. Score all that apply.

- [ ] High pH groundwater (5)
- [ ] Other groundwater (3)
- [x] Precipitation (1) — 1
- [x] Seasonal/Intermittent surface water (3) — 2
- [ ] Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- [x] 100 year floodplain (1) — 1
- [x] Between stream/lake and other human use (1)
- [x] Part of wetland/upland (e.g. forest), complex (1) — 4
- [x] Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- [ ] >0.7 (27.6in) (3)
- [ ] 0.4 to 0.7m (15.7 to 27.6in) (2)
- [x] <0.4m (<15.7in) (1) — 1

3d. Duration inundation/saturation. Score one or dbl check.

- [ ] Semi- to permanently inundated/saturated (4)
- [x] Regularly inundated/saturated (3) — 2
- [ ] Seasonally inundated (2)
- [ ] Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- [ ] None or none apparent (12)
- [x] Recovered (7) — 5
- [x] Recovering (3)
- [ ] Recent or no recovery (1)

Check all disturbances observed

- [ ] ditch
- [ ] tile
- [ ] dike
- [ ] weir
- [ ] stormwater input
- [ ] point source (nonstormwater)
- [x] filling/grading
- [x] road bed/RR track
- [x] dredging
- [ ] other _____

**Metric 4. Habitat Alteration and Development.** 7 / 30 (max 20 pts. / subtotal)

4a. Substrate disturbance. Score one or double check and average.

- [ ] None or none apparent (4)
- [ ] Recovered (3)
- [x] Recovering (2) — 2
- [ ] Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- [ ] Excellent (7)
- [ ] Very good (6)
- [ ] Good (5)
- [ ] Moderately good (4)
- [ ] Fair (3)
- [x] Poor to fair (2) — 2
- [ ] Poor (1)

4c. Habitat alteration. Score one or double check and average.

- [ ] None or none apparent (9)
- [x] Recovered (6)
- [x] Recovering (3) — 3
- [x] Recent or no recovery (1)

Check all disturbances observed

- [x] mowing
- [ ] grazing
- [x] clearcutting
- [ ] selective cutting
- [ ] woody debris removal
- [x] toxic pollutants
- [x] shrub/sapling removal
- [ ] herbaceous/aquatic bed removal
- [ ] sedimentation
- [x] dredging
- [ ] farming
- [ ] nutrient enrichment

30 (subtotal this page)

last revised 1 February 2001 jjm

**Figure C-1. Ohio Rapid Assessment Method Worksheet**

ORAM v. 5.0 Field Form Quantitative Rating Paris-Windham Dump AOC

Site: Wetland 1 | Rater(s): James Groton | Date: 11/30/2011

30 subtotal first page

## Metric 5. Special Wetlands.

0 max 10 pts. | 30 subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

## Metric 6. Plant communities, interspersion, microtopography.

7 max 20 pts. | 37 subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [1] Emergent
- [1] Shrub
- [2] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [3] Moderate (3)
- [ ] Moderately low (2)
- [ ] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [-1] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [1] Amphibian breeding pools

**Vegetation Community Cover Scale**

| | |
|---|---|
| 0 | Absent or comprises <0.1ha (0.2471 acres) contiguous area |
| 1 | Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality |
| 2 | Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality |
| 3 | Present and comprises significant part, or more, of wetland's vegetation and is of high quality |

**Narrative Description of Vegetation Quality**

| | |
|---|---|
| low | Low spp diversity and/or predominance of nonnative or disturbance tolerant native species |
| mod | Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp |
| high | A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp |

**Mudflat and Open Water Class Quality**

| | |
|---|---|
| 0 | Absent <0.1ha (0.247 acres) |
| 1 | Low 0.1 to <1ha (0.247 to 2.47 acres) |
| 2 | Moderate 1 to <4ha (2.47 to 9.88 acres) |
| 3 | High 4ha (9.88 acres) or more |

**Microtopography Cover Scale**

| | |
|---|---|
| 0 | Absent |
| 1 | Present very small amounts or if more common of marginal quality |
| 2 | Present in moderate amounts, but not of highest quality or in small amounts of highest quality |
| 3 | Present in moderate or greater amounts and of highest quality |

37 Category 2

**End of Quantitative Rating. Complete Categorization Worksheets.**

**Figure C-1. Ohio Rapid Assessment Method Worksheet (continued)**

1

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| ***Inorganic Chemicals*** | | | | | | | | | |
| Aluminum | 7429-90-5 | --* | Al EcoSSL | 50 | PRGs[b] | -- | -- | 50 | PRGs |
| Antimony | 7440-36-0 | 0.27 | mammalian EcoSSL for Sb | 5 | PRGs | 0.142 | USEPA Reg 5 | 2.70E-01 | mammalian EcoSSL for Sb |
| Arsenic | 7440-38-2 | 18 | plant EcoSSL for As | 9.9 | PRGs | 5.7 | USEPA Reg 5 | 1.80E+01 | plant EcoSSL for As |
| Barium | 7440-39-3 | 330 | soil invert EcoSSL for Ba | 283 | PRGs | 1.04 | USEPA Reg 5 | 3.30E+02 | soil invert EcoSSL for Ba |
| Beryllium | 7440-41-7 | 21 | mammalian EcoSSL for Be | 10 | PRGs | 1.06 | USEPA Reg 5 | 2.10E+01 | mammalian EcoSSL for Be |
| Bismuth | 7440-69-9 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Boron | 7440-42-8 | -- | -- | 0.5 | PRGs | -- | -- | 5.00E-01 | PRGs |
| Bromine | 7726-95-6 | -- | -- | 10 | PRGs | -- | -- | 1.00E+01 | PRGs |
| Cadmium | 7440-43-9 | 0.36 | mammalian EcoSSL for Cd | 4 | PRGs | 0.00222 | USEPA Reg 5 | 3.60E-01 | mammalian EcoSSL for Cd |
| Calcium | 7440-70-2 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Chromium | 16065-83-1 | 26 | avian EcoSSL for Cr III | 0.4 | PRGs | 0.4 | ESL for Cr+3 | 2.60E+01 | avian EcoSSL for Cr III |
| Chromium, hexavalent | 18540-29-9 | 130 | mammalian EcoSSL for Cr VI | -- | -- | -- | -- | 1.30E+02 | mammalian EcoSSL for Cr VI |
| Cobalt | 7440-48-4 | 13 | plant EcoSSL for Co | 20 | PRGs | 0.14 | USEPA Reg 5 | 1.30E+01 | plant EcoSSL for Co |
| Copper | 7440-50-8 | 28 | avian EcoSSL for Cu | 60 | PRGs | 5.4 | USEPA Reg 5 | 2.80E+01 | avian EcoSSL for Cu |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Cyanide | 57-12-5 | -- | -- | -- | -- | 1.33 | USEPA Reg 5 | 1.33E+00 | USEPA Reg 5 |
| Fluorine | 7782-41-4 | -- | -- | 200 | PRGs | -- | -- | 2.00E+02 | PRGs |
| Iodine | 7553-56-2 | -- | -- | 4 | PRGs | -- | -- | 4.00E+00 | PRGs |
| Iron | 7439-89-6 | --** | Fe EcoSSL | -- | -- | -- | -- | No ESV | No Source |
| Lanthanum | 7439-91-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Lead | 7439-92-1 | 11 | avian EcoSSL for Pb | 40.5 | PRGs | 0.0537 | USEPA Reg 5 | 1.10E+01 | avian EcoSSL for Pb |
| Lithium | 7439-93-2 | -- | -- | 2 | PRGs | -- | -- | 2.00E+00 | PRGs |
| Magnesium | 7439-95-4 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Manganese | 7439-96-5 | 220 | plant EcoSSL for Mn | 500 | PRGs[b] | -- | -- | 2.20E+02 | plant EcoSSL for Mn |
| Mercury | 7439-97-6 | -- | -- | 0.00051 | PRGs | 0.1 | USEPA Reg 5 | 5.10E-04 | PRGs |
| Mercury, methyl | 22967-92-6 | -- | -- | -- | -- | 0.00158 | USEPA Reg 5 | 1.58E-03 | USEPA Reg 5 |
| Molybdenum | 7439-98-7 | -- | -- | 2 | PRGs | -- | -- | 2.00E+00 | PRGs |
| Nickel | 7440-02-0 | 38 | plant EcoSSL for Ni | 30 | PRGs | 13.6 | USEPA Reg 5 | 3.80E+01 | plant EcoSSL for Ni |
| Potassium | 7440-09-7 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Selenium | 7782-49-2 | 0.52 | plant EcoSSL for Se | 0.21 | PRGs | 0.0276 | USEPA Reg 5 | 5.20E-01 | plant EcoSSL for Se |
| Silver | 7440-22-4 | 4.2 | avian EcoSSL for Ag | 2 | PRGs | 4.04 | USEPA Reg 5 | 4.20E+00 | avian EcoSSL for Ag |
| Sodium | 7440-23-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Technetium | 7440-26-8 | -- | -- | 0.2 | PRGs | -- | -- | 2.00E-01 | PRGs |
| Tellurium | 13494-80-9 | -- | -- | -- | -- | -- | -- | No ESV | No Source |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Thallium | 7440-28-0 | -- | -- | 1 | PRGs | 0.0569 | USEPA Reg 5 | 1.00E+00 | PRGs |
| Tin | 7440-31-5 | -- | -- | 50 | PRGs | 7.62 | USEPA Reg 5 | 5.00E+01 | PRGs |
| Titanium | 7440-32-6 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Tungsten | 7440-33-7 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Uranium | 7440-61-1 | -- | -- | 5 | PRGs | -- | -- | 5.00E+00 | PRGs |
| Vanadium | 7440-62-2 | 7.8 | avian EcoSSL for V | 2 | PRGs | 1.59 | USEPA Reg 5 | 7.80E+00 | avian EcoSSL for V |
| Zinc | 7440-66-6 | 46 | avian EcoSSL for Zn | 8.5 | PRGs | 6.62 | USEPA Reg 5 | 4.60E+01 | avian EcoSSL for Zn |
| ***Anions*** | | | | | | | | | |
| Nitrate | 14797-55-8 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Sulfide | 18496-25-8 | -- | -- | -- | -- | 0.00358 | USEPA Reg 5 | 3.58E-03 | USEPA Reg 5 |
| ***Organic Chemicals*** | | | | | | | | | |
| Acenaphthene | 83-32-9 | -- | -- | 20 | PRGs | 682 | USEPA Reg 5 | 2.00E+01 | PRGs |
| Acenaphthylene | 208-96-8 | -- | -- | -- | -- | 682 | USEPA Reg 5 | 6.82E+02 | USEPA Reg 5 |
| Acetone | 67-64-1 | -- | -- | -- | -- | 2.5 | USEPA Reg 5 | 2.50E+00 | USEPA Reg 5 |
| Acetonitrile | 75-05-8 | -- | -- | -- | -- | 1.37 | USEPA Reg 5 | 1.37E+00 | USEPA Reg 5 |
| Acetophenone | 98-86-2 | -- | -- | -- | -- | 300 | USEPA Reg 5 | 3.00E+02 | USEPA Reg 5 |
| Acetylaminofluorene[2-] | 53-96-3 | -- | -- | -- | -- | 0.596 | USEPA Reg 5 | 5.96E-01 | USEPA Reg 5 |
| Acrolein | 107-02-8 | -- | -- | -- | -- | 5.27 | USEPA Reg 5 | 5.27E+00 | USEPA Reg 5 |
| Acrylonitrile | 107-13-1 | -- | -- | -- | -- | 0.0239 | USEPA Reg 5 | 2.39E-02 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Aldrin | 309-00-2 | -- | -- | -- | -- | 0.00332 | USEPA Reg 5 | 3.32E-03 | USEPA Reg 5 |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 4-Aminobiphenyl | 92-67-1 | -- | -- | -- | -- | 0.00305 | USEPA Reg 5 | 3.05E-03 | USEPA Reg 5 |
| Aniline | 62-53-3 | -- | -- | -- | -- | 0.0568 | USEPA Reg 5 | 5.68E-02 | USEPA Reg 5 |
| Anthracene | 120-12-7 | -- | -- | -- | -- | 1480 | USEPA Reg 5 | 1.48E+03 | USEPA Reg 5 |
| Aramite | 140-57-8 | -- | -- | -- | -- | 166 | USEPA Reg 5 | 1.66E+02 | USEPA Reg 5 |
| Azobenzene[p-(dimethylamino)] | 60-11-7 | -- | -- | -- | -- | 0.04 | USEPA Reg 5 | 4.00E-02 | USEPA Reg 5 |
| PCB-1016 | 12674-11-2 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Arochlor-1221 | 11104-28-2 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Arochlor-1232 | 11141-16-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Arochlor-1242 | 53469-21-9 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Arochlor-1248 | 12672-29-6 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| PCB-1254 | 11097-69-1 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| PCB-1260 | 11096-82-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Benzene | 71-43-2 | -- | -- | -- | -- | 0.255 | USEPA Reg 5 | 2.55E-01 | USEPA Reg 5 |
| Benzenemethanol | 100-51-6 | -- | -- | -- | -- | 65.8 | USEPA Reg 5 | 6.58E+01 | USEPA Reg 5 |
| Benz(a)anthracene | 56-55-3 | -- | -- | -- | -- | 5.21 | USEPA Reg 5 | 5.21E+00 | USEPA Reg 5 |
| Benzo(a)pyrene | 50-32-8 | -- | -- | -- | -- | 1.52 | USEPA Reg 5 | 1.52E+00 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Benzo(b)fluoranthene | 205-99-2 | -- | -- | -- | -- | 59.8 | USEPA Reg 5 | 5.98E+01 | USEPA Reg 5 |
| Benzo(ghi)perylene | 191-24-2 | -- | -- | -- | -- | 119 | USEPA Reg 5 | 1.19E+02 | USEPA Reg 5 |
| Benzo(k)fluoranthene | 207-08-9 | -- | -- | -- | -- | 148 | USEPA Reg 5 | 1.48E+02 | USEPA Reg 5 |
| Benzoic acid | 65-85-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| BHC | 608-73-1 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| BHC, alpha | 319-84-6 | -- | -- | -- | -- | 0.0994 | USEPA Reg 5 | 9.94E-02 | USEPA Reg 5 |
| BHC, beta | 319-85-7 | -- | -- | -- | -- | 0.00398 | USEPA Reg 5 | 3.98E-03 | USEPA Reg 5 |
| BHC, delta | 319-86-8 | -- | -- | -- | -- | 9.94 | USEPA Reg 5 | 9.94E+00 | USEPA Reg 5 |
| BHC, gamma (Lindane) | 58-89-9 | -- | -- | -- | -- | 0.005 | USEPA Reg 5 | 5.00E-03 | USEPA Reg 5 |
| Biphenyl | 92-52-4 | -- | -- | 60 | PRGs | -- | -- | 6.00E+01 | PRGs |
| bis(2-chloroethoxy) methane | 111-91-1 | -- | -- | -- | -- | 0.302 | USEPA Reg 5 | 3.02E-01 | USEPA Reg 5 |
| bis(2-Chloroethyl) ether | 111-44-4 | -- | -- | -- | -- | 23.7 | USEPA Reg 5 | 2.37E+01 | USEPA Reg 5 |
| bis(2-Ethylhexyl)phthalate | 117-81-7 | -- | -- | -- | -- | 0.925 | USEPA Reg 5 | 9.25E-01 | USEPA Reg 5 |
| 4-Bromoaniline | 106-40-1 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Bromodichloromethane | 75-27-4 | -- | -- | -- | -- | 0.54 | USEPA Reg 5 | 5.40E-01 | USEPA Reg 5 |
| Bromoform | 75-25-2 | -- | -- | -- | -- | 15.9 | USEPA Reg 5 | 1.59E+01 | USEPA Reg 5 |
| Bromomethane | 74-83-9 | -- | -- | -- | -- | 0.235 | USEPA Reg 5 | 2.35E-01 | USEPA Reg 5 |
| 4-bromophenyl-phenylether | 101-55-3 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 2-Butanone | 78-93-3 | -- | -- | -- | -- | 89.6 | USEPA Reg 5 | 8.96E+01 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Butylbenzyl phthalate | 85-68-7 | -- | -- | -- | -- | 0.239 | USEPA Reg 5 | 2.39E-01 | USEPA Reg 5 |
| N-Nitrosodi-n-Butylamine | 924-16-3 | -- | -- | -- | -- | 0.267 | USEPA Reg 5 | 2.67E-01 | USEPA Reg 5 |
| Carbazole | 86-74-8 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Carbon disulfide | 75-15-0 | -- | -- | -- | -- | 0.0941 | USEPA Reg 5 | 9.41E-02 | USEPA Reg 5 |
| Carbon tetrachloride | 56-23-5 | -- | -- | -- | -- | 2.98 | USEPA Reg 5 | 2.98E+00 | USEPA Reg 5 |
| Chlordane | 12789-03-6 | -- | -- | -- | -- | 0.224 | USEPA Reg 5 | 2.24E-01 | USEPA Reg 5 |
| alpha-Chlordane | 12789-03-6 | -- | -- | -- | -- | 0.224 | USEPA Reg 5 | 2.24E-01 | USEPA Reg 5 |
| gamma-Chlordane | 12789-03-6 | -- | -- | -- | -- | 0.224 | USEPA Reg 5 | 2.24E-01 | USEPA Reg 5 |
| Chloroacetamide | 79-07-2 | -- | -- | 2 | PRGs[c] | -- | -- | 2.00E+00 | PRGs |
| 3-Chloroaniline | 108-42-9 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 4-Chloroaniline | 106-47-8 | -- | -- | -- | -- | 1.1 | USEPA Reg 5 | 1.10E+00 | USEPA Reg 5 |
| Chlorobenzene | 108-90-7 | -- | -- | 40 | PRGs | 13.1 | USEPA Reg 5 | 4.00E+01 | PRGs |
| Chlorobenzilate | 510-15-6 | -- | -- | -- | -- | 5.05 | USEPA Reg 5 | 5.05E+00 | USEPA Reg 5 |
| Chloroethane | 75-00-3 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Chloroform | 67-66-3 | -- | -- | -- | -- | 1.19 | USEPA Reg 5 | 1.19E+00 | USEPA Reg 5 |
| Chloromethane | 74-87-3 | -- | -- | -- | -- | 10.4 | USEPA Reg 5 | 1.04E+01 | USEPA Reg 5 |
| 2-Chloronaphthalene | 91-58-7 | -- | -- | -- | -- | 0.0122 | USEPA Reg 5 | 1.22E-02 | USEPA Reg 5 |
| 2-Chlorophenol | 95-57-8 | -- | -- | -- | -- | 0.243 | USEPA Reg 5 | 2.43E-01 | USEPA Reg 5 |
| 3-Chlorophenol | 108-43-0 | -- | -- | 7 | PRGs | -- | -- | 7.00E+00 | PRGs |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| 4-Chlorophenol | 106-48-9 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 4-Chlorophenyl-phenyl ether | 7005-72-3 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 4-chloro-3-methylphenol | 59-50-7 | -- | -- | -- | -- | 7.95 | USEPA Reg 5 | 7.95E+00 | USEPA Reg 5 |
| Chloropropene | 107-05-1 | -- | -- | -- | -- | 0.0134 | USEPA Reg 5 | 1.34E-02 | USEPA Reg 5 |
| Chloroprene | 126-99-8 | -- | -- | -- | -- | 0.0029 | USEPA Reg 5 | 2.90E-03 | USEPA Reg 5 |
| Chrysene | 218-01-9 | -- | -- | -- | -- | 4.73 | USEPA Reg 5 | 4.73E+00 | USEPA Reg 5 |
| m-Cresol | 108-39-4 | -- | -- | -- | -- | 3.49 | USEPA Reg 5 | 3.49E+00 | USEPA Reg 5 |
| 2,4-D | 94-75-7 | -- | -- | -- | -- | 0.0272 | USEPA Reg 5 | 2.72E-02 | USEPA Reg 5 |
| 4,4'-DDD | 72-54-8 | 0.021 | mammalian EcoSSL for DDT and metabolites | -- | -- | 0.758 | USEPA Reg 5 | 2.10E-02 | mammalian EcoSSL for DDT and metabolites |
| 4,4'-DDE | 72-55-9 | 0.021 | mammalian EcoSSL for DDT and metabolites | -- | -- | 0.596 | USEPA Reg 5 | 2.10E-02 | mammalian EcoSSL for DDT and metabolites |
| 4,4'-DDT | 50-29-3 | 0.021 | mammalian EcoSSL for DDT and metabolites | -- | -- | 0.0035 | USEPA Reg 5 | 2.10E-02 | mammalian EcoSSL for DDT and metabolites |
| Diallate | 2303-16-4 | -- | -- | -- | -- | 0.452 | USEPA Reg 5 | 4.52E-01 | USEPA Reg 5 |
| Diazinon | 333-41-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Dibenz(a,h)anthracene | 53-70-3 | -- | -- | -- | -- | 18.4 | USEPA Reg 5 | 1.84E+01 | USEPA Reg 5 |
| Dibenzofuran | 132-64-9 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 1,2-Dibromo-3-Chloropropane | 96-12-8 | -- | -- | -- | -- | 0.0352 | USEPA Reg 5 | 3.52E-02 | USEPA Reg 5 |
| Dibromochloromethane | 124-48-1 | -- | -- | -- | -- | 2.05 | USEPA Reg 5 | 2.05E+00 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Dibromoethane | 106-93-4 | -- | -- | -- | -- | 1.23 | USEPA Reg 5 | 1.23E+00 | USEPA Reg 5 |
| 2,4-Dichloroaniline | 554-00-7 | -- | -- | 100 | PRGs[c] | -- | -- | 1.00E+02 | PRGs |
| 3,4-Dichloroaniline | 95-76-1 | -- | -- | 20 | PRGs[c] | -- | -- | 2.00E+01 | PRGs |
| 1,2-Dichlorobenzene | 95-50-1 | -- | -- | -- | -- | 2.96 | USEPA Reg 5 | 2.96E+00 | USEPA Reg 5 |
| 1,3-Dichlorobenzene | 541-73-1 | -- | -- | -- | -- | 37.7 | USEPA Reg 5 | 3.77E+01 | USEPA Reg 5 |
| 1,4-Dichlorobenzene | 106-46-7 | -- | -- | 20 | PRGs | 0.546 | USEPA Reg 5 | 2.00E+01 | PRGs |
| 3,3'-Dichlorobenzidine | 91-94-1 | -- | -- | -- | -- | 0.646 | USEPA Reg 5 | 6.46E-01 | USEPA Reg 5 |
| Cis-1,4-dichloro-2-butene | 1476-11-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Trans-1,4-dichloro-2-butene | 110-57-6 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Dichlorodifluromethane | 75-71-8 | -- | -- | -- | -- | 39.5 | USEPA Reg 5 | 3.95E+01 | USEPA Reg 5 |
| 1,1-Dichloroethane | 75-34-3 | -- | -- | -- | -- | 20.1 | USEPA Reg 5 | 2.01E+01 | USEPA Reg 5 |
| 1,2-Dichloroethane | 107-06-2 | -- | -- | -- | -- | 21.2 | USEPA Reg 5 | 2.12E+01 | USEPA Reg 5 |
| 1,1-Dichloroethene | 75-35-4 | -- | -- | -- | -- | 8.28 | USEPA Reg 5 | 8.28E+00 | USEPA Reg 5 |
| 1,2-Dichloroethene | 540-59-0 | -- | -- | -- | -- | 0.784 | USEPA Reg 5 (for trans form) | 7.84E-01 | USEPA Reg 5 (for trans form) |
| 2,4-Dichlorophenol | 120-83-2 | -- | -- | -- | -- | 87.5 | USEPA Reg 5 | 8.75E+01 | USEPA Reg 5 |
| 2,6-Dichlorophenol | 87-65-0 | -- | -- | -- | -- | 1.17 | USEPA Reg 5 | 1.17E+00 | USEPA Reg 5 |
| 3,4-Dichlorophenol | 95-77-2 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 1,2-Dichloropropane | 78-87-5 | -- | -- | 700 | PRGs[c] | 32.7 | USEPA Reg 5 | 7.00E+02 | PRGs |
| cis-1,3-Dichloropropene | 10061-01-5 | -- | -- | -- | -- | 0.398 | USEPA Reg 5 | 3.98E-01 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| trans-1,3-Dichloropropene | 10061-02-6 | -- | -- | -- | -- | 0.398 | USEPA Reg 5 | 3.98E-01 | USEPA Reg 5 |
| Dieldrin | 60-57-1 | 0.0049 | mammalian EcoSSL for Dieldrin | -- | -- | 0.00238 | USEPA Reg 5 | 4.90E-03 | mammalian EcoSSL for Dieldrin |
| O,O-Diethyl O-2-pyrazinylphosphorothioate | 297-97-2 | -- | -- | -- | -- | 0.799 | USEPA Reg 5 | 7.99E-01 | USEPA Reg 5 |
| Diethylphthalate | 84-66-2 | -- | -- | 100 | PRGs | 24.8 | USEPA Reg 5 | 1.00E+02 | PRGs |
| Dimethoate | 60-51-5 | -- | -- | -- | -- | 0.218 | USEPA Reg 5 | 2.18E-01 | USEPA Reg 5 |
| Dimethylphthalate | 131-11-3 | -- | -- | 200 | PRGs[c] | 734 | USEPA Reg 5 | 2.00E+02 | PRGs |
| 3,3'-Dimethylbenzidine | 119-93-7 | -- | -- | -- | -- | 0.104 | USEPA Reg 5 | 1.04E-01 | USEPA Reg 5 |
| 7,12'-Dimethylbenz(a)anthracene | 57-97-6 | -- | -- | -- | -- | 16.3 | USEPA Reg 5 | 1.63E+01 | USEPA Reg 5 |
| alpha,alpha-Dimethylphenethylamine | 122-09-8 | -- | -- | -- | -- | 0.3 | USEPA Reg 5 | 3.00E-01 | USEPA Reg 5 |
| 2,4-Dimethylphenol | 105-67-9 | -- | -- | -- | -- | 0.01 | USEPA Reg 5 | 1.00E-02 | USEPA Reg 5 |
| Di-n-butyl phthalate | 84-74-2 | -- | -- | 200 | PRGs | 0.15 | USEPA Reg 5 | 2.00E+02 | PRGs |
| Di-n-octylphthalate | 117-84-0 | -- | -- | -- | -- | 709 | USEPA Reg 5 | 7.09E+02 | USEPA Reg 5 |
| 1,3-Dinitrobenzene | 99-65-0 | -- | -- | -- | -- | 0.655 | USEPA Reg 5 | 6.55E-01 | USEPA Reg 5 |
| 2,4-Dinitrophenol | 51-28-5 | -- | -- | 20 | PRGs | 0.0609 | USEPA Reg 5 | 2.00E+01 | PRGs |
| 2,4-Dinitrotoluene | 121-14-2 | -- | -- | -- | -- | 1.28 | USEPA Reg 5 | 1.28E+00 | USEPA Reg 5 |
| 2,6-Dinitrotoluene | 606-20-2 | -- | -- | -- | -- | 0.0328 | USEPA Reg 5 | 3.28E-02 | USEPA Reg 5 |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | -- | -- | -- | -- | 0.144 | USEPA Reg 5 | 1.44E-01 | USEPA Reg 5 |
| Dinoseb | 88-85-7 | -- | -- | -- | -- | 0.0218 | USEPA Reg 5 | 2.18E-02 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| 1,4-Dioxane | 123-91-1 | -- | -- | -- | -- | 2.05 | USEPA Reg 5 | 2.05E+00 | USEPA Reg 5 |
| Diphenylamine | 122-39-4 | -- | -- | -- | -- | 1.01 | USEPA Reg 5 | 1.01E+00 | USEPA Reg 5 |
| Disulfoton | 298-04-4 | -- | -- | -- | -- | 0.0199 | USEPA Reg 5 | 1.99E-02 | USEPA Reg 5 |
| Endosulfan I (alpha) | 959-98-8 | -- | -- | -- | -- | 0.119 | USEPA Reg 5 | 1.19E-01 | USEPA Reg 5 |
| Endosulfan II (beta) | 33213-65-9 | -- | -- | -- | -- | 0.119 | USEPA Reg 5 | 1.19E-01 | USEPA Reg 5 |
| Endosulfan, mixed isomers | 115-29-7 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Endosulfan sulfate | 1031-07-8 | -- | -- | -- | -- | 0.0358 | USEPA Reg 5 | 3.58E-02 | USEPA Reg 5 |
| Endrin | 72-20-8 | -- | -- | -- | -- | 0.0101 | USEPA Reg 5 | 1.01E-02 | USEPA Reg 5 |
| Endrin aldehyde | 7421-93-4 | -- | -- | -- | -- | 0.0105 | USEPA Reg 5 | 1.05E-02 | USEPA Reg 5 |
| Ethyl metharcrylate | 97-63-2 | -- | -- | -- | -- | 30 | USEPA Reg 5 | 3.00E+01 | USEPA Reg 5 |
| Ethylbenzene | 100-41-4 | -- | -- | -- | -- | 5.16 | USEPA Reg 5 | 5.16E+00 | USEPA Reg 5 |
| Famphur | 52-85-7 | -- | -- | -- | -- | 0.0497 | USEPA Reg 5 | 4.97E-02 | USEPA Reg 5 |
| Fluoranthene | 206-44-0 | -- | -- | -- | -- | 122 | USEPA Reg 5 | 1.22E+02 | USEPA Reg 5 |
| Fluorene | 86-73-7 | -- | -- | 30 | PRGs[c] | 122 | USEPA Reg 5 | 3.00E+01 | PRGs |
| Furan | 110-00-9 | -- | -- | 600 | PRGs | -- | -- | 6.00E+02 | PRGs |
| Heptane | 142-82-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Heptachlor | 76-44-8 | -- | -- | -- | -- | 0.00598 | USEPA Reg 5 | 5.98E-03 | USEPA Reg 5 |
| Heptachlor Epoxide | 1024-57-3 | -- | -- | -- | -- | 0.152 | USEPA Reg 5 | 1.52E-01 | USEPA Reg 5 |
| Hexachlorobenzene | 118-74-1 | -- | -- | -- | -- | 0.199 | USEPA Reg 5 | 1.99E-01 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Hexachlorobutadiene | 87-68-3 | -- | -- | -- | -- | 0.0398 | USEPA Reg 5 | 3.98E-02 | USEPA Reg 5 |
| Hexachlorocyclopentadiene | 77-47-4 | -- | -- | 10 | PRGs | 0.755 | USEPA Reg 5 | 1.00E+01 | PRGs |
| Hexachloroethane | 67-72-1 | -- | -- | -- | -- | 0.596 | USEPA Reg 5 | 5.96E-01 | USEPA Reg 5 |
| Hexachorophene | 70-30-4 | -- | -- | -- | -- | 0.199 | USEPA Reg 5 | 1.99E-01 | USEPA Reg 5 |
| 2-Hexanone | 591-78-6 | -- | -- | -- | -- | 12.6 | USEPA Reg 5 | 1.26E+01 | USEPA Reg 5 |
| HMX | 2691-41-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | -- | -- | -- | -- | 109 | USEPA Reg 5 | 1.09E+02 | USEPA Reg 5 |
| Isobutyl alcohol | 78-83-1 | -- | -- | -- | -- | 20.8 | USEPA Reg 5 | 2.08E+01 | USEPA Reg 5 |
| Isodrin | 465-73-6 | -- | -- | -- | -- | 0.00332 | USEPA Reg 5 | 3.32E-03 | USEPA Reg 5 |
| Isophorone | 78-59-1 | -- | -- | -- | -- | 139 | USEPA Reg 5 | 1.39E+02 | USEPA Reg 5 |
| Isosafrole | 120-58-1 | -- | -- | -- | -- | 9.94 | USEPA Reg 5 | 9.94E+00 | USEPA Reg 5 |
| Kepone | 143-50-0 | -- | -- | -- | -- | 0.0327 | USEPA Reg 5 | 3.27E-02 | USEPA Reg 5 |
| Malathion | 121-75-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Methacrylonitrile | 126-98-7 | -- | -- | -- | -- | 0.057 | USEPA Reg 5 | 5.70E-02 | USEPA Reg 5 |
| Methapyrilene | 91-80-5 | -- | -- | -- | -- | 2.78 | USEPA Reg 5 | 2.78E+00 | USEPA Reg 5 |
| Methoxychlor | 72-43-5 | -- | -- | -- | -- | 0.0199 | USEPA Reg 5 | 1.99E-02 | USEPA Reg 5 |
| Methyl iodide | 74-88-4 | -- | -- | -- | -- | 1.23 | USEPA Reg 5 | 1.23E+00 | USEPA Reg 5 |
| Methyl methacrylate | 80-62-6 | -- | -- | -- | -- | 984 | USEPA Reg 5 | 9.84E+02 | USEPA Reg 5 |
| Methyl methanesulfanate | 66-27-3 | -- | -- | -- | -- | 0.315 | USEPA Reg 5 | 3.15E-01 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Methyl parathion | 298-00-0 | -- | -- | -- | -- | 0.00029 | USEPA Reg 5 | 2.92E-04 | USEPA Reg 5 |
| 4-Methyl-2-pentanone | 108-10-1 | -- | -- | -- | -- | 443 | USEPA Reg 5 | 4.43E+02 | USEPA Reg 5 |
| 3-Methylcholanthrene | 56-49-5 | -- | -- | -- | -- | 0.0779 | USEPA Reg 5 | 7.79E-02 | USEPA Reg 5 |
| Methylene bromide | 74-95-3 | -- | -- | -- | -- | 65 | USEPA Reg 5 | 6.50E+01 | USEPA Reg 5 |
| Methylene chloride | 75-09-2 | -- | -- | -- | -- | 4.05 | USEPA Reg 5 | 4.05E+00 | USEPA Reg 5 |
| 2-Methylnaphthalene | 91-57-6 | -- | -- | -- | -- | 3.24 | USEPA Reg 5 | 3.24E+00 | USEPA Reg 5 |
| 2-Methylphenol | 95-48-7 | -- | -- | -- | -- | 40.4 | USEPA Reg 5 | 4.04E+01 | USEPA Reg 5 |
| 4-Methylphenol | 106-44-5 | -- | -- | -- | -- | 163 | USEPA Reg 5 | 1.63E+02 | USEPA Reg 5 |
| Mirex | 2385-85-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Naphthalene | 91-20-3 | -- | -- | -- | -- | 0.0994 | USEPA Reg 5 | 9.94E-02 | USEPA Reg 5 |
| 1,4-Naphthoquinone | 130-15-4 | -- | -- | -- | -- | 1.67 | USEPA Reg 5 | 1.67E+00 | USEPA Reg 5 |
| 1-Naphthylamine | 134-32-7 | -- | -- | -- | -- | 9.34 | USEPA Reg 5 | 9.34E+00 | USEPA Reg 5 |
| 2-Naphthylamine | 91-59-8 | -- | -- | -- | -- | 3.03 | USEPA Reg 5 | 3.03E+00 | USEPA Reg 5 |
| 2-Nitroaniline | 88-74-4 | -- | -- | -- | -- | 74.1 | USEPA Reg 5 | 7.41E+01 | USEPA Reg 5 |
| 3-Nitroaniline | 99-09-2 | -- | -- | -- | -- | 3.16 | USEPA Reg 5 | 3.16E+00 | USEPA Reg 5 |
| 4-Nitroaniline | 100-01-6 | -- | -- | -- | -- | 21.9 | USEPA Reg 5 | 2.19E+01 | USEPA Reg 5 |
| Nitrobenzene | 99-95-3 | -- | -- | 40 | PRGs[c] | 1.31 | USEPA Reg 5 | 4.00E+01 | PRGs |
| Nitrocellulose | 9004-70-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Nitroglycerin | 55-63-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Nitroguanidine | 556-88-7 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 2-Nitrophenol | 88-75-5 | -- | -- | -- | -- | 1.6 | USEPA Reg 5 | 1.60E+00 | USEPA Reg 5 |
| 4-Nitrophenol | 100-02-7 | -- | -- | 7 | PRGs | 5.12 | USEPA Reg 5 | 7.00E+00 | PRGs |
| 4-Nitroquinoline-1-oxide | 56-57-5 | -- | -- | -- | -- | 0.122 | USEPA Reg 5 | 1.22E-01 | USEPA Reg 5 |
| 3-Nitrotoluene | 99-08-1 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| N-Nitrosodiethylamine | 55-18-5 | -- | -- | -- | -- | 0.0693 | USEPA Reg 5 | 6.93E-02 | USEPA Reg 5 |
| N-Nitrosodimethylamine | 62-75-9 | -- | -- | -- | -- | 3.2E-05 | USEPA Reg 5 | 3.21E-05 | USEPA Reg 5 |
| N-Nitrosodiphenylamine | 86-30-6 | -- | -- | 20 | PRGs[c] | 0.545 | USEPA Reg 5 | 2.00E+01 | PRGs |
| N-Nitrosomethylethylamine | 10595-95-6 | -- | -- | -- | -- | 0.00166 | USEPA Reg 5 | 1.66E-03 | USEPA Reg 5 |
| N-Nitrosomorpholine | 59-89-2 | -- | -- | -- | -- | 0.0706 | USEPA Reg 5 | 7.06E-02 | USEPA Reg 5 |
| N-Nitrosopiperidine | 100-75-4 | -- | -- | -- | -- | 0.00665 | USEPA Reg 5 | 6.65E-03 | USEPA Reg 5 |
| N-Nitrosopyrrolidine | 930-55-2 | -- | -- | -- | -- | 0.0126 | USEPA Reg 5 | 1.26E-02 | USEPA Reg 5 |
| N-nitroso-di-n-propylamine | 621-64-7 | -- | -- | -- | -- | 0.544 | USEPA Reg 5 | 5.44E-01 | USEPA Reg 5 |
| 2-Nitrotoluene | 88-72-2 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 5-nitro-o-Toluidine | 99-55-8 | -- | -- | -- | -- | 8.73 | USEPA Reg 5 | 8.73E+00 | USEPA Reg 5 |
| 2,2'- oxybis(1-Chloropropane) | 108-60-1 | -- | -- | -- | -- | 19.9 | USEPA Reg 5 | 1.99E+01 | USEPA Reg 5 |
| Parathion | 56-38-2 | -- | -- | -- | -- | 0.00034 | USEPA Reg 5 | 3.40E-04 | USEPA Reg 5 |
| PCDDs | PCDD-S | -- | -- | -- | -- | 2E-07 | USEPA Reg 5 | 1.99E-07 | USEPA Reg 5 |
| Pentachloroaniline | 527-20-8 | -- | -- | 100 | PRGs[c] | -- | -- | 1.00E+02 | PRGs |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Pentachlorobenzene | 608-93-5 | -- | -- | 20 | PRGs | 0.497 | USEPA Reg 5 | 2.00E+01 | PRGs |
| Pentachloroethane | 76-01-7 | -- | -- | -- | -- | 10.7 | USEPA Reg 5 | 1.07E+01 | USEPA Reg 5 |
| Pentachloronitrobenzene | 82-68-8 | -- | -- | -- | -- | 7.09 | USEPA Reg 5 | 7.09E+00 | USEPA Reg 5 |
| Pentachlorophenol | 87-86-5 | 2.1 | avian EcoSSL for PCP | 3 | PRGs | 0.119 | USEPA Reg 5 | 2.10E+00 | avian EcoSSL for PCP |
| PETN | 78-11-5 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Phenacetin | 62-44-2 | -- | -- | -- | -- | 11.7 | USEPA Reg 5 | 1.17E+01 | USEPA Reg 5 |
| Phenanthrene | 85-01-8 | -- | -- | -- | -- | 45.7 | USEPA Reg 5 | 4.57E+01 | USEPA Reg 5 |
| Phenol | 108-95-2 | -- | -- | 30 | PRGs | 120 | USEPA Reg 5 | 3.00E+01 | PRGs |
| p-Phenylenediamine | 106-50-3 | -- | -- | -- | -- | 6.16 | USEPA Reg 5 | 6.16E+00 | USEPA Reg 5 |
| Phorate | 298-02-2 | -- | -- | -- | -- | 0.0005 | USEPA Reg 5 | 4.96E-04 | USEPA Reg 5 |
| 2-Picoline | 109-06-8 | -- | -- | -- | -- | 9.9 | USEPA Reg 5 | 9.90E+00 | USEPA Reg 5 |
| Polychlorinated biphenyls | 1336-36-3 | -- | -- | 0.371 | PRGs | 0.00033 | USEPA Reg 5 | 3.71E-01 | PRGs |
| Polychlorinated dibenzofurans | 51207-31-9 | -- | -- | -- | -- | 3.9E-05 | USEPA Reg 5 | 3.86E-05 | USEPA Reg 5 |
| Polynuclear aromatic hydrocarbons | 130498-29-2 | 1.1 | mammalian EcoSSL for HMW PAHs | -- | -- | -- | -- | 1.10E+00 | mammalian EcoSSL for HMW PAHs |
| Pronamide | 23950-58-5 | -- | -- | -- | -- | 0.0136 | USEPA Reg 5 | 1.36E-02 | USEPA Reg 5 |
| Propionitrile | 107-12-0 | -- | -- | -- | -- | 0.0498 | USEPA Reg 5 | 4.98E-02 | USEPA Reg 5 |
| 4-Nitrotoluene | 99-99-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Pyrene | 129-00-0 | -- | -- | -- | -- | 78.5 | USEPA Reg 5 | 7.85E+01 | USEPA Reg 5 |
| Pyridine | 110-86-1 | -- | -- | -- | -- | 1.03 | USEPA Reg 5 | 1.03E+00 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| RDX | 121-82-4 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Safrole | 94-59-7 | -- | -- | -- | -- | 0.404 | USEPA Reg 5 | 4.04E-01 | USEPA Reg 5 |
| Silvex (2,4,5-TP) | 93-72-1 | -- | -- | -- | -- | 0.109 | USEPA Reg 5 | 1.09E-01 | USEPA Reg 5 |
| Styrene | 100-42-5 | -- | -- | 300 | PRGs | 4.69 | USEPA Reg 5 | 3.00E+02 | PRGs |
| TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin) | 1746-01-6 | -- | -- | 3.15E-06 | PRGs | 2E-07 | USEPA Reg 5 | 3.15E-06 | PRGs |
| TCDF | 51207-31-9 | -- | -- | 8.40E-04 | PRGs | 3.9E-05 | USEPA Reg 5 | 8.40E-04 | PRGs |
| 2,3,5,6-Tetrachloroaniline | 3481-20-7 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | -- | -- | -- | -- | 2.02 | USEPA Reg 5 | 2.02E+00 | USEPA Reg 5 |
| 1,2,3,4-Tetrachlorobenzene | 634-66-2 | -- | -- | 10 | PRGs | -- | -- | 1.00E+01 | PRGs |
| 1,1,1,2-Tetrachloroethane | 630-20-6 | -- | -- | -- | -- | 225 | USEPA Reg 5 | 2.25E+02 | USEPA Reg 5 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | -- | -- | -- | -- | 0.127 | USEPA Reg 5 | 1.27E-01 | USEPA Reg 5 |
| Tetrachloroethene | 127-18-4 | -- | -- | -- | -- | 9.92 | USEPA Reg 5 | 9.92E+00 | USEPA Reg 5 |
| 2,3,4,5-Tetrachlorophenol | 4901-51-3 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 2,3,4,6-Tetrachlorophenol | 58-90-2 | -- | -- | -- | -- | 0.199 | USEPA Reg 5 | 1.99E-01 | USEPA Reg 5 |
| Tetraethyl dithiopyrophosphate | 3689-24-5 | -- | -- | -- | -- | 0.596 | USEPA Reg 5 | 5.96E-01 | USEPA Reg 5 |
| Tetryl | 479-45-8 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Toluene | 108-88-3 | -- | -- | 200 | PRGs | 5.45 | USEPA Reg 5 | 2.00E+02 | PRGs |
| o-Toluidine | 95-53-4 | -- | -- | -- | -- | 2.97 | USEPA Reg 5 | 2.97E+00 | USEPA Reg 5 |
| 4-Toluidine | 106-49-0 | -- | -- | -- | -- | -- | -- | No ESV | No Source |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Toxaphene | 8001-35-2 | -- | -- | -- | -- | 0.119 | USEPA Reg 5 | 1.19E-01 | USEPA Reg 5 |
| 2,4,5-Trichloroaniline | 636-30-6 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 1,2,3-Trichlorobenzene | 87-61-6 | -- | -- | 20 | PRGs | -- | -- | 2.00E+01 | PRGs |
| 1,2,4-Trichlorobenzene | 120-82-1 | -- | -- | 20 | PRGs | 11.1 | USEPA Reg 5 | 2.00E+01 | PRGs |
| 1,1,1-Trichloroethane | 71-55-6 | -- | -- | -- | -- | 29.8 | USEPA Reg 5 | 2.98E+01 | USEPA Reg 5 |
| 1,1,2-Trichloroethane | 79-00-5 | -- | -- | -- | -- | 28.6 | USEPA Reg 5 | 2.86E+01 | USEPA Reg 5 |
| Trichloroethene | 79-01-6 | -- | -- | -- | -- | 12.4 | USEPA Reg 5 | 1.24E+01 | USEPA Reg 5 |
| Trichlorofluoromethane | 75-69-4 | -- | -- | -- | -- | 16.4 | USEPA Reg 5 | 1.64E+01 | USEPA Reg 5 |
| 2,4,5-Trichlorophenol | 95-95-4 | -- | -- | 9 | PRGs | 14.1 | USEPA Reg 5 | 9.00E+00 | PRGs |
| 2,4,6-Trichlorophenol | 88-06-2 | -- | -- | 4 | PRGs | 9.94 | USEPA Reg 5 | 4.00E+00 | PRGs |
| 1,2,3-Trichloropropane | 96-18-4 | -- | -- | -- | -- | 3.36 | USEPA Reg 5 | 3.36E+00 | USEPA Reg 5 |
| 2,4,5-Trichlorophenoxyacetic acid | 93-76-5 | -- | -- | -- | -- | 0.596 | USEPA Reg 5 | 5.96E-01 | USEPA Reg 5 |
| O,O,O-Triethyl phosphorothioate | 126-68-1 | -- | -- | -- | -- | 0.818 | USEPA Reg 5 | 8.18E-01 | USEPA Reg 5 |
| 1,3,5-Trinitrobenzene | 99-35-4 | -- | -- | -- | -- | 0.376 | USEPA Reg 5 | 3.76E-01 | USEPA Reg 5 |
| 2,4,6-Trinitrotoluene | 118-96-7 | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Vinyl acetate | 108-05-4 | -- | -- | -- | -- | 12.7 | USEPA Reg 5 | 1.27E+01 | USEPA Reg 5 |
| Vinyl chloride | 75-01-4 | -- | -- | -- | -- | 0.646 | USEPA Reg 5 | 6.46E-01 | USEPA Reg 5 |

**Table C-1. Ecological Screening Values for Chemical Analytes in Soil (continued)**

| Analyte | CAS Registry Number | Soil Screening Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | USEPA EcoSSLs | | DOE (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] | | USEPA Region 5 Ecological Screening Levels (2003) (update of 1998 EDQLs) | | Preferred Ecological Screening Value (ESV)[d] | |
| | | Number (mg/kg dry soil) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source | Number (mg/kg) | Source |
| Xylenes (total) | 1330-20-7 | -- | -- | -- | -- | 10 | USEPA Reg 5 | 1.00E+01 | USEPA Reg 5 |

Hierarchy of values found in updated Ohio EPA Risk Assessment Guidance, section 3.3.5: http://www.epa.ohio.gov/portals/30/rules/RR-031.pdf
EcoSSLs: http://www.epa.gov/ecotox/ecossl/
Ecological Screening Levels (ESLs), USEPA Region 5, 2003: http://www.epa.gov/reg5rcra/ca/edql.htm
[a]United States Department of Energy (DOE) (1997a). *Preliminary Remediation Goals for Ecological Endpoints*. ES/ER/TM-162/R2. August 1997.
http://www.esd.ornl.gov/programs/ecorisk/documents/tm162r2.pdf
[b]Values for which plant benchmark is lowest. According to DOE (1997a), the PRG is the lowest of three values (earthworm, plant, or wildlife). The only values shown in DOE 1997a are the ones for which the calculated value is lower than earthworm and plant values. Plant values found in: DOE 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants*. ES/ER/TM-85/R3. November 1997.
[c]Values for which earthworm benchmark is lowest. According to DOE (1997a), the PRG is the lowest of three values (earthworm, plant, or wildlife). The only values shown in DOE 1997a are the ones for which the calculated value is lower than earthworm and plant values. Earthworm values found in: DOE 1997c. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process.* ES/ER/TM-126/R2.
[d]The Preferred Soil Value is the EcoSSLs, followed by DOE (1997a), followed by USEPA Region 5 ESLs.
*Aluminum is identified as a chemical of potential concern (COPC) only at sites where the soil pH is less than 5.5
**In well-aerated soils between pH 5 and 8, iron is not expected to be toxic to plants. A determination of the geochemical conditions (i.e., pH and Eh at a minimum) of the environmental setting, as well as the presence of iron floc and the toxic metals, is critical to the determination of the relative importance of iron at an area of concern (AOC).
-- = no value
CAS = Chemical Abstract Service
EDQL = Ecological Data Quality Level
EcoSSL = Ecological Soil Screening Level
Ohio EPA = Ohio Environmental Protection Agency
PRG = Preliminary Remediation Goal
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
Reg = Region
USEPA = United States Environmental Protection Agency

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**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| ***Inorganic Chemicals*** | | | | | | | | | | | |
| Aluminum | 7429-90-5 | -- | -- | 87 | NAWQC 2009 | 100 | Tier II (GLI database) | -- | -- | 8.70E+01 | NAWQC 2009 |
| Ammonia | 7664-41-7 | 500 | Ohio Administrative Code--temp&pH dependent | -- | -- | -- | -- | -- | -- | 5.00E+02 | Ohio Administrative Code--temp&pH dependent |
| Antimony | 7440-36-0 | 900 | Ohio Administrative Code | -- | -- | 30 | Tier II (Suter & Tsao 1996) | 80 | USEPA Reg 5 | 9.00E+02 | Ohio Administrative Code |
| Arsenic III (Diss) | 7440-38-2 | 340 | Ohio Administrative Code | 150 | NAWQC 2009 | -- | -- | -- | -- | 3.40E+02 | Ohio Administrative Code |
| Arsenic | 7440-38-2 | 340 | Ohio Administrative Code | -- | -- | -- | -- | 148 | USEPA Reg 5 | 3.40E+02 | Ohio Administrative Code |
| Arsenic V (Diss) | 7440-38-2 | -- | -- | -- | -- | 3.1 | Tier II (Suter & Tsao 1996) | -- | -- | 3.10E+00 | Tier II (Suter & Tsao 1996) |
| Barium | 7440-39-3 | 2,000 | Ohio Administrative Code | -- | -- | 4.0 | Tier II (Suter & Tsao 1996) | 220 | USEPA Reg 5 | 2.00E+03 | Ohio Administrative Code |
| Beryllium | 7440-41-7 | 93 | Ohio Administrative Code--hardness dependent | -- | -- | 0.66 | Tier II (Suter & Tsao 1996) | 3.6 | USEPA Reg 5 | 9.30E+01 | Ohio Administrative Code--hardness dependent |
| Boron | 7440-42-8 | 33,000 | Ohio Administrative Code | -- | -- | 1.6 | Tier II (Suter & Tsao 1996) | -- | -- | 3.30E+04 | Ohio Administrative Code |
| Cadmium | 7440-43-9 | 4.5 | Ohio Administrative Code--hardness dependent | -- | -- | 0.2 | Tier II (Suter & Tsao 1996) | 0.15 | USEPA Reg 5 | 4.50E+00 | Ohio Administrative Code--hardness dependent |
| Cadmium (Diss) | 7440-43-9 | 4.3 | Ohio Administrative Code--hardness dependent | 0.25 | NAWQC 2009 | -- | -- | -- | -- | 4.30E+00 | Ohio Administrative Code--hardness dependent |
| Calcium | 7440-70-2 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Chlorine (total residual) | 7782-50-5 | 19 | Ohio Administrative Code | 11 | NAWQC 2009 | 5 | Tier II (GLI database) | -- | -- | 1.90E+01 | Ohio Administrative Code |
| Chromium III (Diss) | 7440-47-3 | 570 | Ohio Administrative Code--hardness dependent | 74 | NAWQC 2009 | 210 | Tier II (Suter & Tsao 1996) | 42 | USEPA Reg 5 | 5.70E+02 | Ohio Administrative Code--hardness dependent |
| Chromium | 7440-47-3 | 1,800 | Ohio Administrative Code--hardness dependent | -- | -- | -- | -- | 42 | USEPA Reg 5 | 1.80E+03 | Ohio Administrative Code--hardness dependent |
| Chromium VI (Diss) | 7440-47-3 | 16 | Ohio Administrative Code | 11 | NAWQC 2009 | 11 | Tier II (Suter & Tsao 1996) | -- | -- | 1.60E+01 | Ohio Administrative Code |
| Cobalt | 7440-48-4 | 220 | Ohio Administrative Code | -- | -- | 23 | Tier II (Suter & Tsao 1996) | 24 | USEPA Reg 5 | 2.20E+02 | Ohio Administrative Code |
| Copper (Diss) | 7440-50-8 | 13 | Ohio Administrative Code--hardness dependent | 1.45 | NAWQC 2009 | -- | -- | -- | -- | 1.30E+01 | Ohio Administrative Code--hardness dependent |
| Copper | 7440-50-8 | 14 | Ohio Administrative Code--hardness dependent | -- | -- | -- | -- | 1.58 | USEPA Reg 5 | 1.40E+01 | Ohio Administrative Code--hardness dependent |
| Cyanide | 57-12-5 | 22 | Ohio Administrative Code | 5.2 | NAWQC 2009 | -- | -- | 5.2 | USEPA Reg 5 | 2.20E+01 | Ohio Administrative Code |
| Iron | 7439-89-6 | -- | -- | 1,000 | NAWQC 2009 | 300 | Tier II (GLI database) | -- | -- | 1.00E+03 | NAWQC 2009 |
| Lead (Diss) | 7439-92-1 | 97 | Ohio Administrative Code--hardness dependent | 2.5 | NAWQC 2009 | -- | -- | -- | -- | 9.70E+01 | Ohio Administrative Code--hardness dependent |
| Lead | 7439-92-1 | 120 | Ohio Administrative Code--hardness dependent | -- | -- | -- | -- | 1.17 | USEPA Reg 5 | 1.20E+02 | Ohio Administrative Code--hardness dependent |
| Lithium | -- | -- | -- | -- | -- | 14 | Tier II (Suter & Tsao 1996) | -- | -- | 1.40E+01 | Tier II (Suter & Tsao 1996) |
| Magnesium | 7439-95-4 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Manganese | 7439-96-5 | -- | -- | -- | -- | 120 | Tier II (Suter & Tsao 1996) | -- | -- | 1.20E+02 | Tier II (Suter & Tsao 1996) |
| Mercury | 7439-97-6 | 1.7 | Ohio Administrative Code | -- | -- | 1.3 | Tier II (Suter & Tsao 1996) | 0.0013 | -- | 1.70E+00 | Ohio Administrative Code |
| Mercury (Diss) | 7439-97-6 | 1.4 | Ohio Administrative Code | 0.77 | NAWQC 2009 | -- | -- | -- | -- | 1.40E+00 | Ohio Administrative Code |
| Mercury, methyl | 22967-92-6 | -- | -- | -- | -- | 0.0028 | Tier II (Suter & Tsao 1996) | 2.46E-03 | -- | 2.80E-03 | Tier II (Suter & Tsao 1996) |
| Molybdenum | 7439-98-7 | 190,000 | Ohio Administrative Code | -- | -- | 370 | Tier II (Suter & Tsao 1996) | -- | -- | 1.90E+05 | Ohio Administrative Code |
| Nickel (Diss) | 7440-02-0 | 470 | Ohio Administrative Code--hardness dependent | 52 | NAWQC 2009 | -- | -- | -- | -- | 4.70E+02 | Ohio Administrative Code--hardness dependent |
| Nickel (TR) | 7440-02-1 | 470 | Ohio Administrative Code--hardness dependent | -- | -- | -- | -- | 28.9 | USEPA Reg 5 | 4.70E+02 | Ohio Administrative Code--hardness dependent |
| Potassium | 7440-09-7 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Selenium (Diss) | 7782-49-2 | -- | -- | 4.6 | NAWQC 2009 | -- | -- | -- | -- | 4.61E+00 | NAWQC 2009 |
| Selenium | 7782-49-2 | -- | -- | 5 | NAWQC 2009 | -- | -- | 5 | USEPA Reg 5 | 5.00E+00 | NAWQC 2009 |
| Silver (Diss) | 7440-22-4 | 1.4 | Ohio Administrative Code--hardness dependent | -- | -- | 0.12 | Tier II (Suter & Tsao 1996) | -- | -- | 1.40E+00 | Ohio Administrative Code--hardness dependent |
| Silver | 7440-22-4 | 1.6 | Ohio Administrative Code--hardness dependent | -- | -- | 0.36 | Tier II (Suter & Tsao 1996) | 0.12 | USEPA Reg 5 | 1.60E+00 | Ohio Administrative Code--hardness dependent |
| Sodium | 7440-23-5 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Strontium | 7440-24-6 | 40,000 | Ohio Administrative Code | -- | -- | 1,500 | Tier II (Suter & Tsao 1996) | -- | -- | 4.00E+04 | Ohio Administrative Code |
| Thallium | 7440-28-0 | 79 | Ohio Administrative Code | -- | -- | 12 | Tier II (Suter & Tsao 1996) | 10 | USEPA Reg 5 | 7.90E+01 | Ohio Administrative Code |
| Tin | 7440-31-5 | 1,600 | Ohio Administrative Code | -- | -- | 73 | Tier II (Suter & Tsao 1996) | 180 | USEPA Reg 5 | 1.60E+03 | Ohio Administrative Code |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| Uranium | -- | -- | -- | -- | -- | 2.6 | Tier II (Suter & Tsao 1996) | -- | -- | 2.60E+00 | Tier II (Suter & Tsao 1996) |
| Vanadium | 7440-62-2 | 150 | Ohio Administrative Code | -- | -- | 20 | Tier II (Suter & Tsao 1996) | 12 | USEPA Reg 5 | 1.50E+02 | Ohio Administrative Code |
| Zinc (Diss) | 7440-66-6 | 120 | Ohio Administrative Code | 120 | NAWQC 2009 | -- | -- | -- | -- | 1.20E+02 | Ohio Administrative Code |
| Zinc (TR) | 7440-66-6 | 120 | Ohio Administrative Code | -- | -- | -- | -- | 65.7 | USEPA Reg 5 | 1.20E+02 | Ohio Administrative Code |
| Zirconium | -- | -- | -- | -- | -- | 17 | Tier II (Suter & Tsao 1996) | -- | -- | 1.70E+01 | Tier II (Suter & Tsao 1996) |
| ***Anions*** | | | | | | | | | | | |
| Chloride | 16887-00-6 | -- | -- | 230,000 | NAWQC 2009 | -- | -- | -- | -- | 2.30E+05 | NAWQC 2009 |
| Fluoride | 16984-48-8 | -- | -- | -- | -- | 3,400 | Tier II (GLI database) | -- | -- | 3.40E+03 | Tier II (GLI database) |
| Hydrogen Sulfide | 7783-06-4 | -- | -- | 2 | NAWQC 2009 | 2 | Tier II (GLI database) | -- | -- | 2.00E+00 | NAWQC 2009 |
| Nitrate | 14797-55-8 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Nitrite | 14797-65-0 | -- | -- | -- | -- | 20 | Tier II (GLI database) | -- | -- | 2.00E+01 | Tier II (GLI database) |
| Sulfite | 14265-45-3 | -- | -- | -- | -- | 200 | Tier II (GLI database) | -- | -- | 2.00E+02 | Tier II (GLI database) |
| ***Organic Chemicals*** | | | | | | | | | | | |
| Acenaphthene | 83-32-9 | 19 | Ohio Administrative Code | -- | -- | 5.3 | Tier II (GLI database) | 38 | USEPA Reg 5 | 1.90E+01 | Ohio Administrative Code |
| Acenaphthylene | 208-96-8 | 120 | Ohio Administrative Code, Lake Erie | -- | -- | -- | -- | 4,840 | USEPA Reg 5 | 1.20E+02 | Ohio Administrative Code, Lake Erie |
| Acetaldehyde | 75-07-0 | -- | -- | -- | -- | 130 | Tier II (GLI database) | -- | -- | 1.30E+02 | Tier II (GLI database) |
| Acetone | 67-64-1 | -- | -- | -- | -- | 1,500 | Tier II (Suter & Tsao 1996) | 1,700 | USEPA Reg 5 | 1.50E+03 | Tier II (Suter & Tsao 1996) |
| Acetonitrile | 75-05-8 | 100,000 | Ohio Administrative Code | -- | -- | 12,000 | Tier II (GLI database) | 12,000 | USEPA Reg 5 | 1.00E+05 | Ohio Administrative Code |
| Acetylaminofluorene[2-] | 53-96-3 | -- | -- | -- | -- | -- | -- | 535 | USEPA Reg 5 | 5.35E+02 | USEPA Reg 5 |
| Acrolein | 107-02-8 | -- | -- | 3 | NAWQC 2009 | 0.19 | Tier II (GLI database) | 0.19 | USEPA Reg 5 | 3.00E+00 | NAWQC 2009 |
| Acrylonitrile | 107-13-1 | 650 | Ohio Administrative Code | -- | -- | 78 | Tier II (GLI database) | 66 | USEPA Reg 5 | 6.50E+02 | Ohio Administrative Code |
| Alachlor | 15972-60-8 | -- | -- | -- | -- | 21 | Tier II (GLI database) | -- | -- | 2.10E+01 | Tier II (GLI database) |
| Aldrin | 309-00-2 | -- | -- | -- | -- | 0.035 | Tier II (GLI database) | 0.017 | USEPA Reg 5 | 3.50E-02 | Tier II (GLI database) |
| 2-Amino-4,6-dinitrotoluene | 35572-78-2 | 160 | Ohio Administrative Code | -- | -- | 18 | Tier II (GLI database) | -- | -- | 1.60E+02 | Ohio Administrative Code |
| 4-Amino-2,6-dinitrotoluene | 19406-51-0 | 98 | Ohio Administrative Code | -- | -- | 11 | Tier II (GLI database) | -- | -- | 9.80E+01 | Ohio Administrative Code |
| Aniline | 62-53-3 | 30 | Ohio Administrative Code | -- | -- | 4.1 | Tier II (GLI database) | 4.1 | USEPA Reg 5 | 3.00E+01 | Ohio Administrative Code |
| Anthracene | 120-12-7 | 0.18 | Ohio Administrative Code | -- | -- | 0.73 | Tier II (Suter & Tsao 1996) | 0.035 | USEPA Reg 5 | 1.80E-01 | Ohio Administrative Code |
| Aramite | 140-57-8 | -- | -- | -- | -- | -- | -- | 3.09 | USEPA Reg 5 | 3.09E+00 | USEPA Reg 5 |
| Azobenzene[p-(dimethylamino)] | 60-11-7 | -- | -- | -- | -- | -- | -- | 1.65 | USEPA Reg 5 | 1.65E+00 | USEPA Reg 5 |
| Benzene | 71-43-2 | 700 | Ohio Administrative Code | -- | -- | 130 | Tier II (Suter & Tsao 1996) | 114 | USEPA Reg 5 | 7.00E+02 | Ohio Administrative Code |
| Benzenemethanol | 100-51-6 | -- | -- | -- | -- | 8.6 | Tier II (Suter & Tsao 1996) | 8.6 | USEPA Reg 5 | 8.60E+00 | Tier II (Suter & Tsao 1996) |
| Benzidine | -- | -- | -- | -- | -- | 3.9 | Tier II (Suter & Tsao 1996) | -- | -- | 3.90E+00 | Tier II (Suter & Tsao 1996) |
| Benz(a)anthracene | 56-55-3 | 42 | Ohio Administrative Code, Lake Erie | -- | -- | 0.027 | Tier II (Suter & Tsao 1996) | 0.025 | USEPA Reg 5 | 4.20E+01 | Ohio Administrative Code, Lake Erie |
| Benzo(a)pyrene | 50-32-8 | 0.54 | Ohio Administrative Code, Lake Erie | -- | -- | 0.014 | Tier II (Suter & Tsao 1996) | 0.014 | USEPA Reg 5 | 5.40E-01 | Ohio Administrative Code, Lake Erie |
| Benzo(b)fluoranthene | 205-99-2 | 23 | Ohio Administrative Code, Lake Erie | -- | -- | 2.6 | Tier II (GLI database) | 9.07 | USEPA Reg 5 | 2.30E+01 | Ohio Administrative Code, Lake Erie |
| Benzo(g,h,i)perylene | 191-24-2 | -- | -- | -- | -- | -- | -- | 7.64 | USEPA Reg 5 | 7.64E+00 | USEPA Reg 5 |
| Benzoic Acid | 65-85-0 | -- | -- | -- | -- | 42 | Tier II (Suter & Tsao 1996) | -- | -- | 4.20E+01 | Tier II (Suter & Tsao 1996) |
| BHC, alpha | 319-84-6 | -- | -- | -- | -- | -- | -- | 12.4 | USEPA Reg 5 | 1.24E+01 | USEPA Reg 5 |
| BHC, beta | 319-85-7 | -- | -- | -- | -- | -- | -- | 0.495 | USEPA Reg 5 | 4.95E-01 | USEPA Reg 5 |
| BHC, delta | 319-86-8 | -- | -- | -- | -- | -- | -- | 667 | USEPA Reg 5 | 6.67E+02 | USEPA Reg 5 |
| BHC, gamma (lindane) | 58-89-9 | 0.95 | Ohio Administrative Code | -- | -- | 0.057 | Tier II (GLI database) | 0.026 | USEPA Reg 5 | 9.50E-01 | Ohio Administrative Code |
| Biphenyl | 92-52-4 | 26 | Ohio Administrative Code | -- | -- | 6.5 | Tier II (GLI database) | -- | -- | 2.60E+01 | Ohio Administrative Code |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| Bis(2-chloroethyl) ether | 111-44-4 | -- | -- | -- | -- | -- | -- | 19,000 | USEPA Reg 5 | 1.90E+04 | USEPA Reg 5 |
| Bis(2-ethylhexyl)phthalate | 117-81-7 | 1,100 | Ohio Administrative Code | -- | -- | 3.0 | Tier II (Suter & Tsao 1996) | 0.3 | USEPA Reg 5 | 1.10E+03 | Ohio Administrative Code |
| Bromodichloromethane | 74-97-5 | 3,100 | Ohio Administrative Code, Lake Erie | -- | -- | -- | -- | -- | -- | 3.10E+03 | Ohio Administrative Code, Lake Erie |
| Bromomethane (methyl bromide) | 74-83-9 | 38 | Ohio Administrative Code | -- | -- | 16 | Tier II (GLI database) | 16 | USEPA Reg 5 | 3.80E+01 | Ohio Administrative Code |
| 4-Bromophenyl-phenylether | 101-55-3 | -- | -- | -- | -- | -- | -- | 1.5 | USEPA Reg 5 | 1.50E+00 | USEPA Reg 5 |
| 2-Butanone (methyl ethyl ketone) | 78-93-3 | 200,000 | Ohio Administrative Code | -- | -- | 22,000 | Tier II (GLI database) | 2,200 | USEPA Reg 5 | 2.00E+05 | Ohio Administrative Code |
| Butylbenzylphthalate | 85-68-7 | 130 | Ohio Administrative Code | -- | -- | 23 | Tier II (GLI database) | 23 | USEPA Reg 5 | 1.30E+02 | Ohio Administrative Code |
| Carbofuran | 1563-66-2 | -- | -- | -- | -- | 1 | Tier II (GLI database) | -- | -- | 1.00E+00 | Tier II (GLI database) |
| Carbon Disulfide | 75-15-0 | 130 | Ohio Administrative Code | -- | -- | 15 | Tier II (GLI database) | 15 | USEPA Reg 5 | 1.30E+02 | Ohio Administrative Code |
| Carbon Tetrachloride | 56-23-5 | 2,200 | Ohio Administrative Code | -- | -- | 240 | Tier II (GLI database) | 240 | USEPA Reg 5 | 2.20E+03 | Ohio Administrative Code |
| Chlordane | 57-74-9 | -- | -- | 0.0043 | NAWQC 2009 | -- | -- | 0.0043 | USEPA Reg 5 | 4.30E-03 | NAWQC 2009 |
| 4-Chloroaniline | 106-47-8 | -- | -- | -- | -- | -- | -- | 232 | USEPA Reg 5 | 2.32E+02 | USEPA Reg 5 |
| Chlorobenzene | 108-90-7 | 420 | Ohio Administrative Code | -- | -- | 47 | Tier II (GLI database) | 47 | USEPA Reg 5 | 4.20E+02 | Ohio Administrative Code |
| Chlorobenzilate | 510-15-6 | -- | -- | -- | -- | -- | -- | 7.16 | USEPA Reg 5 | 7.16E+00 | USEPA Reg 5 |
| Chloroform | 67-66-3 | 1,300 | Ohio Administrative Code | -- | -- | 140 | Tier II (GLI database) | 140 | USEPA Reg 5 | 1.30E+03 | Ohio Administrative Code |
| 2-Chloronaphthalene | 91-58-7 | -- | -- | -- | -- | -- | -- | 0.396 | USEPA Reg 5 | 3.96E-01 | USEPA Reg 5 |
| 2-Chlorophenol | 95-57-8 | 290 | Ohio Administrative Code | -- | -- | 32 | Tier II (GLI database) | 24 | USEPA Reg 5 | 2.90E+02 | Ohio Administrative Code |
| Chloropyrifos | 2921-88-2 | -- | -- | 0.041 | NAWQC 2009 | -- | -- | -- | -- | 4.10E-02 | NAWQC 2009 |
| 4-Chloro-3-methylphenol | 59-50-7 | -- | -- | -- | -- | -- | -- | 34.8 | USEPA Reg 5 | 3.48E+01 | USEPA Reg 5 |
| Chrysene | 218-01-9 | 42 | Ohio Administrative Code, Lake Erie | -- | -- | -- | -- | -- | -- | 4.20E+01 | Ohio Administrative Code, Lake Erie |
| Cyanazine | 21725-46-2 | -- | -- | -- | -- | 270 | Tier II (GLI database) | -- | -- | 2.70E+02 | Tier II (GLI database) |
| 2,4-D | 94-75-7 | -- | -- | -- | -- | 240 | Tier II (GLI database) | 220 | USEPA Reg 5 | 2.40E+02 | Tier II (GLI database) |
| 4,4'-DDD | 72-54-8 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| 4,4'-DDE | 72-55-9 | -- | -- | -- | -- | -- | -- | 4.51E-09 | USEPA Reg 5 | 4.51E-09 | USEPA Reg 5 |
| 4,4'-DDT | 50-29-3 | 11 | Erie OMZA for DDT+met, Table 33-2 of OAC | 0.001 | NAWQC 2009 | -- | -- | 1.10E-05 | USEPA Reg 5 | 1.10E+01 | Erie OMZA for DDT+met, Table 33-2 of OAC |
| Demeton | 8065-48-3 | -- | -- | 0.1 | NAWQC 2009 | 0.1 | Tier II (GLI database) | -- | -- | 1.00E-01 | NAWQC 2009 |
| Diazinon | 333-41-5 | -- | -- | 0.17 | NAWQC 2009 | 0.08 | Tier II (GLI database) | -- | -- | 1.70E-01 | NAWQC 2009 |
| Dibenzofuran | 132-64-9 | 36 | Ohio Administrative Code | -- | -- | 4 | Tier II (GLI database) | 4 | USEPA Reg 5 | 3.60E+01 | Ohio Administrative Code |
| Dibromochloromethane | 124-48-1 | 2,900 | Ohio Administrative Code, Lake Erie | -- | -- | -- | -- | -- | -- | 2.90E+03 | Ohio Administrative Code, Lake Erie |
| 2,2-Dibromo-3-nitrilopropionamide | 10222-01-2 | -- | -- | -- | -- | 20 | Tier II (GLI database) | -- | -- | 2.00E+01 | Tier II (GLI database) |
| 1,2-Dichlorobenzene | 95-50-1 | 130 | Ohio Administrative Code | -- | -- | 23 | Tier II (GLI database) | 14 | USEPA Reg 5 | 1.30E+02 | Ohio Administrative Code |
| 1,3-Dichlorobenzene | 541-73-1 | 79 | Ohio Administrative Code | -- | -- | 22 | Tier II (GLI database) | 38 | USEPA Reg 5 | 7.90E+01 | Ohio Administrative Code |
| 1,4-Dichlorobenzene | 106-46-7 | 57 | Ohio Administrative Code | -- | -- | 9.4 | Tier II (GLI database) | 9.4 | USEPA Reg 5 | 5.70E+01 | Ohio Administrative Code |
| Dichlorobenzene | 25321-22-6 | -- | -- | -- | -- | 5 | Tier II (GLI database) | -- | -- | 5.00E+00 | Tier II (GLI database) |
| 3,3'-Dichlorobenzidine | 91-94-1 | -- | -- | -- | -- | -- | -- | 4.5 | USEPA Reg 5 | 4.50E+00 | USEPA Reg 5 |
| 1,1-Dichloroethane | 75-34-3 | 3,700 | Ohio Administrative Code, Lake Erie | -- | -- | 740 | Tier II (GLI database) | 47 | USEPA Reg 5 | 3.70E+03 | Ohio Administrative Code, Lake Erie |
| 1,2-Dichloroethane | 107-06-2 | 9,600 | Ohio Administrative Code | -- | -- | 2,000 | Tier II (GLI database) | 910 | USEPA Reg 5 | 9.60E+03 | Ohio Administrative Code |
| 1,1-Dichloroethene | 75-35-4 | 1,900 | Ohio Administrative Code | -- | -- | 210 | Tier II (GLI database) | 65 | USEPA Reg 5 | 1.90E+03 | Ohio Administrative Code |
| 1,2-Dichloroethene | 540-59-0 | 8,800 | Ohio Administrative Code | -- | -- | 970 | Tier II (GLI database) | 970 | USEPA Reg 5 | 8.80E+03 | Ohio Administrative Code |
| 2,4-Dichlorophenol | 120-83-2 | 110 | Ohio Administrative Code | -- | -- | 11 | Tier II (GLI database) | 11 | USEPA Reg 5 | 1.10E+02 | Ohio Administrative Code |
| 1,2-Dichloropropane | 78-87-5 | 3,300 | Ohio Administrative Code | -- | -- | 520 | Tier II (GLI database) | 360 | USEPA Reg 5 | 3.30E+03 | Ohio Administrative Code |
| 1,3-Dichloropropene | 542-75-6 | 15 | Ohio Administrative Code | -- | -- | 1.7 | Tier II (GLI database) | -- | -- | 1.50E+01 | Ohio Administrative Code |
| Dieldrin | 60-57-1 | 0.24 | Ohio Administrative Code | 0.056 | NAWQC 2009 | -- | -- | 7.10E-05 | USEPA Reg 5 | 2.40E-01 | Ohio Administrative Code |
| Diethylphthalate | 84-66-2 | 980 | Ohio Administrative Code | -- | -- | 220 | Tier II (GLI database) | 110 | USEPA Reg 5 | 9.80E+02 | Ohio Administrative Code |
| 7,12'-Dimethylbenz(a)anthracene | 57-97-6 | -- | -- | -- | -- | -- | -- | 0.548 | USEPA Reg 5 | 5.48E-01 | USEPA Reg 5 |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| 2,4-Dimethylphenol | 105-67-9 | 140 | Ohio Administrative Code | -- | -- | 15 | Tier II (GLI database) | 100 | USEPA Reg 5 | 1.40E+02 | Ohio Administrative Code |
| Dimethylphthalate | 131-11-3 | 3,200 | Ohio Administrative Code | -- | -- | 1,100 | Tier II (GLI database) | -- | -- | 3.20E+03 | Ohio Administrative Code |
| Di-n-butyl phthalate | 84-74-2 | -- | -- | -- | -- | 19 | Tier II (GLI database) | 9.7 | USEPA Reg 5 | 1.90E+01 | Tier II (GLI database) |
| Di-n-octylphthalate | 117-84-0 | -- | -- | -- | -- | -- | -- | 30 | USEPA Reg 5 | 3.00E+01 | USEPA Reg 5 |
| 3,5-Dinitroaniline | 618-87-1 | 210 | Ohio Administrative Code | -- | -- | 70 | Tier II (GLI database) | -- | -- | 2.10E+02 | Ohio Administrative Code |
| 1,3-Dinitrobenzene | 99-65-0 | 100 | Ohio Administrative Code | -- | -- | 22 | Tier II (GLI database) | 22 | USEPA Reg 5 | 1.00E+02 | Ohio Administrative Code |
| 2,4-Dinitrophenol | 51-28-5 | -- | -- | -- | -- | -- | -- | 19 | USEPA Reg 5 | 1.90E+01 | USEPA Reg 5 |
| 2,3-Dinitrotoluene | 602-01-7 | 21 | Ohio Administrative Code | -- | -- | 2.3 | Tier II (GLI database) | -- | -- | 2.10E+01 | Ohio Administrative Code |
| 2,4-Dinitrotoluene | 121-14-2 | 390 | Ohio Administrative Code | -- | -- | 44 | Tier II (GLI database) | 44 | USEPA Reg 5 | 3.90E+02 | Ohio Administrative Code |
| 2,5-Dinitrotoluene | 619-15-8 | 50 | Ohio Administrative Code | -- | -- | 5.6 | Tier II (GLI database) | -- | -- | 5.00E+01 | Ohio Administrative Code |
| 2,6-Dinitrotoluene | 606-20-2 | 730 | Ohio Administrative Code | -- | -- | 81 | Tier II (GLI database) | 81 | USEPA Reg 5 | 7.30E+02 | Ohio Administrative Code |
| 3,5-Dinitrotoluene | 618-85-9 | 860 | Ohio Administrative Code | -- | -- | 95 | Tier II (GLI database) | -- | -- | 8.60E+02 | Ohio Administrative Code |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | -- | -- | -- | -- | -- | -- | 23 | USEPA Reg 5 | 2.30E+01 | USEPA Reg 5 |
| Dinoseb | 88-85-7 | -- | -- | -- | -- | -- | -- | 0.48 | USEPA Reg 5 | 4.80E-01 | USEPA Reg 5 |
| 1,4-Dioxane | 123-91-1 | -- | -- | -- | -- | -- | -- | 22,000 | USEPA Reg 5 | 2.20E+04 | USEPA Reg 5 |
| Diphenylamine | 122-39-4 | -- | -- | -- | -- | -- | -- | 412 | USEPA Reg 5 | 4.12E+02 | USEPA Reg 5 |
| 1,2-Diphenylhydrazine | 122-66-7 | -- | -- | -- | -- | 1.1 | Tier II (GLI database) | -- | -- | 1.10E+00 | Tier II (GLI database) |
| Disulfoton | 298-04-4 | -- | -- | -- | -- | -- | -- | 0.0402 | USEPA Reg 5 | 4.02E-02 | USEPA Reg 5 |
| Endosulfan | 115-29-7 | -- | -- | -- | -- | 0.009 | Tier II (GLI database) | -- | -- | 9.00E-03 | Tier II (GLI database) |
| Endosulfan I (alpha) | 959-98-8 | -- | -- | 0.056 | NAWQC 2009 | -- | -- | 0.056 | USEPA Reg 5 | 5.60E-02 | NAWQC 2009 |
| Endosulfan II (beta) | 33213-65-9 | -- | -- | 0.056 | NAWQC 2009 | -- | -- | 0.056 | USEPA Reg 5 | 5.60E-02 | NAWQC 2009 |
| Endosulfan Sulfate | 1031-07-8 | -- | -- | -- | -- | -- | -- | 2.22 | USEPA Reg 5 | 2.22E+00 | USEPA Reg 5 |
| Endrin | 72-20-8 | 0.086 | Ohio Administrative Code | 0.036 | NAWQC 2009 | -- | -- | 0.036 | USEPA Reg 5 | 8.60E-02 | Ohio Administrative Code |
| Endrin Aldehyde | 7421-93-4 | -- | -- | -- | -- | -- | -- | 0.15 | USEPA Reg 5 | 1.50E-01 | USEPA Reg 5 |
| Ethylbenzene | 100-41-4 | 550 | Ohio Administrative Code | -- | -- | 61 | Tier II (GLI database) | 14 | USEPA Reg 5 | 5.50E+02 | Ohio Administrative Code |
| Ethylene Glycol | 107-21-1 | 1,300,000 | Ohio Administrative Code | -- | -- | 140,000 | Tier II (GLI database) | -- | -- | 1.30E+06 | Ohio Administrative Code |
| Fluoranthene | 206-44-0 | 3.7 | Ohio Administrative Code | 6.16 | NAWQC (Suter & Tsao 1996) | 0.8 | Tier II (GLI database) | 1.9 | USEPA Reg 5 | 3.70E+00 | Ohio Administrative Code |
| Fluorene | 86-73-7 | 110 | Ohio Administrative Code | -- | -- | 19 | Tier II (GLI database) | 19 | USEPA Reg 5 | 1.10E+02 | Ohio Administrative Code |
| Formaldehyde | 50-00-0 | -- | -- | -- | -- | 74 | Tier II (GLI database) | -- | -- | 7.40E+01 | Tier II (GLI database) |
| Guthion | 86-50-0 | -- | -- | 0.01 | NAWQC 2009 | 0.005 | Tier II (GLI database) | -- | -- | 1.00E-02 | NAWQC 2009 |
| Heptachlor | 76-44-8 | -- | -- | 0.0038 | NAWQC 2009 | -- | -- | 3.80E-03 | USEPA Reg 5 | 3.80E-03 | NAWQC 2009 |
| Heptachlor Epoxide | 1024-57-3 | -- | -- | 0.0038 | NAWQC 2009 | -- | -- | 3.80E-03 | USEPA Reg 5 | 3.80E-03 | NAWQC 2009 |
| Hexachlorobenzene | 118-74-1 | -- | -- | -- | -- | -- | -- | 3.00E-04 | USEPA Reg 5 | 3.00E-04 | USEPA Reg 5 |
| Hexachlorobutadiene | 87-68-3 | -- | -- | -- | -- | 1 | Tier II (GLI database) | 0.053 | USEPA Reg 5 | 1.00E+00 | Tier II (GLI database) |
| Hexachlorocyclopentadiene | 77-47-4 | -- | -- | -- | -- | 0.45 | Tier II (GLI database) | 77 | USEPA Reg 5 | 4.50E-01 | Tier II (GLI database) |
| Hexachloroethane | 67-72-1 | -- | -- | -- | -- | -- | -- | 8 | USEPA Reg 5 | 8.00E+00 | USEPA Reg 5 |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| Hexachlorophene | 70-30-4 | -- | -- | -- | -- | -- | -- | 0.228 | USEPA Reg 5 | 2.28E-01 | USEPA Reg 5 |
| 2-Hexanone | 591-78-6 | -- | -- | -- | -- | -- | -- | 99 | USEPA Reg 5 | 9.90E+01 | USEPA Reg 5 |
| HMX | 2691-41-0 | 1,200 | Ohio Administrative Code | -- | -- | 220 | Tier II (GLI database) | -- | -- | 1.20E+03 | Ohio Administrative Code |
| Hydroquinone | 123-31-9 | -- | -- | -- | -- | 2.2 | Tier II (GLI database) | -- | -- | 2.20E+00 | Tier II (GLI database) |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | -- | -- | -- | -- | -- | -- | 4.31 | USEPA Reg 5 | 4.31E+00 | USEPA Reg 5 |
| Isodecyl diphenyl phosphate | 29761-21-5 | -- | -- | -- | -- | 1.73 | Tier II (GLI database) | -- | -- | 1.73E+00 | Tier II (GLI database) |
| Isodrin | 465-73-6 | -- | -- | -- | -- | -- | -- | 0.0309 | USEPA Reg 5 | 3.09E-02 | USEPA Reg 5 |
| Isophorone | 78-59-1 | 7,500 | Ohio Administrative Code | -- | -- | 920 | Tier II (GLI database) | 920 | USEPA Reg 5 | 7.50E+03 | Ohio Administrative Code |
| Isopropylbenzene | 98-82-8 | 43 | Ohio Administrative Code | -- | -- | 4.8 | Tier II (GLI database) | -- | -- | 4.30E+01 | Ohio Administrative Code |
| 4-Isopropyltoluene | 99-87-6 | 150 | Ohio Administrative Code | -- | -- | 16 | Tier II (GLI database) | -- | -- | 1.50E+02 | Ohio Administrative Code |
| Kepone | 143-50-0 | -- | -- | -- | -- | -- | -- | 0.132 | USEPA Reg 5 | 1.32E-01 | USEPA Reg 5 |
| Malathion | 121-75-5 | -- | -- | 0.1 | NAWQC 2009 | 0.1 | Tier II (GLI database) | -- | -- | 1.00E-01 | NAWQC 2009 |
| MBAS (foaming agents, aesthetic criteria) | -- | 500 | Ohio Administrative Code | -- | -- | -- | -- | -- | -- | 5.00E+02 | Ohio Administrative Code |
| Methanol | 67-56-1 | -- | -- | -- | -- | 330 | Tier II (GLI database) | -- | -- | 3.30E+02 | Tier II (GLI database) |
| Methoxychlor | 72-43-5 | -- | -- | 0.03 | NAWQC 2009 | 0.03 | Tier II (GLI database) | 0.019 | USEPA Reg 5 | 3.00E-02 | NAWQC 2009 |
| Methyl Metharcrylate | 80-62-6 | -- | -- | -- | -- | -- | -- | 2,800 | USEPA Reg 5 | 2.80E+03 | USEPA Reg 5 |
| 4-Methyl-2-pentanone | 108-10-1 | -- | -- | -- | -- | -- | -- | 170 | USEPA Reg 5 | 1.70E+02 | USEPA Reg 5 |
| Methyl tert-butyl ether | 1634-04-4 | 6,500 | Ohio Administrative Code | 51,000 | NAWQC 2009 | 730 | Tier II (GLI database) | -- | -- | 6.50E+03 | Ohio Administrative Code |
| Methylamine | 74-89-5 | -- | -- | -- | -- | 860 | Tier II (GLI database) | -- | -- | 8.60E+02 | Tier II (GLI database) |
| 3-Methylcholanthrene | 56-49-5 | -- | -- | -- | -- | -- | -- | 0.0891 | USEPA Reg 5 | 8.91E-02 | USEPA Reg 5 |
| Methylene Chloride (dichloromethane) | 75-09-2 | 11,000 | Ohio Administrative Code | -- | -- | 2,200 | Tier II (Suter & Tsao 1996) | 940 | USEPA Reg 5 | 1.10E+04 | Ohio Administrative Code |
| Methylene Dithiocyanate | 6317-18-6 | -- | -- | -- | -- | 1 | Tier II (GLI database) | -- | -- | 1.00E+00 | Tier II (GLI database) |
| 2-Methylnaphthalene | 91-57-6 | -- | -- | -- | -- | 4.7 | Tier II (GLI database) | 330 | USEPA Reg 5 | 4.70E+00 | Tier II (GLI database) |
| 2-Methylphenol | 95-48-7 | 600 | Ohio Administrative Code | -- | -- | 67 | Tier II (GLI database) | 67 | USEPA Reg 5 | 6.00E+02 | Ohio Administrative Code |
| 3-Methylphenol | 108-39-4 | 560 | Ohio Administrative Code | -- | -- | 62 | Tier II (GLI database) | 62 | USEPA Reg 5 | 5.60E+02 | Ohio Administrative Code |
| 4-Methylphenol | 106-44-5 | 480 | Ohio Administrative Code | -- | -- | 53 | Tier II (GLI database) | 25 | USEPA Reg 5 | 4.80E+02 | Ohio Administrative Code |
| Mirex | 2385-85-5 | -- | -- | 0.001 | NAWQC 2009 | 0.001 | Tier II (GLI database) | -- | -- | 1.00E-03 | NAWQC 2009 |
| Naphthalene | 91-20-3 | 170 | Ohio Administrative Code | -- | -- | 21 | Tier II (GLI database) | 13 | USEPA Reg 5 | 1.70E+02 | Ohio Administrative Code |
| Nitrilotriacetic Acid | 139-13-9 | -- | -- | -- | -- | 5000 | Tier II (GLI database) | -- | -- | 5.00E+03 | Tier II (GLI database) |
| Nitrobenzene | 99-95-3 | 2,000 | Ohio Administrative Code | -- | -- | 380 | Tier II (GLI database) | 220 | USEPA Reg 5 | 2.00E+03 | Ohio Administrative Code |
| Nitroglycerin | 55-63-0 | 160 | Ohio Administrative Code | -- | -- | 18 | Tier II (GLI database) | -- | -- | 1.60E+02 | Ohio Administrative Code |
| 2-Nitrophenol | 88-75-5 | 650 | Ohio Administrative Code | -- | -- | 73 | Tier II (GLI database) | -- | -- | 6.50E+02 | Ohio Administrative Code |
| 4-Nitrophenol | 100-02-7 | -- | -- | -- | -- | 58 | Tier II (GLI database) | 60 | USEPA Reg 5 | 5.80E+01 | Tier II (GLI database) |
| N-Nitrosodiethylamine | 55-18-5 | -- | -- | -- | -- | -- | -- | 768 | USEPA Reg 5 | 7.68E+02 | USEPA Reg 5 |
| N-Nitrosodiphenylamine | 86-30-6 | -- | -- | -- | -- | 25 | Tier II (GLI database) | -- | -- | 2.50E+01 | Tier II (GLI database) |
| 2-Nitrotoluene | 88-72-2 | 640 | Ohio Administrative Code | -- | -- | 71 | Tier II (GLI database) | -- | -- | 6.40E+02 | Ohio Administrative Code |
| 3-Nitrotoluene | 99-08-1 | 380 | Ohio Administrative Code | -- | -- | 42 | Tier II (GLI database) | -- | -- | 3.80E+02 | Ohio Administrative Code |
| 4-Nitrotoluene | 99-99-0 | 410 | Ohio Administrative Code | -- | -- | 46 | Tier II (GLI database) | -- | -- | 4.10E+02 | Ohio Administrative Code |
| Nonylphenol | 84852-15-3 | -- | -- | 28 | NAWQC 2009 | -- | -- | -- | -- | 2.80E+01 | NAWQC 2009 |
| Oil & Grease (aesthetic criteria) | -- | 10,000 | Ohio Administrative Code | -- | -- | -- | -- | -- | -- | 1.00E+04 | Ohio Administrative Code |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| Parathion | 56-38-2 | 0.065 | Ohio Administrative Code | 0.013 | NAWQC 2009 | -- | -- | 0.013 | USEPA Reg 5 | 6.50E-02 | Ohio Administrative Code |
| PCDDs | PCDD-S | -- | -- | -- | -- | -- | -- | 2.78E-07 | USEPA Reg 5 | 2.78E-07 | USEPA Reg 5 |
| Pentachlorobenzene | 608-93-5 | -- | -- | -- | -- | 3.1 | Tier II (GLI database) | 0.019 | USEPA Reg 5 | 3.10E+00 | Tier II (GLI database) |
| Pentachloroethane | 76-01-7 | -- | -- | -- | -- | -- | -- | 56.4 | USEPA Reg 5 | 5.64E+01 | USEPA Reg 5 |
| Pentachlorophenol | 87-86-5 | 5.3 | Ohio Administrative Code--pH dependent | 15 | NAWQC 2009 | -- | -- | 4 | USEPA Reg 5 | 5.30E+00 | Ohio Administrative Code--pH dependent |
| Perchlorate | 14797-73-0 | 20,000 | Ohio Administrative Code | -- | -- | -- | -- | -- | -- | 2.00E+04 | Ohio Administrative Code |
| Phenanthrene | 85-01-8 | 31 | Ohio Administrative Code | -- | -- | 2.3 | Tier II (GLI database) | 3.6 | USEPA Reg 5 | 3.10E+01 | Ohio Administrative Code |
| Phenol | 108-95-2 | 4,700 | Ohio Administrative Code | -- | -- | 400 | Tier II (GLI database) | 180 | USEPA Reg 5 | 4.70E+03 | Ohio Administrative Code |
| Phenol (cold water and salmon spawning habitat) | 108-95-2 | 4,600 | Ohio Administrative Code | -- | -- | -- | -- | -- | -- | 4.60E+03 | Ohio Administrative Code |
| Phorate | 298-02-2 | -- | -- | -- | -- | -- | -- | 3.62 | USEPA Reg 5 | 3.62E+00 | USEPA Reg 5 |
| PCBs | 1336-36-3 | 120 | Erie OMZA, Table 33-2 of OAC | 0.014 | NAWQC 2009 | -- | -- | 1.20E-04 | USEPA Reg 5 | 1.20E+02 | Erie OMZA, Table 33-2 of OAC |
| Propylene Glycol | 57-55-6 | 640,000 | Ohio Administrative Code | -- | -- | 71,000 | Tier II (GLI database) | -- | -- | 6.40E+05 | Ohio Administrative Code |
| Pyrene | 129-00-0 | 42 | Ohio Administrative Code | -- | -- | 4.6 | Tier II (GLI database) | 0.3 | USEPA Reg 5 | 4.20E+01 | Ohio Administrative Code |
| Pyridine | 110-86-1 | -- | -- | -- | -- | -- | -- | 2,380 | USEPA Reg 5 | 2.38E+03 | USEPA Reg 5 |
| RDX | 121-82-4 | 520 | Ohio Administrative Code | -- | -- | 79 | Tier II (GLI database) | -- | -- | 5.20E+02 | Ohio Administrative Code |
| SAS-310 | -- | 5 | Ohio Administrative Code | -- | -- | 0.61 | Tier II (GLI database) | -- | -- | 5.00E+00 | Ohio Administrative Code |
| Silvex (2,4,5-TP) | 93-72-1 | -- | -- | -- | -- | -- | -- | 30 | USEPA Reg 5 | 3.00E+01 | USEPA Reg 5 |
| Simazine | 122-34-9 | -- | -- | -- | -- | 9 | Tier II (GLI database) | -- | -- | 9.00E+00 | Tier II (GLI database) |
| Styrene | 100-42-5 | 290 | Ohio Administrative Code | -- | -- | 32 | Tier II (GLI database) | 32 | USEPA Reg 5 | 2.90E+02 | Ohio Administrative Code |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | -- | -- | -- | -- | 8.3 | Tier II (GLI database) | 3 | USEPA Reg 5 | 8.30E+00 | Tier II (GLI database) |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) | 1746-01-6 | -- | -- | -- | -- | -- | -- | 3.00E-09 | USEPA Reg 5 | 3.00E-09 | USEPA Reg 5 |
| 1,1,1,2-Tetrachloroethane | 630-20-6 | 770 | Ohio Administrative Code | -- | -- | 85 | Tier II (GLI database) | -- | -- | 7.70E+02 | Ohio Administrative Code |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 910 | Ohio Administrative Code | -- | -- | 260 | Tier II (GLI database) | 380 | USEPA Reg 5 | 9.10E+02 | Ohio Administrative Code |
| Tetrachloroethene | 127-18-4 | 430 | Ohio Administrative Code | -- | -- | 53 | Tier II (GLI database) | 45 | USEPA Reg 5 | 4.30E+02 | Ohio Administrative Code |
| 2,3,4,6-Tetrachlorophenol | 58-90-2 | -- | -- | -- | -- | -- | -- | 1.2 | USEPA Reg 5 | 1.20E+00 | USEPA Reg 5 |
| Tetraethyl Dithiopyrophosphate | 3689-24-5 | -- | -- | -- | -- | -- | -- | 13.9 | USEPA Reg 5 | 1.39E+01 | USEPA Reg 5 |
| Tetrahydrofuran | 109-99-9 | 74,000 | Ohio Administrative Code | -- | -- | 11,000 | Tier II (GLI database) | -- | -- | 7.40E+04 | Ohio Administrative Code |
| Tetryl | 479-45-8 | -- | -- | -- | -- | -- | -- | -- | -- | No ESV | No Source |
| Toluene | 108-88-3 | 560 | Ohio Administrative Code | -- | -- | 62 | Tier II (GLI database) | 253 | USEPA Reg 5 | 5.60E+02 | Ohio Administrative Code |
| Toxaphene | 8001-35-2 | -- | -- | 0.0002 | NAWQC 2009 | 0.005 | Tier II (GLI database) | 1.40E-04 | USEPA Reg 5 | 2.00E-04 | NAWQC 2009 |
| Tribromomethane (Bromoform) | 75-25-2 | 1,100 | Ohio Administrative Code | -- | -- | 230 | Tier II (GLI database) | 230 | USEPA Reg 5 | 1.10E+03 | Ohio Administrative Code |
| 2,4,6-Tribromophenol | 118-79-6 | 50 | Ohio Administrative Code | -- | -- | 5.6 | Tier II (GLI database) | -- | -- | 5.00E+01 | Ohio Administrative Code |
| Tributyltin (TBT) | 688-73-3 | -- | -- | 0.072 | NAWQC 2009 | -- | -- | -- | -- | 7.20E-02 | NAWQC 2009 |
| Trichlorobenzene | 12002-48-1 | -- | -- | -- | -- | 5 | Tier II (GLI database) | -- | -- | 5.00E+00 | Tier II (GLI database) |
| 1,2,4-Trichlorobenzene | 120-82-1 | -- | -- | -- | -- | -- | -- | 30 | USEPA Reg 5 | 3.00E+01 | USEPA Reg 5 |

**Table C-2. Ecological Screening Values for Chemical Analytes in Surface Water (continued)**

| Analyte | CAS Registry Number | Surface Water Screening Values | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ohio EPA OMZM[a] | | Updated Values for Suter and Tsao 1996[b] | | | | USEPA Region 5 ESLs (2003)[c] (update of 1998 EDQLs) | | Preferred Surface Water Value[d] | |
| | | | | NAWQC 2009 Update | | Tier II Values | | | | | |
| | | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference | Number (µg/L) | Reference |
| 1,1,1-Trichloroethane | 71-55-6 | 690 | Ohio Administrative Code | -- | -- | 76 | Tier II (GLI database) | 76 | USEPA Reg 5 | 6.90E+02 | Ohio Administrative Code |
| 1,1,2-Trichloroethane | 79-00-5 | 3,300 | Ohio Administrative Code | -- | -- | 740 | Tier II (GLI database) | 500 | USEPA Reg 5 | 3.30E+03 | Ohio Administrative Code |
| Trichloroethene | 79-01-6 | 2,000 | Ohio Administrative Code | -- | -- | 220 | Tier II (GLI database) | 47 | USEPA Reg 5 | 2.00E+03 | Ohio Administrative Code |
| 2,4,5-Trichlorophenol | 95-95-4 | -- | -- | -- | -- | 1.9 | Tier II (GLI database) | -- | -- | 1.90E+00 | Tier II (GLI database) |
| 2,4,6-Trichlorophenol | 88-06-2 | 39 | Ohio Administrative Code | -- | -- | 4.9 | Tier II (GLI database) | 4.9 | USEPA Reg 5 | 3.90E+01 | Ohio Administrative Code |
| 2,4,5-Trichlorophenoxyacetic Acid | 93-76-5 | -- | -- | -- | -- | -- | -- | 686 | USEPA Reg 5 | 6.86E+02 | USEPA Reg 5 |
| O,O,O-Triethyl Phosphorothioate | 126-68-1 | -- | -- | -- | -- | -- | -- | 58.2 | USEPA Reg 5 | 5.82E+01 | USEPA Reg 5 |
| Trimethylbenzene | 25551-13-7 | -- | -- | -- | -- | 15 | Tier II (GLI database) | -- | -- | 1.50E+01 | Tier II (GLI database) |
| 1,2,4-Trimethylbenzene | 95-63-6 | 140 | Ohio Administrative Code | -- | -- | 15 | Tier II (GLI database) | -- | -- | 1.40E+02 | Ohio Administrative Code |
| 1,3,5-Trimethylbenzene | 108-67-8 | 230 | Ohio Administrative Code | -- | -- | 26 | Tier II (GLI database) | -- | -- | 2.30E+02 | Ohio Administrative Code |
| 1,3,5-Trinitrobenzene | 99-35-4 | 27 | Ohio Administrative Code | -- | -- | 11 | Tier II (GLI database) | -- | -- | 2.70E+01 | Ohio Administrative Code |
| 2,4,6-Trinitrotoluene | 118-96-7 | 120 | Ohio Administrative Code | -- | -- | 13 | Tier II (GLI database) | -- | -- | 1.20E+02 | Ohio Administrative Code |
| Triphenyl Phosphate | 115-86-6 | -- | -- | -- | -- | 4 | Tier II (GLI database) | -- | -- | 4.00E+00 | Tier II (GLI database) |
| Urea | 57-13-6 | 150,000 | Ohio Administrative Code | -- | -- | 17,000 | Tier II (GLI database) | -- | -- | 1.50E+05 | Ohio Administrative Code |
| Vinyl Acetate | 108-05-4 | -- | -- | -- | -- | -- | -- | 248 | USEPA Reg 5 | 2.48E+02 | USEPA Reg 5 |
| Vinyl Chloride | 75-01-4 | 8,400 | Ohio Administrative Code | -- | -- | 930 | Tier II (GLI database) | 930 | USEPA Reg 5 | 8.40E+03 | Ohio Administrative Code |
| Xylenes (total) | 1330-20-7 | 240 | Ohio Administrative Code | -- | -- | 27 | Tier II (GLI database) | 27 | USEPA Reg 5 | 2.40E+02 | Ohio Administrative Code |

[a]Ohio Environmental Protection Agency (Ohio EPA), Division of Surface Water. 1999. Ohio Administrative Code (OAC), Chapters 3745-1, 3745-2, May 11 (Ohio River Basin). Where Ohio River Basin is unavailable, Lake Erie is used (as noted).
[b]Suter, G. W. and C.L. Tsao, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, ES/ER/TM-96/R2 Lockheed Martin Energy Systems, Oak Ridge National Laboratory. See notes below for NAWQC and GLI.
[c]United States Environmental Protection Agency (USEPA) 2003. Ecological Screening Levels (ESLs). Formerly Ecological Data Quality Levels (EDQLs). http://www.epa.gov/reg5rcra/ca/edql.htm
[d]The preferred surface water value is the hierarchy of Chapters 3745-1 and 3745-2 of the Ohio Administrative Code for the Ohio River Basin (1999), Suter and Tsao 1996 (NAWQC followed by Tier II), and EDQLs from USEPA Region 5 (USEPA 2003).
GLI = Great Lakes Initiative Clearinghouse database, contains Tier II secondary chronic values; http://epa.gov/gliclear/. Values used as supplement to original Suter and Tsao values because of scholarship and methodology shown in Suter and Tsao.
Ohio EPA Tier II values used where available; otherwise lowest or most recent value, as appropriate.
NAWQC = National Ambient Water Quality Criteria, originally found in Suter and Tsao 1996 and updated 2009 as National Recommended Water Quality Criteria; values are freshwater chronic. http://epa.gov/waterscience/criteria/wqctable/
NAWQC 2009 value for copper can be found at http://www.epa.gov/waterscience/criteria/copper/2007/criteria-full.pdf
NAWQC 2009 value for methyl tert-butyl ether can be found at http://www.epa.gov/waterscience/criteria/mtbe/#findings
-- = no value
CAS = Chemical Abstract Service
Diss = dissolved
ID = Insufficient data available to calculate criterion
ESV = Ecological Screening Value
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
OMZM = Outside Mixing Zone Maximum
PCB = Polychlorinated Biphenyl
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

**Table C-3. SRC and COPEC Screening with Maximum Ratio for Shallow Surface Soil (0-1 ft bgs Discrete Samples) at Dump Along Paris-Windham Road: Fill Area EU**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | PBT[b] Compound? (yes/no) | SRC? (yes/no) | SRC Justification | ESV | ESV Source[c] | COPEC? (yes/no) | COPEC Justification | Ratio of Max to ESV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 5/ 5 | 6500 | 11000 | 8240 | 17700 | No | No | Below background | 50 | PRGs | No | Below background | 220 |
| Arsenic | 7440-38-2 | 5/ 5 | 9.2 | 13 | 11.2 | 15.4 | No | No | Below background | 18 | EcoSSL | No | Below background | 0.72 |
| Barium | 7440-39-3 | 5/ 5 | 47 | 180 | 76.6 | 88.4 | No | Yes | Exceeds background | 330 | EcoSSL | No | Below ESV | 0.55 |
| Beryllium | 7440-41-7 | 5/ 5 | 0.34 | 1.2 | 0.576 | 0.88 | No | Yes | Exceeds background | 21 | EcoSSL | No | Below ESV | 0.06 |
| Calcium | 7440-70-2 | 5/ 5 | 1500 | 39000 | 9860 | 15800 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Chromium | 7440-47-3 | 5/ 5 | 8.3 | 11 | 9.96 | 17.4 | No | No | Below background | 26 | EcoSSL | No | Below background | 0.42 |
| Cobalt | 7440-48-4 | 5/ 5 | 4.3 | 7.1 | 5.98 | 10.4 | No | No | Below background | 13 | EcoSSL | No | Below background | 0.55 |
| Copper | 7440-50-8 | 5/ 5 | 9.3 | 19 | 14 | 17.7 | No | Yes | Exceeds background | 28 | EcoSSL | No | Below ESV | 0.68 |
| Iron | 7439-89-6 | 5/ 5 | 14000 | 22000 | 18000 | 23100 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Lead | 7439-92-1 | 5/ 5 | 14 | 19 | 16.2 | 26.1 | No | No | Below background | 11 | EcoSSL | No | Below background | 1.73 |
| Magnesium | 7439-95-4 | 5/ 5 | 1500 | 6100 | 2580 | 3030 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Manganese | 7439-96-5 | 5/ 5 | 390 | 880 | 540 | 1450 | No | No | Below background | 220 | EcoSSL | No | Below background | 4 |
| **Mercury** | **7439-97-6** | **5/ 5** | **0.025** | **0.048** | **0.036** | **0.036** | **Yes** | **Yes** | **Exceeds background** | **0.00051** | **PRGs** | **Yes** | **Exceeds ESV, PBT Compound** | **94.12** |
| Nickel | 7440-02-0 | 5/ 5 | 10 | 21 | 14.2 | 21.1 | No | No | Below background | 38 | EcoSSL | No | Below background | 0.55 |
| Potassium | 7440-09-7 | 5/ 5 | 740 | 1100 | 892 | 927 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Sodium | 7440-23-5 | 5/ 5 | 130 | 380 | 202 | 123 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Vanadium | 7440-62-2 | 5/ 5 | 10 | 15 | 12.2 | 31.1 | No | No | Below background | 7.8 | EcoSSL | No | Below background | 1.92 |
| **Zinc** | **7440-66-6** | **5/ 5** | **50** | **100** | **66.8** | **61.8** | **No** | **Yes** | **Exceeds background** | **46** | **EcoSSL** | **Yes** | **Exceeds ESV** | **2.17** |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | |
| Acenaphthylene | 208-96-8 | 1/ 1 | 0.13 | 0.13 | 0.13 | 0 | No | Yes | Detected organic | 682 | USEPA Reg 5 | No | Below ESV | 1.91E-04 |
| Anthracene | 120-12-7 | 1/ 1 | 0.12 | 0.12 | 0.12 | 0 | No | Yes | Detected organic | 1480 | USEPA Reg 5 | No | Below ESV | 8.11E-05 |
| Benz(a)anthracene | 56-55-3 | 1/ 1 | 1 | 1 | 1 | 0 | No | Yes | Detected organic | 5.21 | USEPA Reg 5 | No | Below ESV | 0.19 |
| Benzo(a)pyrene | 50-32-8 | 1/ 1 | 1.3 | 1.3 | 1.3 | 0 | No | Yes | Detected organic | 1.52 | USEPA Reg 5 | No | Below ESV | 0.86 |
| Benzo(b)fluoranthene | 205-99-2 | 1/ 1 | 1.2 | 1.2 | 1.2 | 0 | No | Yes | Detected organic | 59.8 | USEPA Reg 5 | No | Below ESV | 0.02 |
| Benzo(ghi)perylene | 191-24-2 | 1/ 1 | 0.75 | 0.75 | 0.75 | 0 | No | Yes | Detected organic | 119 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Benzo(k)fluoranthene | 207-08-9 | 1/ 1 | 1.4 | 1.4 | 1.4 | 0 | No | Yes | Detected organic | 148 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Chrysene | 218-01-9 | 1/ 1 | 1.1 | 1.1 | 1.1 | 0 | No | Yes | Detected organic | 4.73 | USEPA Reg 5 | No | Below ESV | 0.23 |
| Dibenz(a,h)anthracene | 53-70-3 | 1/ 1 | 0.24 | 0.24 | 0.24 | 0 | No | Yes | Detected organic | 18.4 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Fluoranthene | 206-44-0 | 1/ 1 | 1.7 | 1.7 | 1.7 | 0 | No | Yes | Detected organic | 122 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 1/ 1 | 0.75 | 0.75 | 0.75 | 0 | No | Yes | Detected organic | 109 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Phenanthrene | 85-01-8 | 1/ 1 | 0.32 | 0.32 | 0.32 | 0 | No | Yes | Detected organic | 45.7 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Pyrene | 129-00-0 | 1/ 1 | 1.4 | 1.4 | 1.4 | 0 | No | Yes | Detected organic | 78.5 | USEPA Reg 5 | No | Below ESV | 0.02 |
| ***Pesticides/PCBs*** | | | | | | | | | | | | | | |
| **PCB-1254[d]** | **11097-69-1** | **1/ 1** | **0.23** | **0.23** | **0.23** | **0** | **Yes** | **Yes** | **Detected organic** | **0.371** | **PRGs** | **Yes** | **PBT Compound** | **0.62** |

[a]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).
[b]Persistent, Bioaccumulative, and Toxic (PBT) chemicals are defined by Ohio EPA 2008 as: aldrin/dieldrin, chlordane,1,1'-(2,2,2trichloroethylidene)bis[4-chlorobenzene] (DDT) and metabolites (DDD+DDE), hexachlorobenzene, hexachlorobutadiene (hexachloro-1,3-butadiene), hexachlorocyclohexanes (BHCs, alpha-BHC, beta-BHC, delta-BHC), lindane (gammahexachlorocyclohexane), alkyl-lead, mercury and its compounds, mirex, photomirex, octachlorostyrene, PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), dioxin, PCDF (furans), 1,2,3,4-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene, toxaphene, and other chemicals that are reasonably anticipated to bioaccumulate in animal tissues.
[c]Screening Level Source: See table C-1. Hierarchy of values according to Ohio EPA Risk Assessment Guidance is EcoSSLs, followed by DOE 1997a (*Preliminary Remediation Goals for Ecological Endpoints.* ES/ER/TM-162/R2. August 1997), followed by Region 5 ESLs.
[d]ESV is for total PCBs
bgs = below ground surface
CAS = Chemical Abstract Service
COPEC = Chemical of Potential Ecological Concern
DOE = United States Department of Energy
EcoSSL = Ecological Soil Screening Level
ESV = Ecological Screening Value
EU = Exposure Unit
Max = Maximum concentration
Ohio EPA = Ohio Environmental Protection Agency
PCB = Polychlorinated biphenyl
PRG = Preliminary Remediation Goal
SRC = Site-related Contaminant
USEPA = United States Environmental Protection Agency

**Table C-4. SRC and COPEC Screening with Maximum Ratio for Shallow Surface Soil (0-1 ft bgs Discrete Samples) at Dump Along Paris-Windham Road: Surface Area EU**

| Analyte (mg/kg) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | PBT[b] Compound? (yes/no) | SRC? (yes/no) | SRC Justification | ESV | ESV Source[c] | COPEC? (yes/no) | COPEC Justification | Ratio of Max to ESV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | |
| **Aluminum** | **7429-90-5** | **13/ 13** | **5300** | **18000** | **8350** | **17700** | **No** | **Yes** | **Exceeds background** | **50** | **PRGs** | **Yes** | **Exceeds ESV** | **360** |
| Antimony | 7440-36-0 | 2/ 13 | 0.49 | 0.6 | 0.31 | 0.96 | No | No | Below background | 0.27 | EcoSSL | No | Below background | 2.22 |
| Arsenic | 7440-38-2 | 13/ 13 | 2.6 | 13 | 7.53 | 15.4 | No | No | Below background | 18 | EcoSSL | No | Below background | 0.72 |
| Barium | 7440-39-3 | 13/ 13 | 40 | 150 | 74.8 | 88.4 | No | Yes | Exceeds background | 330 | EcoSSL | No | Below ESV | 0.45 |
| Beryllium | 7440-41-7 | 13/ 13 | 0.33 | 1.9 | 0.566 | 0.88 | No | Yes | Exceeds background | 21 | EcoSSL | No | Below ESV | 0.09 |
| **Cadmium** | **7440-43-9** | **4/ 13** | **0.1** | **0.59** | **0.204** | **0** | **No** | **Yes** | **Exceeds background** | **0.36** | **EcoSSL** | **Yes** | **Exceeds ESV** | **1.64** |
| Calcium | 7440-70-2 | 13/ 13 | 1700 | 55000 | 6650 | 15800 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Chromium | 7440-47-3 | 13/ 13 | 7.9 | 17 | 12.4 | 17.4 | No | No | Below background | 26 | EcoSSL | No | Below background | 0.65 |
| Cobalt | 7440-48-4 | 13/ 13 | 4.7 | 7.5 | 5.85 | 10.4 | No | No | Below background | 13 | EcoSSL | No | Below background | 0.58 |
| Copper | 7440-50-8 | 13/ 13 | 9.4 | 27 | 18.5 | 17.7 | No | Yes | Exceeds background | 28 | EcoSSL | No | Below ESV | 0.96 |
| Iron | 7439-89-6 | 13/ 13 | 12000 | 18000 | 14800 | 23100 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| **Lead** | **7439-92-1** | **13/ 13** | **15** | **29** | **19.5** | **26.1** | **No** | **Yes** | **Exceeds background** | **11** | **EcoSSL** | **Yes** | **Exceeds ESV** | **2.64** |
| Magnesium | 7439-95-4 | 13/ 13 | 1300 | 10000 | 2700 | 3030 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| **Manganese** | **7439-96-5** | **13/ 13** | **95** | **1900** | **386** | **1450** | **No** | **Yes** | **Exceeds background** | **220** | **EcoSSL** | **Yes** | **Exceeds ESV** | **8.64** |
| **Mercury** | **7439-97-6** | **13/ 13** | **0.045** | **0.08** | **0.0631** | **0.036** | **Yes** | **Yes** | **Exceeds background** | **0.00051** | **PRGs** | **Yes** | **Exceeds ESV, PBT Compound** | **156.86** |
| Nickel | 7440-02-0 | 13/ 13 | 9.9 | 37 | 19.1 | 21.1 | No | Yes | Exceeds background | 38 | EcoSSL | No | Below ESV | 0.97 |
| Potassium | 7440-09-7 | 13/ 13 | 730 | 1900 | 1180 | 927 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Silver | 7440-22-4 | 1/ 13 | 0.39 | 0.39 | 0.396 | 0 | No | Yes | Exceeds background | 4.2 | EcoSSL | No | Below ESV | 0.09 |
| Sodium | 7440-23-5 | 11/ 13 | 120 | 480 | 185 | 123 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Vanadium | 7440-62-2 | 13/ 13 | 9.3 | 18 | 13 | 31.1 | No | No | Below background | 7.8 | EcoSSL | No | Below background | 2.31 |
| **Zinc** | **7440-66-6** | **13/ 13** | **51** | **120** | **81.7** | **61.8** | **No** | **Yes** | **Exceeds background** | **46** | **EcoSSL** | **Yes** | **Exceeds ESV** | **2.61** |
| ***Explosives*** | | | | | | | | | | | | | | |
| **Nitrocellulose** | **9004-70-0** | **1/ 1** | **2** | **2** | **2** | **0** | **No** | **Yes** | **Detected organic** | **No ESV** | **No Source** | **Yes** | **Detected organic** | **No ESV** |
| ***Semi-volatile Organic Compounds*** | | | | | | | | | | | | | | |
| Benz(a)anthracene | 56-55-3 | 1/ 1 | 0.25 | 0.25 | 0.25 | 0 | No | Yes | Detected organic | 5.21 | USEPA Reg 5 | No | Below ESV | 0.05 |
| Benzo(a)pyrene | 50-32-8 | 1/ 1 | 0.33 | 0.33 | 0.33 | 0 | No | Yes | Detected organic | 1.52 | USEPA Reg 5 | No | Below ESV | 0.22 |
| Benzo(b)fluoranthene | 205-99-2 | 1/ 1 | 0.39 | 0.39 | 0.39 | 0 | No | Yes | Detected organic | 59.8 | USEPA Reg 5 | No | Below ESV | 0.01 |
| Benzo(k)fluoranthene | 207-08-9 | 1/ 1 | 0.33 | 0.33 | 0.33 | 0 | No | Yes | Detected organic | 148 | USEPA Reg 5 | No | Below ESV | 0.002 |
| Chrysene | 218-01-9 | 1/ 1 | 0.33 | 0.33 | 0.33 | 0 | No | Yes | Detected organic | 4.73 | USEPA Reg 5 | No | Below ESV | 0.07 |
| Fluoranthene | 206-44-0 | 1/ 1 | 0.44 | 0.44 | 0.44 | 0 | No | Yes | Detected organic | 122 | USEPA Reg 5 | No | Below ESV | 0.004 |
| Pyrene | 129-00-0 | 1/ 1 | 0.44 | 0.44 | 0.44 | 0 | No | Yes | Detected organic | 78.5 | USEPA Reg 5 | No | Below ESV | 0.01 |
| ***Pesticides/PCBs*** | | | | | | | | | | | | | | |
| **PCB-1254[d]** | **11097-69-1** | **1/ 1** | **0.086** | **0.086** | **0.086** | **0** | **Yes** | **Yes** | **Detected organic** | **0.371** | **PRGs** | **Yes** | **PBT Compound** | **0.23** |
| ***Volatile Organic Compounds*** | | | | | | | | | | | | | | |
| Acetone | 67-64-1 | 1/ 1 | 0.041 | 0.041 | 0.041 | 0 | No | Yes | Detected organic | 2.5 | USEPA Reg 5 | No | Below ESV | 0.02 |

[a]Background criteria for soil 0-1 ft bgs from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).
[b]PBT Persistent, Bioaccumulative, and Toxic (PBT) chemicals are defined by Ohio EPA 2008 as: aldrin/dieldrin, chlordane,1,1'-(2,2,2trichloroethylidene)bis[4-chlorobenzene] (DDT) and metabolites (DDD+DDE), hexachlorobenzene, hexachlorobutadiene (hexachloro-1,3-butadiene), hexachlorocyclohexanes (BHCs, alpha-BHC, beta-BHC, delta-BHC), lindane (gammahexachlorocyclohexane), alkyl-lead, mercury and its compounds, mirex, photomirex, octachlorostyrene, polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), dioxin, PCDF (furans), 1,2,3,4-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene, toxaphene, and other chemicals that are reasonably anticipated to bioaccumulate in animal tissues.
[c]Screening Level Source: See table C-1. Hierarchy of values according to Ohio EPA Risk Assessment Guidance is EcoSSLs, followed by DOE 1997a (*Preliminary Remediation Goals for Ecological Endpoints*. ES/ER/TM-162/R2. August 1997), followed by Region 5 ESLs.
[d]ESV is for total PCBs
bgs = below ground surface
CAS = Chemical Abstract Service
COPEC = Chemical of Potential Ecological Concern
DOE = United States Department of Energy
EcoSSL = Ecological Soil Screening Level
ESV = Ecological Screening Value
EU = Exposure Unit
Max = Maximum concentration
Ohio EPA = Ohio Environmental Protection Agency
PRG = Preliminary Remediation Goal
SRC = Site-related Contaminant
USEPA = United States Environmental Protection Agency

**Table C-5. SRC and COPEC Screening for Surface Water at Dump Along Paris-Windham Road**

| Analyte (mg/L) | CAS Number | Freq of Detect | Minimum Detect | Maximum Detect | Average Result | Background Criteria[a] | PBT[b] Compound? (yes/no) | SRC? (yes/no) | SRC Justification | ESV | ESV Source[c] | COPEC? (yes/no) | COPEC Justification | Ratio of Max to ESV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganic Chemicals*** | | | | | | | | | | | | | | |
| Aluminum | 7429-90-5 | 7/ 7 | 0.042 | 0.28 | 0.104 | 3.37 | No | No | Below background | 0.087 | NAWQC 2009 | No | Below background | 3.22 |
| Arsenic | 7440-38-2 | 7/ 7 | 0.0028 | 0.0082 | 0.00549 | 0.0032 | No | Yes | Exceeds background | 0.34 | Ohio Administrative Code | No | Below ESV | 0.02 |
| Barium | 7440-39-3 | 7/ 7 | 0.035 | 0.12 | 0.066 | 0.0475 | No | Yes | Exceeds background | 2 | Ohio Administrative Code | No | Below ESV | 0.06 |
| Calcium | 7440-70-2 | 7/ 7 | 23 | 60 | 41.4 | 41.4 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Cobalt | 7440-48-4 | 4/ 7 | 0.001 | 0.0015 | 0.00177 | 0 | No | Yes | Exceeds background | 0.22 | Ohio Administrative Code | No | Below ESV | 0.01 |
| Copper | 7440-50-8 | 7/ 7 | 0.0022 | 0.0039 | 0.0025 | 0.0079 | No | No | Below background | 0.014 | Ohio Administrative Code[d] | No | Below background | 0.28 |
| Iron | 7439-89-6 | 7/ 7 | 3.6 | 9.4 | 5.04 | 2.56 | No | No | Essential Nutrient | 1 | NAWQC 2009 | No | Essential Nutrient | 9.40 |
| Lead | 7439-92-1 | 2/ 7 | 0.0019 | 0.0027 | 0.00137 | 0 | No | Yes | Exceeds background | 0.12 | Ohio Administrative Code[d] | No | Below ESV | 0.02 |
| Magnesium | 7439-95-4 | 7/ 7 | 6 | 12 | 9.4 | 10.8 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| **Manganese** | **7439-96-5** | **7/ 7** | **0.26** | **0.56** | **0.379** | **0.391** | **No** | **Yes** | **Exceeds background** | **0.12** | **Tier II (Suter & Tsao 1996)** | **Yes** | **Exceeds ESV** | **4.67** |
| **Mercury** | **7439-97-6** | **6/ 7** | **0.000072** | **0.0001** | **0.0000896** | **0** | **Yes** | **Yes** | **Exceeds background** | **0.0017** | **Ohio Administrative Code** | **Yes** | **PBT Compound** | **0.06** |
| Nickel | 7440-02-0 | 4/ 7 | 0.002 | 0.0075 | 0.00487 | 0 | No | Yes | Exceeds background | 0.47 | Ohio Administrative Code[d] | No | Below ESV | 0.02 |
| Potassium | 7440-09-7 | 7/ 7 | 1.7 | 5.4 | 4.17 | 3.17 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Sodium | 7440-23-5 | 7/ 7 | 4.2 | 9.9 | 7.76 | 21.3 | No | No | Essential Nutrient | No ESV | No Source | No | Essential Nutrient | No ESV |
| Zinc | 7440-66-6 | 4/ 7 | 0.013 | 0.024 | 0.0149 | 0.042 | No | No | Below background | 0.12 | Ohio Administrative Code | No | Below background | 0.20 |
| ***Miscellaneous*** | | | | | | | | | | | | | | |
| **Asbestos (MFL)** | **1332-21-4** | **1/ 6** | **0.0001** | **0.0001** | **6.73** | **0** | **No** | **Yes** | **Exceeds background** | **No ESV** | **No Source** | **Yes** | **Exceeds background** | **No ESV** |
| ***Explosives*** | | | | | | | | | | | | | | |
| **Nitrocellulose** | **9004-70-0** | **1/ 1** | **0.094** | **0.094** | **0.094** | **0** | **No** | **Yes** | **Exceeds background** | **No ESV** | **No Source** | **Yes** | **Exceeds background** | **No ESV** |

[a]Background criteria from final facility-wide background values for RVAAP, published in the *Final Phase II Remedial Investigation Report for Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001).
[b]PBT chemicals are defined by Ohio EPA 2008 as: aldrin/dieldrin, chlordane,1,1'-(2,2,2trichloroethylidene)bis[4-chlorobenzene] (DDT) and metabolites (DDD+DDE), hexachlorobenzene, hexachlorobutadiene (hexachloro-1,3-butadiene), hexachlorocyclohexanes (BHCs, alpha-BHC, beta-BHC, delta-BHC), lindane (gammahexachlorocyclohexane), alkyl-lead, mercury and its compounds, mirex, photomirex, octachlorostyrene, polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), dioxin, PCDF (furans), 1,2,3,4-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene, toxaphene, and other chemicals that are reasonably anticipated to bioaccumulate in animal tissues.
[c]Screening Level Source: See table C-2. Hierarchy of values according to Ohio EPA Risk Assessment Guidance and letter from Ohio EPA is Ohio EPA OMZM (Outside Mixing Zone Max), followed by NAWQC or Tier II values, followed by Region 5 ESLs.
[d]Value is hardness dependent
CAS = Chemical Abstract Service
COPEC = Chemical of Potential Ecological Concern
ESL = Ecological Screening Level
ESV = Ecological Screening Value
Max = Maximum concentration
MFL = Million Fibers per Liter
NAWQC = National Ambient Water Quality Criteria
Ohio EPA = Ohio Environmental Protection Agency
PBT = Persistent, Bioaccumulative, and Toxic
RVAAP = Ravenna Army Ammunition Plant
SRC = Site-related Contaminant
**Bold** = Chemical is a COPEC

**Table C-6. Checklist of Important Ecological Places and Resources at Dump Along Paris-Windham Road**

| Resource | Army (2005) | Ohio EPA (2008) | Dump Along Paris-Windham Road | |
|---|---|---|---|---|
| | | | Absent | Present |
| National Park | X | X | X | |
| Designated Federal Wilderness Area | X | X | X | |
| National Lakeshore Recreational Area | X | X | X | |
| Habitat known to be used by federal designated or proposed threatened or endangered species | X | X | X | |
| National or State Wildlife Refuge | X | X | X | |
| Federal land designated for protection of natural ecosystems | X | X | X | |
| Habitat known to be used by state designated threatened or endangered species | X | X | X | |
| Federally-designated Scenic or Wild River | X | X | X | |
| State land designated for wildlife or game management | X | X | X | |
| State-designated Scenic or Wild River | X | X | X | |
| **Wetlands and waters of the State**[a] | X | X | | X |
| National preserve | X | X[b] | X | |
| State-designated Natural Areas | X | X[b] | X | |
| Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters | X | X[c] | X | |
| Migratory pathways and feeding areas critical for maintenance of anadromous fish species[d] | X | X[c] | X | |
| Terrestrial areas used for breeding by large or dense aggregations of animals | X | X[c] | X | |
| **Particular areas, relatively small in size, important to maintenance of unique biotic communities** | X | X[c] | X | |
| **Locally important ecological place**[e] | X | | X | |
| Critical habitat for federal designated threatened or endangered species | X | | X | |
| Marine Sanctuary | X | | X | |
| Areas identified under the Coastal Zone Management Act | X | | X | |
| Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program | X | | X | |
| Critical areas identified under the Clean Lakes Program | X | | X | |
| National Monument | X | | X | |
| National Seashore Recreational Area | X | | X | |
| Unit of Coastal Barrier Resources System | X | | X | |
| Coastal Barrier (undeveloped) | X | | X | |
| Coastal Barrier (partially developed) | X | | X | |
| Administratively Proposed Federal Wilderness Area | X | | X | |
| National river reach designated as Recreational | X | | X | |

**Table C-6. Checklist of Important Ecological Places and Resources at Dump Along Paris-Windham Road (continued)**

| Resource | Army (2005) | Ohio EPA (2008) | Dump Along Paris-Windham Road | |
|---|---|---|---|---|
| | | | Absent | Present |
| Habitat known to be used by species under review as to its Federal threatened or endangered status | X | | X | |
| State-designated areas for protection or maintenance of aquatic life | X | | X | |
| Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes | X | | X | |
| State, local, or private land designated for protection of natural ecosystems | | X | X | |
| Federal land designated for wildlife or game management | | X | X | |
| Surface water, as that term is used in Chapter 3745-1 of the OAC | | X | X | |
| Federally-listed or state-listed threatened or endangered species | | X | X | |
| State of Ohio special interest or declining species and its associated habitat | | X | X | |
| State Park | | X | X | |

U.S. Army Biological Technical Assistance Group, *Technical Document for Ecological Risk Assessment: Process for Developing Management Goals*. August 2005.
Ohio EPA. *Guidance for Conducting Ecological Risk Assessments (Ohio EPA)*. Division of Emergency and Remedial Response. April 2008.
[a]For Ohio EPA 2008, as qualified by "regulated under federal law and state of Ohio's water quality laws."
[b]Ohio EPA does not restrict preserves and natural areas to National or State.
[c]Ohio EPA lists "wildlife populations and their associated important nesting areas and food resources, taking into consideration land use and the quality and extent of habitat on and in the vicinity of the site."
[d]Within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time.
[e]Identified by the Integrated Natural Resource Management Plan (INRMP), Base Realignment and Closure (BRAC) Cleanup Plan or Redevelopment Plan, or other official land management plans.
The Ohio Army National Guard (OHARNG 2008) has five special interest areas (important resources) at RVAAP: mixed mature woods, Hemlock Ravine-Wadsworth Glen, mixed swamp forest, mixed valuable communities, and oak/maple swamp forest. Also, the OHARNG recognizes the importance of federal and state-listed threatened and endangered plant and animal species.
x = designated as important and **when bolded there are possible qualifiers**
OAC = Ohio Administrative Code
Ohio EPA = Ohio Environmental Protection Agency

1 **Table C-7. Natural Resources Management Goals (OHARNG 2008)**

| Goals and Objectives of Ohio Army National Guard | Comments on Goals Relative to HTRW Work at RVAAP |
|---|---|
| **Goal 1.** Manage natural resources in a manner that is compatible with and supports the military mission while complying with applicable Federal and State laws and Army regulations and policies.<br><br>Objective 1.1: Initiate programs and projects that enhance the training land and training opportunities and/or do not unnecessarily limit training land availability.<br><br>Objective 1.2: Continue to educate Camp Ravenna users regarding the natural resources at the Camp Ravenna and their part in ensuring sustainable use of the site in perpetuity. | U.S. Army committed to natural resources management in a manner that is compatible with and supports the military mission and complies with Federal and State laws and Army regulations and policies. |
| **Goal 2.** Maintain and foster positive working relationships with the U.S. Fish and Wildlife Service, the ODNR DOW, and other federal, state and local natural resources management agencies and organizations for the benefit of the military mission, the natural resources being managed, and the citizens of Ohio and the nation.<br><br>Objective 2.1: Effectively communicate mission needs to cooperating agencies and solicit input/review on projects with the potential to impact natural resources, especially in areas of regulatory primacy.<br><br>Objective 2.2: Provide copies of biological surveys to interested cooperating agencies.<br><br>Objective 2.3: Facilitate cooperative management programs and projects that are compatible with the military mission and within the capabilities of the Camp Ravenna staff. | The U.S. Army works and coordinates with other federal and state agencies as necessary if mission or projects have the potential to impact natural resources. |
| **Goal 3.** Monitor the condition of the natural resources and the implied impacts from training and the natural resources management program on the natural resources at the Camp Ravenna.<br><br>Objective 3.1: Maintain current species inventories and other PLSs through periodic reoccurring surveys and inventories. | The U.S. Army conducts natural resource management activities at the facility to monitor potential impacts from training or other disturbance activities. |
| **Goal 4.** Protect and maintain populations of rare plant and animal species on the Camp Ravenna in compliance with Federal and State laws and regulations.<br><br>Objective 4.1: Avoid negative impacts to federally listed species and avoid/minimize impacts to State listed and otherwise rare species. | The U.S. Army protects and maintains populations of rare plant and animal species by implementing a natural resource management plan at the facility and by avoiding and/or not disturbing areas with rare species. |

**Table C-7. Natural Resources Management Goals (OHARNG 2008) (continued)**

| Goals and Objectives of Ohio Army National Guard | Comments on Goals Relative to HTRW Work at RVAAP |
|---|---|
| **Goal 5.** Sustain usable training lands and native natural resources by managing non-native and invasive species, vegetation and plant communities, and nuisance wildlife species.<br><br>Objective 5.1: Manage populations of invasive plant species where they hinder training and/or habitat management objectives.<br><br>Objective 5.2: Manage non-native and invasive insect species that pose a threat to forest resources.<br><br>Objective 5.3: Manage terrestrial vegetation to support training, encourage native plant communities, and prevent damage to training site facilities and infrastructure.<br><br>Objective 5.4: Manage the beaver population to prevent damage to training site facilities and infrastructure and to maintain the quality warm water habitats of Hinkley Creek, Sand Creek, and South Fork Eagle Creek.<br><br>Objective 5.5: Manage other nuisance animals that negatively impact the ecosystem. | The U.S. Army sustains usable training lands and native natural resources by implementing a natural resource management plan which incorporates invasive species and nuisance species management and by utilizing native species mixes for re-vegetation after ground disturbance activities. |
| **Goal 6.** Manage wildlife resources in a manner compatible with the military mission and within the limits of the natural habitat.<br><br>Objective 6.1: Cooperatively manage wildlife resources with the Ohio DOW.<br><br>Objective 6.2: Provide opportunity for wildlife recreation to the public that is compatible with the military mission.<br><br>Objective 6.3: Maintain wildlife population without augmenting the habitat with artificial food plots. | The U.S. Army minimizes habitat disturbance during HTRW activities and utilizes sustainability practices when disturbance is required in order to properly manage and maintain wildlife populations and resources. |

**Table C-7. Natural Resources Management Goals (OHARNG 2008) (continued)**

| Goals and Objectives of Ohio Army National Guard | Comments on Goals Relative to HTRW Work at RVAAP |
|---|---|
| **Goal 7.** Manage forest resources to the benefit of the military mission, to perpetuate the ecosystem functions, to support regional ecosystem needs, and for the production of forest products.<br><br>Objective 7.1: Maintain current forest resource data.<br><br>Objective 7.2: Implement forest management strategies identified in the Camp Ravenna INRMP. | The U.S. Army sustains and manages forest resources by implementing a natural resource management plan. During HTRW activities, efforts are made by the Army to minimize impacts to forest communities. |
| **Goal 8.** Manage wetlands and other surface waters in accordance with applicable Federal, State, and local regulations and to protect water quality and ecological functions while facilitating the military mission.<br><br>Objective 8.1: Avoid wetland fills.<br><br>Objective 8.2: Minimize and mitigate unavoidable wetland fills.<br><br>Objective 8.3: Maintain healthy aquatic ecosystems in ponds.<br><br>Objective 8.4: Restore, enhance and create wetlands when possible and compatible with the military mission. | Wetlands and other surface waters are to be protected during disturbance activities in accordance with federal, state, and local regulations. Avoidance measures will be implemented as practical. Some AOCs have wetlands. |
| **Goal 9.** Manage soil to maintain productivity and prevent and repair erosion in accordance with State and Federal laws and regulations so that the Camp Ravenna can support doctrinally required military training in perpetuity.<br><br>Objective 9.1: Conduct training and other activities in locations with soil most suitable for supporting the activity.<br><br>Objective 9.2: Rehabilitate, repair, and maintain areas damaged by training and other activities. | Management of soil relevant to remedial activities under CERCLA. Appropriate storm water and erosion controls are to be utilized during activities that require ground disturbance. |

**Table C-7. Natural Resources Management Goals (OHARNG 2008) (continued)**

| Goals and Objectives of Ohio Army National Guard | Comments on Goals Relative to HTRW Work at RVAAP |
|---|---|
| **Goal 10.** Manage cultural resources on the Camp Ravenna in accordance with State and Federal laws and regulations while implementing the natural resources management program.<br><br>Objective 10.1: Comply with Federal, State, and local laws and regulations pertaining to cultural resources found on the training site. | The U.S. Army utilizes a cultural resource management plan to manage and protect cultural resources at the facility. Coordination with state and federal agencies regarding cultural resources is conducted as necessary. Restoration contractors are also advised to utilize the Camp Ravenna Policy for Inadvertent Discoveries for reporting purposes should they come upon a cultural item. |
| **Goal 11.** Develop, maintain, and manage data regarding natural resources at the Camp Ravenna through the use of GIS for efficient data storage, retrieval, analysis, and presentation.<br><br>Objective 11.1: Develop accurate and usable natural resources GIS data. | Natural resource data is collected and managed by the OHARNG. This data may be utilized during restoration activities in order to provide an accurate portrait of natural resources at an AOC. |

OHARNG. *Integrated Natural Resources Management Plan and Environmental Assessment for the Ravenna Training and Logistics Site, Portage and Trumbull Counties, Ohio.* March 2008.

AOC = Area of Concern
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
DOW = Department of Wildlife
GIS = Geographic Information System
HTRW = Hazardous, Toxic and Radioactive Waste
INRMP = Integrated Natural Resources Management Plan
ODNR = Ohio Department of Natural Resources
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
PLS = Planning Level Survey (Wetland)
RVAAP = Ravenna Army Ammunition Plant
T & E = Threatened and Endangered Species
USACE = United States Army Corps of Engineers

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# APPENDIX D

## Detailed Cost Estimate

**Focused Feasibility Study for Soil and Dry Sediment**
**Dump Along Paris-Windham Road - Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio**
**Summary of Alternatives**

| Dump Along Paris-Windham Road Alternatives | | Duration | Non Discounted Cost | | |
|---|---|---|---|---|---|
| | | | Soil and Dry Sediment | | |
| | | | Capital Cost | O&M Cost | Total |
| 1 | No Action | 30 years | $0 | $0 | $0 |
| 2 | Land Use Controls | 30 years | $16,024 | $142,015 | $158,039 |

| Dump Along Paris-Windham Road Alternatives | | Duration | Discounted Cost (4.125%) | | |
|---|---|---|---|---|---|
| | | | Soil and Dry Sediment | | |
| | | | Capital Cost | O&M Cost | Total |
| 1 | No Action | 30 years | $0 | $0 | $0 |
| 2 | Land Use Controls | 30 years | $16,024 | $77,360 | $93,384 |

Notes:

1. The base year of comparison and cost data will be CY2010. The discounted rates used to calculate present values will be based on Economic Guidance Memorandum, 11-01, Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011.

2. Costs were estimated for comparison purposes only and are believed to be accurate within a range of -30% to +50%. Use of these costs for other purposes, including but not limited to, budgetary or construction cost estimating is not appropriate.

**Dump Along Paris-Windham Road - Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio**
**Alternative 2 - Land Use Controls**
**Key Parameters and Assumptions**

**Key Parameters and Assumptions:**

| Item | Unit | Value | Notes |
|---|---|---|---|
| **Capital Cost** | | | |
| **Land Use Controls** | | | |
| Base Master Planning Documents | hrs | 80 | Assume 80 hrs to review and revise BMP documents. Included deed and groundwater restrictions. |
| Legal/Technical Labor | $/hr | 120 | |
| **Site Work** | | | |
| Site Area | sf | 12,000 | |
| Civil Survey | day | 1.0 | Survey AOC for land use controls. RSMeans 017123131100. |
| Civil Survey | $/day | 950 | |
| As Built Drawings | hours | 8 | Develop record drawings. |
| As Built Drawings | $/hr | 60 | |
| Install Signs on Posts | ea | 6 | Assume warning signs located around AOC perimeter at 300 ft centers. RSMeans 028907000100 & 1500. Add 25% for custom letters. Furnish, place, and install. |
| Install Signs on Posts | $/ea | 209.00 | |
| **Plans and Reports** | | | |
| Corrective Action Completion Report | hrs | 80 | Includes documentation of corrective action and report. |
| Technical Labor | $/hr | 80 | |
| **O&M Cost (Years 0 to 30)** | | | |
| Site Inspection and Maintenance | years | 30 | |
| Site Inspection | events | 60 | |
| Site Inspections | hrs | 4 | Inspect site semi-annually for disturbance/erosion, warning signs, and complete checklist for annual report. |
| Field Labor | $/hr | 60 | |
| Site Maintenance | events | 30 | Assume signs are replaced every 10 years. Assume AOC area is overseeded and fertilized every 5 years. Costs have been annualized. |
| Site Maintenance | $/yr | 290 | |
| Annual Report | | | |
| Annual O&M Report | event | 30 | |
| Annual O&M Report | $/year | 640 | Assume 8 hours @ $80/hr for letter report. |
| **CERCLA Reviews** | | | |
| CERCLA 5-Year Reviews | events | 6 | Assume 5 year reviews for 30 years. |
| CERCLA 5-Year Reviews | $/event | 7,400 | Assume 80 hours/review @ $80/hr. Add $1,000 misc expenses. |

**Dump Along Paris-Windham Road - Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio**
**Alternative 2 - Land Use Controls**
**Cost Estimate**

**CAPITAL COST** **$16,024**

| Activity (unit) | Quantity | Unit Cost | Total |
|---|---|---|---|
| **Land Use Controls** | | | |
| Base Master Planning Documents (hr) | 80 | $120.00 | $9,600 |
| **Site Work** | | | |
| Civil Survey (day) | 1.0 | $950.00 | $950 |
| As Built Drawings (hrs) | 8 | $60.00 | $480 |
| Install Signs on Posts (ea) | 6 | $209.00 | $1,254 |
| **Plans and Reports** | | | |
| Corrective Action Completion Report (ea) | 80 | $80.00 | $6,400 |
| Subtotal | | | $9,084 |
| Design | | 20% | $1,817 |
| Office Overhead | | 5% | $454 |
| Field Overhead | | 15% | $1,363 |
| Subtotal | | | $12,718 |
| Profit | | 6% | $763 |
| Contingency | | 20% | $2,544 |
| Total | | | $16,024 |

**OPERATION AND MAINTENANCE** **$142,015**

| Activity (unit) | Quantity | Unit Cost | Total Cost | Present Value (4.125%) |
|---|---|---|---|---|
| **Site Inspection and Maintenance** | | | | |
| Site Inspection (ea) | 60 | $240 | $14,400 | $8,176 |
| Site Maintenance (ea) | 30 | $290 | $8,700 | $4,939 |
| **Annual Report** | | | | |
| Annual O&M Report (ea) | 30 | $640 | $19,200 | $10,901 |
| **CERCLA Reviews** | | | | |
| CERCLA 5-Year Reviews (ea) | 6 | $7,400 | $44,400 | $23,213 |
| Subtotal O&M | | | $86,700 | $47,228 |
| Design | | 10% | $8,670 | $4,723 |
| Office Overhead | | 5% | $4,335 | $2,361 |
| Field Overhead | | 15% | $13,005 | $7,084 |
| Subtotal | | | $112,710 | $61,397 |
| Profit | | 6% | $6,763 | $3,684 |
| Contingency | | 20% | $22,542 | $12,279 |
| Total | | | $142,015 | $77,360 |

**TOTAL ALTERNATIVE CAPITAL AND O&M COST (Non Discounted Cost)** **$158,039**

# APPENDIX E

# Ohio EPA Correspondence

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

March 1, 2013

RE: RAVENNA ARMY AMMUNITION PLANT PORTAGE/TRUMBULL COUNTIES, REGARDING APPROVAL WITH MODIFICATIONS, REVISED DRAFT SITE CHARACTERIZATION AND FFS FOR RVAAP-51 DUMP PARIS-WINDHAM ROAD, CRT DATED JANUARY 24, 2013, (Ohio EPA ID # 267-000859-040)

Mr. Mark Patterson
Installation Manager
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, OH 44266

**CERTIFIED MAIL**
**7012 1010 0000 9467 5182**

Dear Mr. Patterson:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the "Revised Draft Site Characterization and Focused Feasibility Study for the RVAAP-51 Dump Along Paris-Windham Road" for the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on April 5, 2012, and is dated April 5, 2012. The document was prepared for the U.S. Army Corps of Engineers (USACE) – Louisville District by EQM, under contract no. W912QR-08-D-0008, Delivery Order No. 0014.

Ohio EPA reviewed the document and provided comments in a letter dated October 31, 2012. A conference call was held between Ohio EPA and the USACE on November 7, 2012, to discuss the comments pursuant to paragraph 42 of the June 14, 2004 Director's Final Findings and Orders (DFFOs).

On November 20, 2012, Ohio EPA received a letter from the Department of the Army requesting an extension of the comment response and version 2 of the "Revised Draft Site Characterization and Focused Feasibility Study for the RVAAP-51 Dump Along Paris-Windham Road." The new date of resubmittal as requested was January 4, 2013. Ohio EPA received the Comment Response Table on January 24, 2013.

Pursuant to the DFFOs and Paragraph 39 (b), Ohio EPA approves the submittal upon specified conditions as presented below:

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1. Revise the Human Health Risk Assessment in accordance with the direction/path forward determined in a meeting between the USACE, Ohio EPA, and the National Guard Bureau, on February 28, 2013. Ultimately, the agreed upon Technical Memorandum that is currently being prepared by USACE, and which

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will be reviewed and ultimately approved by Ohio EPA, will be the guiding document for the Risk Assessment.

Pursuant to the CERCLA process, the property owner usually can provide the expected land uses to assist in ensuring that the investigation addresses all receptors for both current and future land uses. Be advised that due to land use uncertainty, Ohio EPA may require additional work, in the future, to address data gaps. It is incumbent upon the Army to finalize land use at Camp Ravenna as soon as possible, otherwise additional work and schedule slippage may result.

This document was reviewed by personnel from Ohio EPA's Division of Environmental Response and Revitalization (DERR). Ohio EPA has determined that the document is approved upon satisfactory revision of the Human Health Risk Assessment, as described.

If you have any questions, please call Eileen Mohr.

Sincerely,

Nancy Zikmanis

Nancy Zikmanis, CHMM
Environmental Supervisor
Division of Environmental Response and Revitalization

NZ/kss

cc: Ann Wood, NGB
Katie Tait, OHARNG RTLS

ec: Eileen Mohr, Ohio EPA, NEDO, DERR
Kevin Palombo, Ohio EPA, NEDO, DERR
Brian Tucker, Ohio EPA, CO, DERR
Justin Burke, Ohio EPA, CO, DERR