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Baseline Ecological Risk Assessment Report

for the

Fields Brook Floodplain/Wetlands Area

EPA

Prepared by

U.S. EPA

Region V

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October 1996

Executive Summary

Historical activities in and around the Fields Brook Superfund site in Ashtabula, Ohio have resulted in the potential exposure of ecological receptors to elevated levels of industry-related contaminants within the floodplain/wetland areas of the brook. In order to assess the potential risk associated with these contaminants, several actions were undertaken by both the US EPA and the Fields Brook Potentially Responsible Parties Organization (FBPRPO). These included preparation of ecological assessment work plans; sampling of soils, sediments, water, and biological tissue; and preparation of separate ecological risk assessment reports by FBPRPO and US EPA-Edison. Results of these efforts led to a set of proposed ecological clean-up or remediation goals.

The ecological risk assessment reports prepared by EPA and FBPRPO were based on current guidelines but differed in aspects of approach, including in the use assumptions and toxicity information. Both reports concluded, however, that elevated levels of risk to some ecological receptors were present from exposure to site contaminants. Differences in the level of risk to receptors determined in both reports were based primarily on the assumptions and uncertainty factors applied in the development of toxicity reference values and hazard quotients. EPA-Edison's assessment applied conservative assumptions in the estimation of these values, while the ecological risk assessment report submitted by FBPRPO applies less conservative assumptions to calculation of risk estimates. Previous reviewers have suggested that factors associated with the Fields Brook assessment warrant use of conservative assumptions. The FBPRPO risk assessment also incorporates several factors which have been questioned by EPA and other agencies. These include the statistical treatment of environmental data, estimates of exposure rates, use of inappropriate reference areas for comparative purposes, and singular focus on the floodplain/wetland area of the total site. Although the appropriateness of the risk assessment approach utilized by FBPRPO is questionable, EPA has concluded that differences in risk estimates for the brook are not significantly different from one another.

Results of the ecological risk assessment reports prepared by EPA-Edison and FBPRPO were used to develop clean-up or remediation goals for the brook floodplain. The final remedy will take into account the limitations and uncertainties in the risk assessments in an effort to ensure protection of the ecological receptors. EPA-Edison risk estimates were based on conservative assumptions, which may have resulted in CUGs below background levels. Although elements of the assessment developed by FBPRPO may also be inappropriate, final clean-up goals agreed upon for remediation of the Fields Brook floodplain/wetland areas are expected to be protective of ecological receptors inhabiting the area.

Introduction

Report Organization

Historical activities in and around the Fields Brook Superfund site in Ashtabula, Ohio have resulted in the potential exposure of ecological receptors to elevated levels of industry-related contaminants. In order to assess the potential risk associated with these contaminants, several actions were undertaken by both the US EPA and the Fields Brook Potentially Responsible Parties Organization (FBPRPO). These included work plan preparation, the sampling of soils, sediments, water, and biological tissue and the development of two separate ecological risk assessment reports. This document presents the results of the risk assessment efforts and attempts to summarize remaining US EPA comments in regard to the ecological assessments of the Fields Brook site. The document includes the following major components:

- A revised version of the baseline ecological risk assessment report prepared by FBPRPO in October, 1995. Text has been added or deleted to reflect EPA comments on report content.
- An ecological risk assessment report prepared by US EPA—Edison, for the Fields Brook site, based on Phase I and Phase II field data.
- A summary of ecological clean-up goals (ECUGs) developed by US EPA and FBPRPO
- A brief summary of major issues and concerns relating to previously prepared assessment reports.

Project /Site Background

The Fields Brook Superfund site is located in the City of Ashtabula in northeastern Ohio. Portions of the upstream reaches of the Brook drain through an industrial area with multiple sources that historically contributed both organic and inorganic contaminants to the brook and associated floodplain. Previous investigations of Fields Brook have verified the presence of contaminants in channel sediments. The brook itself has been listed by the U.S. EPA on the National Priorities List (NPL) and contamination in channel sediments has been addressed separately. Sediment cleanup will proceed as the Sediment Operable Unit (SOU) under the established Record of Decision (1986) for Fields Brook. The floodplain/ wetlands area (FWA) is not included within any operable units of the Fields Brook NPL site, but was assessed in accordance with federal and State of Ohio guidance in order to identify any potential need for and approach to risk management actions which might supplement any remedial activities at site operable units.

The FBPRPO initiated a separate voluntary assessment of the nature and extent of contamination and an evaluation of risks potentially associated with contamination in the FWA of the Fields Brook riparian corridor. This began with preparation of a ecological risk assessment work plan in May 1993. Following EPA comment, a revised work plan and Sampling and Analysis Plan was prepared by FBPRPO in September 1993. Field activities in support of the risk assessment were initiated in Spring of 1993 and were completed following a third phase of sampling in 1994.

Following an extended comment period on the original ecological risk assessment work plan, US EPA in conjunction with CH2M HILL, prepared a separate work plan for the Fields Brook Floodplain in March 1994 . Significant portions of this work plan were eventually incorporated into FBPRPO's work plan prior to completion of the work at the site.

FBPRPO prepared and submitted to EPA an initial draft baseline ecological risk assessment report in June of 1994. Following EPA review and comment, a second draft of ecological risk assessment was submitted in June of 1995, with a third revision in October, 1995. These reports incorporated the baseline human health risk assessment which also had been prepared for the Fields Brook FWA. In an effort to produce a more acceptable assessment of potential risk to ecological receptors at the site, US EPA—Edison prepared a separate ecological risk assessment report in February of 1995. Results of these efforts are discussed below.

Revised FBPRPO Baseline Ecological Risk Assessment

As indicated, the FBPRPO initiated a separate voluntary assessment of the nature and extent of contamination and an evaluation of risks potentially associated with contamination in the FWA of the Fields Brook riparian corridor. This included the preparation of a quantitative baseline ecological risk assessment. The assessment included a characterization of potential receptors, evaluation of exposure pathway completeness, and risk quantification. This effort was initiated in April 1992 with a site reconnaissance visit by personnel from the FBPRPO and regulatory agencies, and continued with field sampling activities during 1993 and 1994. A draft ecological assessment document was initially submitted to EPA in June of 1994. Following revision and incorporation of the human health assessment a third draft document was prepared in October 1995.

The baseline ecological risk assessment report submitted by FBPRPO in October, 1995 is provided as Attachment I. Information relating to the human health assessment has now been deleted. EPA has developed a human health assessment for the Fields Brook FWA as a separate document. Revisions have been made to the FBPRPO October 1995 report. These revisions reflect comments on the risk assessment document previously provided by EPA and other agencies including Ohio EPA, and the US Army Corps of Engineers. Additional modifications were considered necessary to produce a document which reflected EPA and other agency concerns. Previous efforts to provide comments to the FBPRPO document failed to result in a risk assessment acceptable to EPA in terms of approach and interpretation of data.

Previous, unresolved comments on the FBPRPO assessment include, in summary:

- A continued lack of all necessary data needed to evaluate the appropriateness and accuracy of risk calculations.
- Use of a probabilistic statistical approach to the determination of exposure concentrations.
- Calculation of Hazard Quotients (HQ's) and Toxicity Reference Values (TRV's) using less than appropriate Uncertainty Factors.

- Application of Area Use Factors (AUF's) which may underestimate exposure and/or fail to provide an estimate of risk which is protective of the floodplain system as a whole.
- Use of data from inappropriate reference areas, which differed from on-site locations in terms of habitat and other factors. This included use of fish tissue concentrations from upstream locations to estimate current risk to mink and heron.
- Use of ingestion and/or feeding rates for receptors which were considered inappropriate.
- Interpretation of field and laboratory test data which downplayed the potential risk to ecological receptors. This included interpretation of earthworm toxicity tests, which although varied in result, indicated toxicity to test groups.

US EPA—Edison, Ecological Risk Assessment of the Fields Brook Site

US EPA, Edison, at the request of EPA Region V, initiated and prepared a ecological risk assessment report for the Fields Brook Floodplain/Wetlands Area in February 1995. This report was based, in part, on the results of soil and biota samples gathered by FBPRPO in 1993 and 1994. Although the quality of some of the data presented in the FBPRPO report, prepared by EA Engineering, Science and Technology, Inc. in 1994, was considered questionable, available site-specific information sources were limited.

A copy of the EPA risk assessment for Fields Brook Floodplain/Wetland Area is provided as Attachment II. This report knowingly incorporates several conservative assumptions in regards to the determination of exposure and calculation of hazard quotient values. These conservative assumptions, however, were considered appropriate for use in the assessment due to the questionable nature of the data upon which risk calculations were based. Questions of data quality were due, in part, to the fact that samples of biota gathered for contaminant analysis were composited across species. Compositing across species potentially obscures elevated contaminant concentration in organisms which have markedly different feeding habitats, and potentially different rates of contaminant exposure.

Conclusions of the EPA-Edison risk assessment report indicated that all receptor species were at risk from exposure levels for PCBs, hexachlorobenzene, and mercury. In some cases hazard values for these contaminants suggested high levels of risk. Risk calculations also indicated that some receptor species within the brook floodplain may be at risk from exposure to cadmium, copper, and lead.

Remediation Goals and Objectives for the Fields Brook Site

Following completion of the ecological risk assessment reports, FBPRPO and EPA proposed remediation or Clean-Up Goals (CUGs) considered to protective of ecological receptors at the Fields Brook site. EPA and FBPRPO CUGs are presented in Table 1 for comparison. Individual contaminant concentrations proposed by EPA and FBPRPO were both derived in a similar fashion through the risk assessment approach. This process involves application of uncertainty factors and several assumptions relative to exposure, bioavailability, etc. Clean-up goals developed by EPA are considered to be very conservative and in some cases may be below background. Although some ecological CUG values proposed by EPA and

FBPRPO differ, the protection of ecological receptors will be addressed through the development of a remedy taking into account the differences and uncertainties.

Table 1
Proposed Ecological Clean-Up Goals (CUGs)
for the Fields Brook Site, Ashtabula, Ohio

Chemical of Concern		FBPRPO ECUGs (ppm)	EPA ECUGS (ppm)
PCBs	1248	310.00	0.37*
	1254	3.30	
	1260	0.35	
Hexachlorobenzene			0.59
Benzo(a)pyrene			1.47
Fluoranthene			74.9
Naphthalene			12.10
Phenanthrene			20.50
Cadmium		14.80	0.07
Copper			2.94
Lead			0.44
Mercury		1.95	0.04
Zinc			51.90
Arsenic		13.6	
Beryllium		25.4	
Chromium		14.7	
Hexachlorobutadiene		1.96	
Hexachloroethane		9.8	
*Clean-up goal value for total PCB's			

Summary and Conclusion

Historical activities in and around the Fields Brook Superfund site in Ashtabula, Ohio have resulted in the potential exposure of ecological receptors to elevated levels of industry-related contaminants within the floodplain/wetland areas of the brook. In order to assess the potential risk associated with these contaminants, several actions were undertaken by both the US EPA and the Fields Brook Potentially Responsible Parties Organization (FBPRPO). These included, but were not limited to, the following:

- Separate Ecological Assessment Work Plans prepared by FBPRPO and US EPA

- Sampling of soils, sediments, water, and biological tissue during three Phases of activity from 1993 to 1994
- Preparation of separate ecological risk assessment reports by FBPRPO in October 1995 and EPA-Edison in February, 1995.
- Development of ecological clean-up or remediation goals

The ecological risk assessment reports prepared by EPA and FBPRPO were similar in approach to the assessment, while differing in the use assumptions and toxicity information. Both reports concluded, however, that elevated levels of risk to some ecological receptors were present from exposure to site contaminants. Differences in the level of risk to receptors determined in both reports were based primarily on the assumptions and uncertainty factors applied in the development of toxicity reference values and hazard quotients. EPA-Edison's assessment applied conservative assumptions in the estimation of these values. These assumptions were considered appropriate however, due the quality of the data upon which risk calculations were made.

The ecological risk assessment report submitted by FBPRPO applies less conservative assumptions to calculation of risk estimates. Although these values may be considered appropriate in some cases, other factors associated with the Fields Brook assessment suggest use of conservative assumptions is warranted. In addition, the FBPRPO risk assessment also incorporates several factors which have been questioned by EPA and other agencies. These include the statistical treatment of environmental data, estimates of exposure rates, and use of inappropriate reference areas for comparative purposes. The FBPRPO risk assessment considered the FWA singularly, and did not account for current interactions between FWA ecological receptors and brook sediments and fish. Although the appropriateness of the risk assessment approach utilized by FBPRPO is questionable, EPA has concluded that differences in risk estimates for the brook are not significantly different from one another.

Results of the ecological risk assessment reports prepared by EPA-Edison and FBPRPO were used to develop clean-up or remediation goals for the brook floodplain. Although values generated by the two assessments differ in value, significant differences in the level of protection of ecological receptors are not expected. EPA-Edison risk estimates were based on conservative assumptions, which may have resulted in CUGs below background levels. Although elements of the assessment developed by FBPRPO may also be inappropriate, final clean-up goals agreed upon for remediation of the Fields Brook floodplain/wetland areas are expected to be protective of ecological receptors inhabiting the area.

Attachment I
The Baseline Ecological Risk Assessment for the Fields Brook Floodplain/Wetland Area prepared by EA Engineering, Science and Technology, October 1995 and Revised by EPA, October 1996

Baseline Ecological Risk Assessment for the Fields Brook Floodplains/Wetlands Area

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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirements
AUF	Area Use Factor
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CUG	Cleanup Goal
CLP	Contract Laboratory Procedure
ERL	Environmental Research Laboratory
FBPRPO	Fields Brook Potentially Responsible Parties Organization
FEU	Floodplain Exposure Unit
FWA	Floodplain/Wetland Area
GC/MS	Gas Chromatography/Mass Spectrometry
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HQ	Hazard Quotient
LCS	Laboratory Control Sample
LC50	Lethal Concentration to 50 percent of the Population
LD50	Lethal Dose to 50 percent of the Population
LOAEL	Lowest Observed Adverse Effects Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCP	National Contingency Plan
NOAEL	No Observed Adverse Effects Level
NPL	National Priorities List
PCB	Polychlorinated Biphenyls
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RfD	Reference Dose
ROC	Receptor of Concern
ROD	Record of Decision
RPD	Relative Percent Difference
RT	Retention Time
RI/FS	Remedial Investigation/Feasibility Study
SHQ	Screening Hazard Quotient
SOU	Sediment Operable Unit
SVOC	Semi-Volatile Organic Compounds
SQDI	Sediment Quantification Design Investigation
TM	Technical Memorandum
TRV	Toxicity Reference Value
UAO	Unilateral Administrative Order
UCL	Upper Confidence Limit
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
WCC	Woodward Clyde Consultants

Executive Summary

Ecological Risk Assessment for the Fields Brook Floodplain

The Fields Brook floodplain and wetlands area (FWA) consists of the lowlands surrounding the Sediment Operable Unit (SOU) of Fields Brook. US EPA Region V in conjunction with the Fields Brook Potentially Responsible Party Organization (FBPRPO) has prepared this baseline risk assessment (BRA) to examine the need for remediation of the FWA which is not presently part of any Superfund Operable Unit. This BRA generally follows EPA superfund guidance for ecological risk assessment.

Overview

Using FWA surface soil data collected over 4 years in three rounds (Phases I, II, and III) and biota samples collected in Phases II and III, chemicals of concern (COCs) and areas of consideration for the ecological risk assessment were established (Table ES-1 and Figure ES-1). Four ecological exposure units, called "Zones", were established for the ecological risk assessment based on physical boundaries, such as highways, which tend to separate foraging areas for some animals. These zones were somewhat arbitrary, however, and may not apply to all species. Zone 4 is considered an upstream reference area, although other areas may have provided a more appropriate comparison. After a rigorous screening process, the ecological risk assessment evaluated a set of COCs that included organics and several trace metals.

The ecological risk assessment involved three elements—field characterization of flora and fauna, FWA soil toxicity testing using a sensitive indigenous species (earthworms), and estimation of risk to potentially indigenous species. Risk estimation, represented as Hazard Quotients (HQ), involved characterization of the dose of each COC to each of these species in each Zone by considering their uptake *via* soil and food.

Nature of Contamination

Within the Ecological Zones, COC concentrations vary from background and non-detect to several hundred parts per million (ppm or mg/kg). Maximum concentrations for some of the semivolatile organics were: 610 mg/kg for total PCB, 480 mg/kg for hexachlorobenzene, 170 mg/kg for hexachlorobutadiene; for some of the volatile organics were: 56 mg/kg for trichloroethene, 89 mg/kg for tetrachloroethene and 8.5 mg/kg for vinyl chloride; and for some of the trace metals were: 43 mg/kg for arsenic and 57.7 mg/kg for mercury. Average and upper confidence limit concentrations for ecological COCs are summarized in Table ES-2.

Ecological Risk Assessment

Within the Fields Brook floodplain, distinct habitat types include shrub and forest cover, mowed areas, and wetland areas that include *Phragmites australis* (common reed). Forest is the predominant cover type in downstream reaches of the Fields Brook FWA. Forested areas exist adjacent to Fields Brook on stream banks in lower reaches and are dominated by maple, black cherry, ash, and oak trees. Shrub cover is evident in all reaches, yet is distributed as patches rather than large continuous areas. Commonly observed shrub species occurring at Fields Brook include multi-flora rose, honeysuckle, and dogwood. Herbaceous wetland areas frequently contain *Phragmites* and dominate large sections of the Fields Brook FWA. *Phragmites* wetlands dominate large areas of the upper reaches of the Fields Brook floodplain. More information regarding species compositions present in the FWA is presented in Table ES-3.

Tissue Concentration Measurements

Additional COCs, including several trace metals (lead, cadmium, chromium, vanadium, and barium), were considered in the ecological risk assessment. PCBs, hexachlorobenzene, and hexachlorobutadiene were the organics that were fully assessed; others were eliminated because screening level hazard quotients (SHQs) were below 1.0 for all receptors of concern.

Aroclor-1248 was observed in the FWA biota only to a limited extent. It was found only in the earthworm composite in Zones 1 and 2 and was identified in both earthworms and vegetation in Zone 3. Aroclor-1254 was not found in any biotic tissues at the site. Aroclor-1260 was identified only in mammal tissues in Zones 1, 2, and 3 at concentrations ranging as high as 11.0 ppm in a single Phase II composite. Most concentrations of Aroclor-1260 were well below this level ranging from 0.029 to 4.8 ppm in other samples.

Arsenic was observed in all tissue matrices throughout the FWA (including Zone 4) at concentrations ranging from 0.080 (mice Zone 2) to 1.5 ppm (earthworms Zone 4). Distributions of arsenic in tissues do not suggest that the area of concern is different from the upstream reference (Zone 4), although, comparisons to other reference areas may have yielded different results.

Barium was observed only in tissues of small mammals and earthworms. Concentrations ranged from 1.3 ppm (shrews Zone 3) to 54.2 ppm (mice Zone 2). Barium was also detected in earthworms from Zone 4 at a concentration of 7.9 ppm.

Cadmium was detected in all tissue matrices throughout the FWA (including Zone 4) at concentrations ranging from 0.14 ppm (mice, shrews, and vegetation Zone 2) to 4.5 ppm (earthworms Zone 2). Cadmium was also detected in earthworms obtained from Zone 4 at a concentration of 2.3 ppm.

Chromium was detected in all biological media from all zones (including Zone 4). Concentrations ranged from 0.34 ppm (vegetation in Zones 3 and 4) to 3.7 ppm (earthworms in Zone 3). Visual inspection of the data suggests that concentrations are generally similar between the upstream reference (Zone 4) and the lower zones of concern. Comparisons with other reference locations may have yielded different results.

Hexachlorobenzene was detected in all tissue matrices throughout the FWA (including Zone 4) at concentrations ranging from 0.0031 ppm (mouse Zone 2) to 1.2 ppm (mice Zone 2). No clear pattern of contaminant distribution is evident from visual inspection of the data.

Hexachlorobutadiene was observed only in a single earthworm sample from Zone 2 at a concentration of 0.044 ppm (estimated value).

Lead was detected in all tissue matrices throughout the FWA (including Zone 4) at concentrations ranging from 0.05 ppm (mice Zone 2) to 6.6 ppm (earthworms in Zone 3). Concentrations of lead of 5.5 ppm were measured in earthworms in Zone 4.

Mercury was detected in all tissue matrices throughout the FWA (including Zone 4) at concentrations ranging from 0.08 ppm (mammals and vegetation in Zones 2, 3, and 4) to 2.2 ppm (shrews in Zone 2).

Vanadium was observed in earthworms from all 4 Zones with concentrations ranging from 2.2 ppm to 3.5 ppm in Zones 1, 2, and 3 and a concentration of 1.6 ppm in Zone 4. Vanadium was also observed in mammals in Zones 2 (0.49 ppm) and 3 (0.36 ppm). Vanadium does not appear to be a widespread contaminant in the floodplain/wetland area.

Toxicity Tests

Mortality of earthworms in 14 day bioaccumulation/toxicity tests ranged from as high as 100 percent to as little as zero percent within a Reach (Figure ES-1). For example, all samples tested at Reach 4-1 were obtained at the same time and within 10 feet of each other. Mortalities at this location were 0.0, 89.3, and 100 percent indicating that either the responsible agent(s) are distributed in small patches, or that the tests are in error. Inspection of the analytical data on the earthworm tissues and exposure media revealed no apparent relationship between concentrations of contaminants in tissues and observed mortality. Reasons for the variability in mortality rates are currently unknown.

Ecological Risks

Ecological exposures were modeled deterministically by calculating the concentration per unit time (dose) that a receptor receives from its diet (including soil and water). Dose is a function of which dietary items a receptor consumes, the concentrations of contaminants in those dietary items, and the rate at which these dietary items are consumed. Using measurements from Phase II and III tissue sampling events and Phase I, II, and III soil sampling events, both mean and 95 percent UCLM concentrations were used to evaluate ecological risks. Risk values based on various area use factors were also calculated.

Note that the Phase II fish tissue samples used in the ecological risk assessment modeling were obtained from upstream reference locations and therefore do not provide an estimate of the current risk to ecological receptors such as the mink and great blue heron whose diet is composed of a significant portion of fish (see Table 3-1, mink 55 percent; heron 85 percent). Fish tissue samples were not obtained from the downstream contaminated area. The association of FWA species with Fields Brook aquatic species was excluded from the risk characterization which may result in an underestimation of total site risk.

The results of the ecological BRA included Hazard Quotients based on a high estimate of exposure concentrations (95 percent UCLM) were generally less than 1, although every COC had a few species/zone combinations with HQs greater than 1. The highest Hazard Quotients, based on 95 percent UCLM exposure concentrations, for each COC evaluated, assuming an adjusted area use factor (foraging area of the species in the FWA) as described above were:

COC	Maximum Site HQ (95% UCLM)	Upstream Reference (Zone 4) Maximum HQ (95% UCLM)
Total PCB	3.2 (Rabbit, Zone 2)	0.3 (Rabbit)
Hexachlorobenzene	5.0 (Robin, Zone 2)	NC
Hexachlorobutadiene	5.1 (Rabbit, Zone 2)	1.8 (Rabbit)
Arsenic	1.3 (Shrew, Zone 3)	1.0 (Shrew)
Barium	2.7 (Mink, Zone 2)	NC
Cadmium	3.0 (Robin, Zone 2)	1.5 (Robin)
Chromium	5.4 (Shrew, Zone 3)	1.6 (Shrew)
Lead	5.1 (Shrew, Zone 2)	2.9 (Shrew)
Mercury	14.6 (Shrew, Zone 3)	9.6 (Shrew)
Vanadium	6.2 (Mink, Zone 3)	NC

NC = Not Calculated because of data gaps

These HQs are based on conservative assumptions regarding aspects such as bioavailability. Use of factors that assume each receptor forages entirely within each Zone (*i.e.*, an area use factor of 1, which is appropriate for some species), increases Hazard Quotients about 2 to 4 times higher. In addition, application of more conservative uncertainty factors, as suggested by some authors, would increase HQ values even greater.

1 Project Overview

1.1 Introduction

Fields Brook is located in the City of Ashtabula in northeastern Ohio. The upstream reaches of the Brook drain through an industrial area with multiple sources that historically contributed both organic and inorganic contaminants to the site. Previous investigations of Fields Brook have found contaminants in channel sediments, and the brook itself has been listed by the U.S. EPA on the National Priorities List (NPL). Contamination in Fields Brook channel sediments has been addressed separately, and sediment cleanup will proceed as the Sediment Operable Unit (SOU) under the established Record of Decision (1986).

The Fields Brook Potentially Responsible Parties Organization (FBPRPO) has undertaken a separate voluntary assessment of the nature and extent of contamination and an evaluation of risks potentially associated with contamination in the floodplain/wetlands area of the Fields Brook riparian corridor. The floodplain/wetlands area is not included within any operable units of the Fields Brook NPL site, but is being assessed in accordance with federal and State of Ohio guidance in order to identify any potential need for and approach to risk management actions which might supplement any remedial activities at site operable units.

Potential ecological concerns relating to the Fields Brook floodplain/wetlands area include:

- Baseline risk to biota; and
- Risk-of-remedy (potential habitat destruction associated with possible soil or sediment removal operations) and risk of residual contamination under various possible remediation scenarios.

To address these concerns, a quantitative baseline ecological risk assessment has been conducted and is the subject of this report. This assessment includes characterization of potential receptors, evaluation of exposure pathway completeness, and risk quantitation. This effort was initiated in April 1992 with a site reconnaissance visit by personnel from the FBPRPO and regulatory agencies, continued with field sampling activities during 1993 and 1994, and reaches a decision milestone with this integrated risk assessment.

1.2 Project Objectives

The overall objectives of this project are:

- To meet the applicable requirements of CERCLA and the NCP for environmental assessment at NPL sites; and
- To address issues and concerns raised by U.S. EPA and Ohio EPA during meetings with the FBPRPO and in comments from various agencies received throughout investigation of the floodplain/wetlands.

The approach detailed in this report incorporates the latest available guidance and concepts on ecological risk assessment (U.S. EPA 1985; 1988a; 1989b; 1992a; 1992b; 1992c; 1992d; Ohio

EPA, 1991), and details state-of-the-art analyses to assess contaminant bioavailability, bioaccumulation, and biological effects. In keeping with current guidance and the NCP, specific objectives of the project were to:

- Characterize the nature and extent of contamination;
- Quantify potential contaminant impacts to the biological community; and
- Support development and evaluation of risk management alternatives.

1.3 Organization and Approach

Ecological risk evaluations at this site are being driven by specific technical and regulatory issues. Guidance applicable at the time of production of this report (U.S. EPA, 1989a; 1989b) describes eight subtasks which make up complete baseline risk assessments:

1. Specify objectives;
2. Define scope;
3. Describe site and study area;
4. Describe contaminants of concern;
5. Characterize exposure;
6. Characterize risk or threat;
7. Apply risk estimates to site assessment/remediation process; and
8. Describe assessment conclusions and limitations.

This report and companion documents are designed to address these issues. The recent draft guidance (U.S. EPA, 1994b) specifies the following steps in the ecological risk assessment process (Figure 1-1):

1. Preliminary problem formulation and ecological effects evaluation;
2. Preliminary exposure estimate and risk calculation;
3. Problem formulation: assessment endpoint selection and formulation of testable hypotheses;
4. Conceptual model development: conceptual model, measurement endpoint selection, and study design;
5. Site assessment to confirm ecological sampling and analysis plan;
6. Site field investigations;

7. Risk characterization; and

8. Risk management.

This report is organized into eight Sections:

- Section 1, Project Overview: This section identifies the primary purposes of risk assessments and describes the report organization.

- Section 2, Problem Formulation: This section summarizes the site background and setting, including site descriptions, site history, findings of previous investigations, identification of contaminants of potential concern, and description of project endpoints.

- Section 3, Exposure Assessment: This section describes the methods that were used for characterization of exposure of environmental receptors to contaminants of concern (COCs).

- Section 4, Toxicity Assessment: This section describes the methods used to assess toxicity of the COCs.

- Section 5, Risk Characterization: This section describes the methods that were used to quantify ecological risk.

- Section 6, Uncertainty in Ecological Risk Assessment: This section describes the limitations and uncertainty in the assessment of ecological risk.

- Section 7, References: This section identifies the guidance and technical documents that were used for preparation of this report.

2 Problem Formulation

2.1 History of Site

Fields Brook is located in the city, township, and county of Ashtabula, Ohio. A portion of the United States Geological Survey (USGS) topographic map showing the general location of the Fields Brook watershed is provided in Figure 2-1. Fields Brook drains a 6.0 square mile (sq. mi.) area. The eastern portion of the watershed drains Ashtabula Township and the western portion drains the eastern portion of the city of Ashtabula. The main channel is 3.9 mi. in length and begins at Cook Road, just south of the Penn Central Railroad tracks. From this point, Fields Brook flows northwest to Middle Road, then west to its confluence with the Ashtabula River. From Cook Road downstream to State Route 11, Fields Brook flows through an industrialized area. Downstream of State Route 11 to near its confluence with the Ashtabula River, Fields Brook flows through undeveloped and residential areas in the city of Ashtabula. Fields Brook discharges to the Ashtabula River approximately 8,000 feet (ft) upstream from Lake Erie. In order to facilitate locating features and sampling points along Fields Brook and its tributaries, the stream system has been divided into segments identified by a unique numbering system involving stream reaches. Figure 2-2 shows the identification of these reach segments and industrial property boundaries within the Fields Brook watershed.

The Fields Brook Superfund site, as defined in the Unilateral Administrative Order issued by the U.S. EPA in 1989, "consists of Fields Brook, Ashtabula County, Ohio, its tributaries, and any surrounding areas which contribute, potentially may contribute, or have contributed to the contamination of the brook and its tributaries."

Fields Brook was determined by the U.S. EPA and the Ohio Environmental Protection Agency (Ohio EPA) to contain contaminated sediments resulting from industrial discharges to Fields Brook (U.S. EPA 1986). The Fields Brook site was included on the National Priorities List (NPL) of uncontrolled hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on September 8, 1983.

A study of rivers within 60 major United States watersheds conducted in 1976 by the U.S. EPA Environmental Research Laboratory (ERL) reported that fish collected in and near Fields Brook contained a variety of chlorinated compounds. A follow-up study conducted in 1978 substantiated the results of the 1976 ERL study and reported the presence of polychlorinated biphenyls (PCBs) and hexachlorobenzene.

The U.S. EPA Great Lakes National Program Office funded a 1979 Fields Brook watershed study to investigate concentrations of organic compounds in sediments. Organic compounds, particularly hexachlorobenzene and hexachlorobutadiene (HCBD), were identified in Fields Brook sediments. This study also reported that Fields Brook sediment samples contained polychlorinated solvents.

The 1982 U.S. EPA Toxic Summary Report contained information on hazardous waste generators affecting the Ashtabula area. Reconnaissance inspections were conducted at 10 of the area's facilities. The report prepared following these inspections discussed the activities and handling of potentially toxic and hazardous materials at each facility. The investigation identified a number of organic priority pollutants from industrial effluents.

Between April 1983 and July 1986, an RI/FS was conducted at the Fields Brook site by CH2M Hill on behalf of U.S. EPA. A partial list of the findings from the RI Report (U.S. EPA 1985) with respect to Fields Brook sediments and surface water includes:

- Chlorinated benzene compounds, polynuclear aromatic hydrocarbons (PAHs), HCBD, and PCBs were detected in sediment and surface water samples collected from Fields Brook;

- Organic compounds detected in surface water samples were also detected in sediment and/or industrial effluent samples;

- Volatile organic compounds (VOCs), chlorinated benzene compounds, PAHs, HCBD, and phthalate compounds were reported in relatively high concentrations in some sediment samples; and,

- Concentrations greater than 50 milligrams/kilogram (mg/kg) of PCBs in sediments were reported in sediment samples collected from Fields Brook at some locations.

As stated in the 1986 Unilateral Administrative Order (UAO), follow-on work was to include a Source Control Operable Unit (SCOU) Remedial Investigation/Feasibility Study (RI/FS) and SOU Design Investigations. The overall objectives of these work elements are:

- Source Control RI/FS: "to determine the sources of sediment contamination in Fields Brook and its tributaries from potential sources in the area and to evaluate cost-effective remedial alternatives that will prevent the recontamination of the Fields Brook by these sources."

- SOU Design Investigations: "to refine the estimates of the nature and extent of sediment contamination, substantiate waste treatability assumptions made in the Sediment Operable Unit Feasibility Study, and develop preliminary design data."

The studies described above were all aimed at the brook sediment and potential upland sources. The floodplain was investigated voluntarily by the FBPRPO, even though there is no operable unit designated thereon, nor is it part of an existing operable unit. The above work elements have been managed as separate sections of the Fields Brook project. Results obtained during the Phase I Source Control Remedial Investigation were submitted to U.S. EPA in August 1994 (Revision 1). Technical Memorandum 3 (TM-3) of the Source Control Operable Unit was submitted to U.S. EPA in December 1994. Results obtained during the Phase II SQDI (Revision 0) were submitted to U.S. EPA in February 1995.

2.2 Nature and Extent of Contamination

2.2.1 Data Management and Validation

The floodplain soil analytical results presented in this report represent sampling efforts that have taken place within the floodplain/wetland area of the Fields Brook Superfund Site during the past five years. Some of these soils data were collected as part of brook sediment sampling programs. The soils data used in the risk assessment were collected from the upper 12 inches of the mineral soil identified in the floodplain. This was accomplished by removing leaf litter and the vegetation root mat at each location prior to sampling.

A total of 211 floodplain soil samples have been included in this analysis. Included are:

- 14 Samples Phase I Sediment Quantification Design Investigation (SQDI), Spring 1990
- 55 Samples Phase II Sediment Quantification Design Investigation, September 1993
- 137 Samples Phase III Floodplain/Wetland Assessment, December 1994
- 5 Samples Phase I Source Control RI, January 1993

The sampling strategy for each of these projects has been described in their respective work plans. As part of the Phase I Sediment Quantification Design Investigation (SQDI) sampling, the 14 sampling locations were randomly selected to provide a general characterization of site conditions adjacent to the brook. During Phase II SQDI, the 55 sampling locations were located along transects perpendicular to the Fields Brook channel. Transects were located near Phase I SQDI sediment sampling locations that reported elevated concentrations of COCs. During the Phase III assessment, the 137 sampling locations were located within each Floodplain Exposure Unit (FEU) used in the human health assessment to represent a statistically valid number of samples. In general, a total of 40 samples was collected within each FEU. An attempt was made to spread evenly the sampling locations within each FEU and maintain an equal number on the north and south sides of the main channel of Fields Brook.

Ecological investigations of the Fields Brook study area were conducted on six separate occasions. The first investigation consisting of a preliminary site reconnaissance visit was conducted on 28 April, 1992. Participants included representatives of EA Engineering, Science, and Technology (EA), Woodward Clyde Consultants (WCC), de maximis, Inc. (formerly Technical Environmental Consultants), Ohio EPA, members of the FBPRPO, and U.S. EPA consultants/affiliates. The second investigation was conducted on 10 and 11 November, 1992 to evaluate the character of the floodplain/wetland area. Participants included representatives from EA, WCC, Ohio EPA, and U.S. EPA consultants/affiliates. The third investigation was conducted from 14 to 18 June, 1993 to obtain samples of water, soil, benthic organisms, toxicity test samples, vegetation, terrestrial mammals (composites), fish, community characterization information, and related measurements and observations. Participants included representatives from EA, WCC, and U.S. EPA consultants/affiliates. The fourth investigation was conducted from 27 September to 1 October, 1993 to complete biological collections and obtain additional toxicity test samples. Participants included representatives from EA and U.S. EPA consultants/affiliates. The fifth investigation was conducted on 11 and 12 October, 1993 to complete community characterization, conduct vegetative cover evaluations, and obtain additional terrestrial vegetation samples. Participants included representatives from EA and U.S. EPA consultants/affiliates. The final (sixth) investigation occurred between 9 and 11 November, 1994, involved representatives from EA and WCC, and was conducted to obtain samples of terrestrial invertebrates and individual mammals. All of the analytical data obtained as indicated above were used in preparation of this assessment.

Details on frequency and type of QA/QC sampling are provided in Section 5 of the Quality Assurance Project Plan, Fields Brook Sediment Operable Unit Design Investigation, dated July, 1993 (SOU QAPP). Modifications to the pesticide/PCB methodology for soils are discussed in the Fields Brook Phase III Floodplain Sampling Design Investigation Quality Assurance Project Plan Addendum, dated November 1994 (QAPP Addendum). QA/QC samples were sent directly to the contract laboratory. The analytical testing was conducted by HES Laboratories as specified in Section 9.4 of the SOU QAPP (AC 1993a) in accordance with the analytical methodologies specified in Table 9-1 of the SOU QAPP and amended in the QAPP Addendum, or by EA Laboratories for biological samples. Quality control checks were performed to ensure the collection of representative samples and the generation of valid analytical results. These checks were updated and maintained by project personnel throughout the project. The QC checks included field duplicates, equipment rinsate blanks, and matrix spike and matrix spike duplicates.

2.2.2 Soils

For each FEU, the soils data from the Phase I, II, and III Sediment Operable Unit Floodplain Investigations were combined and evaluated. As part of this evaluation, an analysis of the concentrations of COCs detected on the north and south sides of Fields Brook was performed to determine whether these data sets are statistically different. For those samples that fit either a normal or lognormal distribution, a t-test was performed to determine whether the means of each distribution are consistent with the hypothesis that they represent samples drawn from a similar distribution. The *t-test requires the assumption of normality, thus if the data are lognormal the t-test was performed on* the logarithms of the data sets, which fit a normal distribution. For those data sets that did not fit either a normal or lognormal distribution (determined using the Kolmogorov-Smirnov (K-S) test on each chemical data set), the Wilcoxon Rank Sum, a non-parametric method, was used. This method does not require any a priori assumption regarding the form of the data distribution.

Those data sets that passed either the t-test or the rank sum test were deemed to be statistically equal at the given probability level reported in the tabular summaries of the statistical results. The hypothesis that the two data sets (north versus south) are statistically similar is accepted when the t-test statistic or the rank sum statistic are greater than a specified probability level (α). Generally, a probability limit of 5 percent to 1 percent is the criterion for rejecting the above hypothesis. Most COCs in most FEUs passed the statistical tests, indicating that their concentrations are equivalent on the north and south sides of the brook. The exceptions to this are discussed in the summary of data for each FEU; these exceptions are not expected to impact the risk results, as discussed later in this report.

The data summaries for each FEU are presented in the following subsections and include the following information: frequency of detection, maximum detected concentration, and average concentrations. It should be noted, that FEUs were established for the human health assessment and other approaches to data summary for the ecological assessment may produce different results. For brevity's sake, the average concentration detected is only discussed for a few key indicator organic compounds: Aroclor-1248, hexachlorobenzene, and hexachlorobutadiene. Concentrations of inorganics were compared to the background sediment upper confidence limits established for Fields Brook sediment. All summary statistics were generated on the combined north and south data set for each FEU. Sampling locations are depicted on Figures 2-3 through 2-7.

2.2.2.1 Summary of Soils Data for Floodplain Exposure Unit 2

The frequency of detection, maximum detected and average detected concentrations for chemicals detected in soil within Floodplain Exposure Unit (FEU) 2 are summarized in Table 2-1. The most frequently observed organic compounds in FEU 2 were polynuclear aromatic hydrocarbons (PAHs), PCBs (primarily Aroclor 1248), bis-2-ethylhexylphthalate, dibenzofuran, hexachlorobenzene, hexachloro-butadiene, di-n-butylphthalate, acetone, methylene chloride, tetrachloroethene and toluene. The average detected concentration of Aroclor 1248 was 24.2 mg/kg. The average detected concentration of hexachlorobenzene was 14.3 mg/kg and the average hexachlorobutadiene concentration was 0.81 mg/kg. The maximum detected concentrations of the following inorganic chemicals of concern (see Section 2.3) exceeded the sediment background concentrations established for the SOU: arsenic, beryllium, cadmium, chromium, lead, and mercury.

Vinyl chloride was not detected in any of the 22 samples collected on the north side of the brook and was detected in 1 of the 22 samples collected on the south side of the brook. Therefore, vinyl chloride concentrations were statistically different on the north and south sides. In addition, trichloroethene concentrations were also found to differ between the north and south sides; the maximum detected concentrations on the north and south were 0.15 mg/kg and 6.8 mg/kg, respectively. The concentrations of all other chemicals of concern (COCs) (see Section 2.3) were determined to be equivalent on the north and south sides of the brook.

2.2.2.2 Summary of Soils Data for Floodplain Exposure Unit 3

The frequency of detection, maximum detected and average detected concentrations for chemicals detected in soil within FEU 3 are summarized in Table 2-2. The most frequently observed organic compounds in FEU 3 were polynuclear aromatic hydrocarbons (PAHs), PCBs (primarily Aroclor 1248), di-n-butylphthalate, bis-2-ethylhexylphthalate, methylene chloride, tetrachloroethene, and hexachloro-benzene. The average detected concentration of Aroclor 1248 was 29.1 mg/kg. The average detected concentrations of hexachlorobenzene and hexachlorobutadiene were 6.4 mg/kg and 2.8 mg/kg, respectively. The maximum detected concentrations of the following inorganic COCs (see Section 2.3) exceeded the sediment background concentrations established for the SOU: arsenic, beryllium, cadmium, chromium, and mercury.

1,1,2,2-Tetrachloroethane concentrations were statistically different on the north and south sides of the brook; the maximum detected concentrations on the north and south were 0.022 mg/kg and 0.22 mg/kg, respectively. The concentrations of all other COCs (see Section 2.3) were determined to be equivalent on the north and south sides of the brook.

2.2.2.3 Summary of Soils Data for Floodplain Exposure Unit 4

The frequency of detection, maximum detected and average detected concentrations for chemicals detected in soil within FEU 4 are summarized in Table 2-3. The most frequently observed organic compounds in FEU 4 were polynuclear aromatic hydrocarbons (PAHs), PCBs (primarily Aroclor 1248), 1,2-dichloroethene, 1,2,4-trichlorobenzene, 1,1,2,2-tetrachloroethane, acetone, 2-butanone, tetrachloro-ethene, trichloroethene, bis-2(ethylhexyl)phthalate, di-n-butylphthalate, hexachlorobenzene and hexachlorobutadiene. The average detected concentration of Aroclor 1248 was 63.5 mg/kg. The average detected concentrations of hexachlorobenzene and hexachlorobutadiene were 29.2 mg/kg and 9.2 mg/kg, respectively. The maximum detected concentrations of the following inorganic COCs (see Section 2.3) exceeded the sediment background concentrations established for the SOU: arsenic, beryllium, cadmium, chromium, lead, and mercury.

The concentrations of all COCs (see Section 2.3) were determined to be equivalent on the north and south sides of the brook.

2.2.2.4 Summary of Soils Data for Floodplain Exposure Unit 6

The frequency of detection, maximum detected and average detected concentrations for chemicals detected in soil within FEU 6 are summarized in Table 2-4. The most frequently observed organic compounds in FEU 6 were polynuclear aromatic hydrocarbons (PAHs), PCBs (primarily Aroclor 1248), 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,2-dichloroethene, 1,2-dichloro-benzene, bis-2-ethylhexylphthalate, methylene chloride, acetone, tetrachloroethene, trichloroethene, and xylenes. The average detected concentration of Aroclor 1248 was 73.9 mg/kg. The average detected concentrations of hexachlorobenzene and hexachlorobutadiene were 33.2 mg/kg and 10.8 mg/kg, respectively. The maximum detected concentrations of the following inorganic COCs (see Section 2.3) exceeded the sediment background concentrations established for the SOU: arsenic, beryllium, cadmium, chromium, lead, and mercury.

Beryllium concentrations were statistically different on the north and south sides of the brook. The average concentration on the north was 1.36 mg/kg, with a maximum detected concentration of 6 mg/kg, whereas the average concentration on the south was 0.6 mg/kg, with a maximum detected concentration of 2.2 mg/kg. The concentrations of all other COCs (see Section 2.3) were determined to be equivalent on the north and south sides of the brook.

2.2.2.5 Summary of Soils Data for Floodplain Exposure Unit 8

The frequency of detection, maximum detected and average detected concentrations for chemicals detected in soil within FEU 8 are summarized in Table 2-5. The most frequently observed organic compounds in FEU 8 were polynuclear aromatic hydrocarbons (PAHs), PCBs (primarily Aroclor 1248), dimethyl-phthalate, diethylphthalate, butylbenzylphthalate, bis-2-ethylhexylphthalate, carbazole, dibenzofuran, 1,2-dichloroethene, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,4-dichlorobenzene, trichloroethene, tetrachloroethene, 2-butanone, hexachlorobenzene, hexachloroethane and hexachlorobutadiene. The average detected concentration of Aroclor 1248 was 30.1 mg/kg. The average detected concentrations of hexachlorobenzene and hexachlorobutadiene were 30.0 mg/kg and 1.2 mg/kg, respectively. The maximum detected concentrations of the following inorganic COCs (see Section 2.3) exceeded the sediment background concentrations established for the SOU: arsenic, beryllium, cadmium, chromium, lead, and mercury.

Beryllium concentrations were statistically different on the north and south sides of the brook. The average concentration on the north was 1.86 mg/kg, with a maximum detected concentration of 19.4 mg/kg, whereas the average concentration on the south was 0.7 mg/kg, with a maximum detected concentration of 2.3 mg/kg. The concentrations of all other COCs (see Section 2.3) were determined to be equivalent on the north and south sides of the brook.

Although there appears to be somewhat more beryllium in the floodplain on the north side of FEU6 and 8 than on the south side, calculated risks for beryllium are quite low and beryllium is not a determinant for remediation in either FEU. Vinyl chloride is rarely detected and influences neither risks nor remediation. Similarly, trichloroethene is somewhat more prevalent on the south side of FEU2, and 1,1,2,2-tetrachloroethane is somewhat more prevalent on the south side of FEU3, but calculated risks (discussed in Section 5) for trichloroethene in FEU2 and 1,1,2,2-tetrachloroethane in FEU3 are extremely low, on the order of 10^{-10}. In conclusion, the statistical tests indicate that for those COCs that influence risks and remediation needs, there is no substantial difference in concentration levels on the north and south sides of Fields Brook.

2.2.3 Biota

Biota tissues were obtained as described in project work plans by EA (1994), CH2M-Hill (1994), and in Woodward Clyde's "Phase III floodplain sampling design Fields Brook Site, Ashtabula, Ohio" (1994). Tissue samples were collected from fish, mice, shrews, earthworms, voles, and insects. In addition, soil, water, and vegetation were collected and analyzed for the same parameters. The composition and collection location of each sample used in this assessment is presented in Table 2-6 and maps showing mammal trap lines are presented in Figures 2-8a through 2-8d. Raw analytical data are presented in Appendix A. Sample numbers corresponding to mammal trap locations are not provided, however. Only contaminants of concern (see Section 2.3) are described below.

PCBs. Aroclor 1248 was found only in the earthworm composite in Zones 1 and 2 and was identified in both earthworms and vegetation in Zone 3. Aroclor-1254 was not found in any biotic tissues at the site. Aroclor-1260 was identified only in mammal tissues in Zones 1, 2, and 3. A concentration of 11.0 ppm was detected in a single Phase II composite, however, most concentrations of Aroclor-1260 were well below this level ranging from 0.029 to 4.8 ppm in other samples.

Arsenic. Arsenic was observed in all tissue matrices throughout the floodplain/wetland area (including the background reference area, Zone 4) at concentrations ranging from 0.080 (mice Zone 2) to 1.5 ppm (earthworms Zone 4). Distributions of arsenic in tissues do not suggest that the area of concern is different from the upstream reference (Zone 4), although comparisons with other reference areas may have yielded different results.

Barium. Barium was observed only in tissues of small mammals and earthworms. Concentrations ranged from 1.3 ppm (shrews Zone 3) to 54.2 ppm (Mice Zone 2). Barium was also detected in earthworms from Zone 4 at a concentration of 7.9 ppm.

Cadmium. Cadmium was detected all tissue matrices throughout the floodplain/wetland area (including Zone 4) at concentrations ranging from 0.14 ppm (mice, shrews, and vegetation Zone 2) to 4.5 ppm (earthworms Zone 2). Cadmium was also detected in earthworms obtained from Zone 4 at a concentration of 2.3 ppm.

Chromium. Chromium was detected in all biological media from all zones (including Zone 4). Concentrations ranged from 0.34 ppm (vegetation in Zones 3 and 4) to 3.7 ppm (earthworms in Zone 3). Visual inspection of the data suggests that concentrations are generally similar between the upstream reference (Zone 4) and the lower zones of concern. Comparisons with other reference locations may have produced different results.

Hexachlorobenzene. Hexachlorobenzene was detected all tissue matrices throughout the floodplain/wetland area (including Zone 4) at concentrations ranging from 0.0031 ppm (mouse Zone 2) to 1.2 ppm (mice Zone 2). No clear pattern of contaminant distribution is evident from visual inspection of the data.

Hexachlorobutadiene. Hexachlorobutadiene was observed only in a single earthworm sample from Zone 2 at a concentration of 0.044 ppm (estimated value).

Lead. Lead was detected all tissue matrices throughout the floodplain/wetland area (including Zone 4) at concentrations ranging from 0.05 ppm (mice Zone 2) to 6.6 ppm (earthworms in Zone 3). Concentrations of lead of 5.5 ppm were measured in earthworms in Zone 4.

Mercury. Mercury was detected all tissue matrices throughout the floodplain/wetland area (including Zone 4) at concentrations ranging from 0.08 ppm (mammals and vegetation in Zones 2, 3, and 4) to 2.2 ppm (shrews in Zone 2).

Vanadium. Vanadium was observed in earthworms from all 4 zones with concentrations ranging from 2.2 ppm to 3.5 ppm in Zones 1, 2, and 3 and a concentration of 1.6 ppm in Zone 4. Vanadium was also observed in mammals in Zones 2 (0.49 ppm) and 3 (0.36 ppm). Vanadium does not appear to be a widespread contaminant in the floodplain/wetland area.

2.3 Selection of Contaminants of Concern

Selection of contaminants of concern (COC) is a critical step in the risk assessment process because it allows focused attention on those chemicals that contribute significantly to overall site risk. Because ecological receptors are exposed differently to site related contaminants, the selection of COCs is discussed separately for each receptor type below.

2.3.1 Ecological Assessment

Contaminants of Potential Concern (COPCs) for ecological receptors were selected by U.S. EPA (1995) and CH2M-Hill (1994). Appendix C discusses screening of COPCs to a final list of COCs. At issue after generation of this list of COCs was copper, with a preliminary maximum screening hazard quotient (SHQ) of 1.08. Copper has since been dismissed as a COC *via* recalculation of the SHQ (0.66) using the final exposure assumptions presented in this document (Section 3; see responses to comments submitted by B. Jones April 11, 1995). The final list of ecological COCs includes: Aroclor 1248, Aroclor 1254, Aroclor 1260, arsenic, barium, cadmium, chromium, hexachlorobenzene, hexachlorobutadiene, lead, mercury, and vanadium.

2.4 Ecosystem Characterization

To evaluate potential ecological risks in the Fields Brook floodplain/wetland, it was necessary to develop an understanding of the function and structure of the ecosystem components present. For this purpose, a number of field activities were undertaken with specific focus on basic floodplain characteristics including community analysis and ecosystem structure analysis.

Specifically, these activities were conducted to:

- Develop an inventory of potential environmental receptors present in the floodplain, including key wetland plants and animals, and endangered or threatened species;
- Develop an ecological risk assessment model that is representative of the Fields Brook ecosystem; and
- Supplement the existing delineation of Fields Brook floodplain.

2.4.1 Floodplain Ecosystem Characterization

Ecological characteristics (plants and animals present, litter layer depth and structure, habitat quality, disturbance levels) were noted for biotic communities throughout the floodplain. In addition to general notes on the floodplain ecosystem, field crews also sought to identify:

- Obvious evidence of toxicant effects to vegetation or wildlife;
- Evidence of natural or anthropogenic disturbance such as tree and brush cutting, storm damage, vehicle use;
- Degree of vegetation structure, presence and type of canopy, understory and herbaceous layers; and
- Character and extent of distinct habitat types (primarily vegetation communities supplemented by notes on substratum).

This information was used to support qualitative and quantitative evaluations of site habitat quality, potential contaminant effects, current levels of disturbance, and risk-of-remedy (potential habitat destruction associated with possible soil or sediment removal operations). These considerations are critical to an effective ecological risk assessment (U.S. EPA, 1989a; 1989b). In particular, data gathered during this investigation were used to:

- Quantify any areas of obvious toxicant impact;
- Quantify non-toxicant related disturbance effects;
- Document habitat types present;
- Document habitat quality; and
- Determine potential receptors-of-concern.

Methods for floodplain ecosystem characterization were observational. As described above, field crews noted specific aspects of the habitat, biota present, and obvious toxicant effects. It should be noted, however, that toxicant effects on fish and wildlife are not always documented through an observational approach. Data quality was maintained by employing a consistent suite of parameters as the basis for each observation point. The parameters used included: type and intensity of vegetation damage or chlorosis, fish and wildlife presence, fish and wildlife gross condition, presence, type, and intensity of disturbance, presence, height, and type of canopy, presence and type of understory, presence and type of herbaceous layer, habitat type and observed biota. The results were used to support both qualitative and quantitative assessment. More in-depth discussion of methods used is presented in the text of EA (1993b).

Habitat quality maps (Figures 2-9a through 2-9d) were generated based on the information sources described above. These maps provide details of sampling locations (transects) in the field that were used for describing the nature and extent of distinct habitat quality areas within the Fields Brook floodplain (due to overlap, slight inconsistencies exist between habitat areas mapped on Figures 2-9c and 2-9d). It should be noted that the ecological investigation transects referred to in this report do not correspond to those developed by WCC for soil/sediment sampling. Within the Fields Brook floodplain, distinct habitat types included shrub and forest cover, mowed areas, and wetland areas dominated by *Phragmites*, a non-native wetland plant species. There was no obvious evidence of toxicant impact to Fields Brook floodplain/wetland flora or fauna, but toxicant impacts are not always readily observable.

Forest is the predominant cover type in downstream reaches of the Fields Brook floodplain/wetland. Forested areas exist adjacent to Fields Brook on stream banks in lower reaches and are dominated by maple, black cherry, ash, and oak trees. Forest cover is proportionally lower in the upper reaches, where shrubs and herbaceous vegetation predominate.

Shrub cover is evident in all reaches, yet is distributed as patches rather than large continuous areas. Shrub cover is most prevalent near transects 11 through 18, and in the DS tributary area. Commonly observed shrub species occurring at Fields Brook include multi-flora rose, honeysuckle, and dogwood.

Herbaceous wetland areas frequently contain *Phragmites australis* (common reed) and dominate large sections of the Fields Brook floodplain. *Phragmites* is noticeably absent from the lower reaches of Fields Brook from transects 2A through 13, with the exception of small stands near transects 4 and 9. *Phragmites* becomes more prevalent near transect 14 and is present at all transects upstream from this location. *Phragmites* wetlands dominate large areas of the upper reaches of the Fields Brook floodplain, from transects 21 through 25.

Mowed areas within the Fields Brook floodplain occur near transects 19 to 21. These areas comprise only a small fraction of the floodplain area and are not expected to greatly influence habitat quality. Several paved areas cross the Fields Brook floodplain and include 15th and 16th Streets, Columbus Road, Route 11, and State Road. These paved areas may serve as sources of anthropogenic contaminants to Fields Brook. These roads also disrupt habitat continuity and function as habitat boundaries that some ecological receptors are unlikely to cross. Because of these boundaries, four distinct ecological "exposure zones" were proposed for the flood plains/wetlands area. These zones are somewhat arbitrary, however, and may not apply to all species of concern. Zone 1 begins at 16th street (no floodplain exists below this point) and ends at Route 11 where this highway disrupts floodplain continuity with Zone 2. Zone 2 is bounded by Route 11 on the west and State Road on the east which separates Zone 2 from Zone 3 with a discontinuity similar to that which exists between Zones 1 and 2. Zone 3 begins at State Road and ends at the point where the floodplain becomes a ponded area (approximately at the power line cut between reaches 8-1 and 8-2), and Zone 4 is the ponded area. This ponded area is believed to be above the influence of the FBPRPO discharges to the Brook and serves in this assessment as a potential upstream reference area. The appropriateness of Zone 4 as a reference area has been questioned, however, due to differences in habitat and the potential for contamination. Use of other, more appropriate reference areas could have resulted in different assessment results.

2.4.2 Biological Communities

Data obtained from both tissue analysis samples and from field observations were used to identify which species occur at Fields Brook. A generic list of animal species observed and potentially present is presented in Tables 2-7 through 2-10. Native wetland vegetation in the form of trees, shrubs, and herbaceous species present throughout the floodplain corridor provides a mature habitat for many native animal species (Table 2-11). Avian species observed (either directly or *via* sign such as feces or tracks) at Fields Brook include geese, starlings, sparrows, crows, bluejays, and robins. Mammals observed include mice, shrews, voles, squirrels, muskrats, beavers, opossum, raccoon, deer, and rabbits. Small mammals such as mice, voles, and shrews were collected throughout the Fields Brook floodplain (Table 2-8).

In addition to species observed at the site, many other animal species are potentially present at Fields Brook (Tables 2-7 through 2-10 and Table 2-12) but were not observed (*e.g.*, mink). Raptorial birds may use the area to forage on the abundant populations of small mammals at the site. Herons, grebes, geese, and ducks may use the floodplain as habitat due to the presence of wetlands at the site (although none were observed below the ponded area). The wetland areas apparently serve as habitat for a wide variety of reptiles and amphibians, and various benthic invertebrate species that colonize wetland (silty) sediments. The ponded areas also appear to provide adequate habitat for several species of fish.

2.4.3 Soil Community Structure

Soil invertebrates are extremely important agents in the generation and maintenance of the biological, chemical, and physical character of the soil ecosystem (Dindal, 1990). In addition to being potential indicators of contamination in soil, the soil organism community can be an important component of the food-web in an ecosystem. In both disturbed and undisturbed soil, the types and numbers of soil organisms and their specific functions reflect the status of soil formation, vegetative successional patterns, and environmental perturbations of given sites (Dindal, 1990). Because of their prolonged contact with the soil, a potentially contaminated medium, and their importance in the terrestrial food web, soil fauna were evaluated during the ecological evaluation of Fields Brook.

The soil community was characterized by summarizing taxa richness (number of taxa), taxonomic composition, and abundance. A total of twenty four terrestrial invertebrate taxa were collected in pitfall traps from 9 Fields Brook locations (Table 2-13). The dominant taxa collected from Fields Brook were Diptera (flies) and Collembola (springtails). Total number of individuals ranged from 50 in Reach 13 to 185 in Reach 6-1.

The intimacy of contact with the soil varies among groups from those that burrow in the soil (*e.g.*, round worms and segmented worms), to those in contact with the surface (*e.g.*, spiders, beetles, and ants) to those that may only have incidental contact (*e.g.*, flies, wasps, and moths). Overall, species diversity was well distributed throughout all locations at Fields Brook. The Fields Brook soil fauna appears typical of the habitat conditions present, but direct comparison to reference areas were not made.

2.4.4 Ecological Pathway Analysis

The sources of contaminants considered in this study are those associated with prior releases of contaminants to Fields Brook that were deposited along with sediments in the floodplain/wetland area. Potential release mechanisms include surface water runoff, solubilization, and air transport of particulate matter and volatile compounds. Through these release mechanisms, contaminants originating from a specific location could be transported to potential receptors.

Contaminants sequestered in secondary source material may be released *via* several mechanisms, including incorporation into the food-web (Figure 2-10). Contaminants present in soils can be contacted or ingested directly by terrestrial receptors. Terrestrial receptors (including humans) may directly contact or ingest surface soil at the site. Through food-web interactions, ecological receptors can become potentially contaminated media, which can be ingested in turn by other receptors.

Pathways that are the mostly likely to be complete at this site include the following:

- Surface Water and Soil
  - Ingestion of surface water by biota during current or future activities;
  - Ingestion of soil, U.S. EPA (draft; 1994a) indicates that for ecological receptors, dermal exposure pathways are very difficult to document as complete and that for many receptors such as small mammals, grooming will likely result in ingestion of contaminants prior to actual dermal contact.

    For this reason, dermal exposure will be considered to be adequately addressed for ecological receptors either as a contributor to measured body burdens or oral doses.
- Air
  - Air exposure pathways are not well characterized for ecological receptors. Because contaminant exposure from this source for ecological receptors cannot be quantified, potential exposure *via* these routes contributes to the uncertainties surrounding conclusions. In addition, dust and volatilization in the FWA are unlikely due the dense vegetative cover over the FWA soils.
- Biota
  - Ingestion of biota by upper trophic level ecological receptors.

2.5 Ecological Measurement and Assessment Endpoints

Definitions of endpoints and methods of endpoint selection follow the general guidance provided by Suter and Barnthouse (1993). To determine if adverse impacts have occurred or are occurring due to introduction of anthropogenic chemicals, it is necessary to synthesize a complete understanding of the various measurement endpoints as a weight-of-evidence approach to addressing assessment endpoints.

The process for endpoint selection begins with identification of risk management goals for environmental components and receptors of concern that may be susceptible to chemical substances in the environment. For this site, the goals are:

- Identification of possible sources of contamination;
- Compliance with appropriate ARARs and protection of organisms residing on and near the sites;
- Protection of ecosystems, communities, and populations that may be exposed to contaminants;
- Protection of higher trophic-level organisms that may be indirectly exposed to bioaccumulative substances in prey from the sites.

Measurement endpoints are parameters obtained by local environmental sampling or laboratory testing. The measurement endpoints selected for this site include a wide variety of analytical and observational data.

EXAMPLE ASSESSMENT AND MEASUREMENT ENDPOINTS

ASSESSMENT ENDPOINT

- **Decline in avian carnivore population(s)**

MEASUREMENT ENDPOINTS

- **Doses of bioaccumulative organic compounds (pesticide/PCBs). Rationale: Disruption of growth, metabolism, behavior, and, through calcium metabolism, reproduction (*i.e.*, eggshell thinning)**
- **Doses of non-bioaccumulative organic compounds (solvents, PAHs). Rationale: potential tumor production; mutagenesis**
- **Doses of bioaccumulative inorganic analytes (mercury). Rationale: effects range from degraded growth, metabolism, and reproduction to mortality.**
- **Doses of non-bioaccumulative inorganic analytes (non-mercury metals). Rationale: various effects from impaired growth and reproduction to reduced survival.**

Assessment endpoints are general, large-scale expressions of environmental components or characteristics that may be at risk and, therefore, require protection. Although related and highly interdependent, measurement and assessment endpoints are not the same. In general, measurement endpoints are used to derive a quantitative expression of potential effects, which then forms the basis for extrapolation to higher levels of organization or complexity.

An example is provided in the text box that illustrates the relationship of specific measurement endpoints to a specific assessment endpoint, and provides a rationale for the measurement endpoints (*i.e.*, what drives the risk concern for a given measurement endpoint).

Table 2-14 contains a matrix of receptor guilds versus measurement endpoints (the assessment endpoints [population decline] are inferred). Receptor guilds (organisms with similar life histories or niches in the environment) have been used rather than individual species for this assessment because the general characteristics of guild will provide risk estimates that are representative of the entire guild and as such, can be extrapolated more broadly than single species estimates. The body of the table contains the known effects of the chemical classes represented in the measurement endpoints on receptor groups.

To illustrate the linkage between the samples described in this report and the measurement endpoints, the purposes of the environmental media samples are listed below.

Surface water samples - provide data on chemical concentrations likely to be present in water at the site following sediment operable unit remediation (from upstream reference locations) and provide drinking-water intake fraction for dose modeling of mammals and birds. Use of this data, however, does not provide an estimate of current risk levels.

Soil samples - were obtained during Phases I, II, and III and provide information on chemical distributions at the site. These data were also used as a diet fraction in the dose model for receptors.

Fish tissue samples - were obtained from upstream reference locations during Phase II (EA 1994) and were used to calculate dietary dose to receptors expected following remediation of the sediment operable unit. Use of this data, as with upstream water concentrations, does not provide an estimate of current risk levels to site receptors. Fish tissue samples were not obtained from the downstream contaminated areas and therefore, an estimate of the current risk to ecological receptors such as the mink and great blue heron whose diet is composed of a significant portion of fish (see Table 3-1) was not evaluated.

Small mammal tissue samples - were obtained during Phases II, and III and were used to calculate dietary doses of chemicals for avian and mammalian carnivore guilds. In some cases, samples were composited across species.

Vegetation tissue samples - were obtained during Phase II (EA 1994) and were used to calculate dietary dose of chemicals to herbivorous and omnivorous receptors. As with some mammal tissue data, samples of vegetation were composited across species.

The following suite of assessment endpoints are each related to a specific receptor group, or "guild". For some guilds, risk assessment is restricted to the most sensitive receptor in each guild to reduce the number of receptors of concern evaluated and streamline the process.

The suite of assessment endpoints and associated receptor guilds are as follows. Population reduction in:

1. Avian carnivores
2. Avian omnivores
3. Mammalian carnivores
4. Mammalian omnivores
5. Mammalian herbivores

The guild concept has advantages over individual species evaluations. There are very few toxicological data for many specific ecological receptors. Research data on a single animal species often must be used to develop TRVs for other animals for which there are no toxicological data. For example, published data on the effects of lead on the red-tailed hawk may be used to develop TRVs for other birds. Therefore, it is appropriate to group receptors into trophic guilds. Another advantage is that, when data from a single test species is used to develop a TRV for several different receptors, the modeled outcome for each receptor will depend on differences represented by the individual receptor's food habits and foraging range. In this case, modeling was restricted to the most highly exposed receptors (*i.e.*, those that eat food items with higher COC concentrations and/or have a smaller foraging range). It should be noted that although the stream channel itself is not part of this risk assessment, the floodplain area is in close association with the aquatic environment of the brook. Species which may heavily utilize the aquatic environment of the brook have been excluded from the assessment.

2.6 Project ARARs

As indicated, a Feasibility Study is currently being undertaken to evaluate remedial response areas and strategies within the FWA of the Fields Brook Site. As part of the alternative analysis evaluation Applicable or Relevant and Appropriate Requirements (ARARs) will be developed and presented in the FS.

3 Exposure Assessment

3.1 Ecological Exposure Assessment

Ecological exposures were modeled deterministically by calculating the concentration per unit time (dose) which a receptor receives from its prey (its dietary dose). Dose is a function of which dietary items a receptor consumes, the concentrations of contaminants in those dietary items, and the rate at which these dietary items are consumed. If we let "R" represent the feeding rate in kg food per kg consumer per day, "Fr" the fraction of the diet accounted for by a specific dietary item, and "Cf" the concentration of contaminants in a given dietary item, dose would be calculated as the dietary fraction weighted average of the concentrations in all dietary items (Σ Fr $\times$ Cf) times the consumption rate (R). For example, assume a hypothetical receptor that consumes 0.1 kg/kg body weight per day of food, this food is composed of 40 percent plants and 60 percent mice, plants have a concentration of 2 ppm of some contaminant and mice have a concentration of 3 ppm of that contaminant. The dietary fraction weighted concentration in the diet is 40 percent times 2 ppm (plants) plus 60 percent times 3 ppm (mice) or 2.6 ppm. The dose is this concentration times the consumption rate or 2.6 ppm times 0.1 kg/kg body weight per day which is 0.26 mg of contaminant per kg of consumer (on a fresh or live weight basis) per day. While this example is an over-simplification because it does not consider contaminant uptake from soil, water, *etc.*, but, the technique employed is the same. The specific methods used for this assessment are discussed below. The exposure assessment did not allow for differences that may exist in contaminant concentrations from one side of the brook to the other. Although it is acknowledged that location differences may be present, dose calculations assumed that exposure levels were equivalent on both sides of the brook. Analysis of data from both sides of the brook revealed few significant differences in COC concentrations (See Section 2.2.2)

3.1.1 Food-Web Model

All of the input parameter values shown in Table 3-4 were obtained from the literature. The receptor groups evaluated include: mink, hawk, heron, robin, rabbit, mouse, and shrew. For each of these receptor groups, the biological parameters used in the food-web model (Figure 2-10; described below) are presented in Table 3-1. Aquatic species such as fish and amphibians were not included in the model, although these organisms may be part of the Fields Brook ecosystem. Biological parameters used for each species were derived from the literature and are generally considered acceptable. Input values for the American Robin, however, were determined through use of an allometric equation. Published ingestion rates for the American Robin (1.52 kg/kg bw/day) differ from those presented herein and use of this rate may alter estimates of risk. Table 3-2 presents the portion of each receptor's activities (area use factor; AUF) which will be conducted in each Zone (Figure 2-2; assuming 195 acres are represented by the four zones). The values presented are used as multipliers to decrement the dose calculated by the food-web model:

$$\mathrm{Dose}_{ik} = \mathrm{R}_k \times \sum_{j=1}^{n} \{\mathrm{Fr}_{kj} \times \mathrm{Cf}_{if}\} \times \mathrm{AUF}_{kz} \qquad (4)$$

Where:

$Dose_{ik}$	=	Dose of compound I to the kth consumer; mg compound per kg organism wet weight (fresh or live weight) per day
Cf_{ij}	=	Concentration of compound I in food source j (includes soil)
Fr_{kj}	=	Fraction of k's diet which is food source j
R_k	=	Feeding rate; kg food (wet) per kg organism (wet) per day
n	=	Number of food sources
AUF_{kz}	=	Area use factor for receptor k in zone z

Area use factors are presented in Table 3-2. Although use of AUF's of less than 1 is appropriate for some species, such as the red-tailed hawk, to be protective of the floodplain as a whole, use of conservative AUF's is justified. Assimilation efficiency (ability of consumer to extract a contaminant from food or abiotic media) for all contaminants except mercury was set to 1.0 because the efficiency with which organisms on site extract contaminants from their food are likely similar to those in studies used in derivation of TRVs. As such, doses obtained from consumption of contaminated dietary items may be similar both at the site and in literature studies. Data used to drive the model (ingestion rate, dietary fractions, water consumption, *etc.*) were derived from the literature.

Approaches to the determination of concentrations of contaminants in biological and other media are described in Appendix D. Parameter distributions were estimated using methods such as the Gibbs sampler. It is acknowledged that other approaches to data analysis exist and the methods used in this study have not been reviewed for acceptability by EPA.

3.1.1.1 Qualifications

The presence of non-detects complicated the analysis. In this investigation non-detects were replaced with half the detection limit, prior to the analyses presented above. Moreover, composite samples were treated as single observations. The analyses involving the normal and uniform distributions were less formal than what was accomplished for the lognormal distribution presented above. However, the additional analyses were only meant to supplement the more rigorous analysis when the lognormality assumption could not be supported. Statistics describing the distributions of contaminants of concern for ecological assessment are presented in Table 3-3.

4 Toxicity Assessment

4.1 Ecological

A toxicity reference value (TRV) is an exposure level for a receptor taxon (including sensitive subgroups such as taxa under regulatory protection) that is likely to be without appreciable risk of deleterious effects. TRVs may be developed for different routes of exposure such as oral, inhalation, and dermal. They may be obtained from appropriate regulatory criteria, or be developed using either exposure dose (expressed as mg/kg body weight/day for oral intake); concentration in food, water, or air (expressed as mg/kg, mg/L, mg/m^3, respectively); or body burden [*i.e.*, internal dosage, mg/kg (fresh or live weight)]. For this assessment, dose-based TRVs were obtained or developed from available toxicological literature to provide a basis to evaluate exposure of site biota exposed to concentrations of COCs measured on-site. These derivations were made in a manner consistent with that presented in the draft U.S. EPA ecological risk assessment guidance (1994a) although uncertainty factors were obtained from another source (discussed below). When toxicity data are lacking for some taxa, a sensitive toxicological endpoint was identified from the most appropriate and available taxa and extrapolated for application. When uncertainties associated with extrapolations were excessive, no TRV was calculated.

In developing TRVs for ROCs, uncertainty factors (UFs) were set at values reflecting the relationship between experimental response and the risk under consideration for each COC. UFs are established based on values suggested by the literature and the toxicological database for the COCs of interest at the site. There are past studies that suggest that a consistent use of only factors of ten as UF values result in overly conservative estimates of risk (see discussion below). These studies show that many UFs can safely provide protection of 80 to 99.9 percent when set at values less than ten. Scientific justification for use of factors less than 10 is limited, however, and many current authors recommend factors of between 10 and 100.

For this investigation, a factor of five was used to account for inter-taxon variability, a value that is realistic based on previous studies examining UFs. The studies of Evans *et al.* (1944), *Lehman and Fitzhugh (1954), and Hayes (1967) indicate that extrapolations of animal studies to* humans for prolonged and repeated exposures only require adjustments of about two to four times. Suter and Rosen (1988) in contrast, using an aquatic database, suggested that UFs of 10 and 20 or more may be required for extrapolating between families and orders, respectively. Use of factors of 10, as suggested by some authors, would appreciably increase the estimated level of risk for some receptors in this study.

For TRV estimation, a factor of ten was used to extrapolate from lowest observed adverse effect level (LOAEL) to no observed adverse effect level (NOAEL) endpoints and from subchronic to chronic endpoints. A factor of 100 was used to extrapolate from single oral doses and acute LD50s to chronic NOAELs. These UFs are conservative (*i.e.*, indicate lower concentrations of toxicological concern than are actually of concern) based on suggested values found in the literature. Weil and McCollister (1963) observed that factors of 2, 3, 5, and less than 10 could provide an equivalent full chronic NOAEL downward adjustment from a subchronic NOAEL 59, 73, 90, and 97 percent of the time, respectively, for small mammals. McNamara (1976) similarly noted a value of approximately three for the subchronic to chronic NOAEL ratios for 41 different compounds. Weil and McCollister (1963) showed that 96 percent (50 of 52) of small mammal studies had LOAEL-to-NOAEL ratios of 5 or less. The average ratio for the subchronic studies was less than 3, while full chronic studies showed a mean ratio of approximately 3.5. In comparison, Suter and Rosen (1988) developed regressions between LC50 data and maximum acceptable toxicant concentrations (by definition lower than a LOAEL because it is the geometric mean of the LOAEL and NOAEL) and found extrapolation factors of 8, 18, 22, and 34 for marine invertebrates and fish, and freshwater invertebrates and fish, respectively.

The most scientifically sound data point found for each COC was selected for calculation of TRVs for each ROC at the site. Whenever possible, the toxicity endpoint used as a TRV is a NOAEL for chronic or subchronic exposures. Since the true effects level is higher by an unknown amount than the NOAEL, the NOAEL may result in overestimation of risk, and as such, may be a conservative endpoint. Use of NOAEL values, however, are generally considered protective of receptors for which limited toxicity information exists. When more than one NOAEL is available for a particular animal, the lowest NOAEL with a serious effect (*e.g.*, liver necrosis versus decreased body weight gain) was chosen. The maximum adjustment adopted for the TRV derivation approach discussed above was set at 500 for those data considered to be the most uncertain when extrapolated, *i.e.*, lethal endpoints observed under acute or single exposure conditions for organisms other than the ROCs.

Toxicity data for terrestrial animals are relatively scant, and few exist for the specific receptors selected at this site. Development of TRVs for this investigation was based largely on toxicity of chemicals to laboratory animals, primarily rats and mice, that were developed for human health assessments. Primary literature sources were used whenever possible in generating TRVs for each COPC and ROC at this site. It is acknowledged that other sources of toxicity information may exist beyond those discussed below. Use of this information may have resulted in TRVs which differ from those presented.

The following text presents the supporting information for TRV development. TRVs are summarized in Table 4-1.

Aroclor 1248 - Small Mammals, Mouse, Shrew (1.3 mg/kg-bw/day) - This value was based on a 5 wk LOAEL of 13 mg/kg-bw/day for mice exposed to Aroclor 1248 (Thomas and Hindsill 1978 in ATSDR 1991). After 5 weeks of exposure, mice at the LOAEL had decreased resistance to infection, resulting in increased mortality. Also reported in ATSDR (1991) was a 4 wk NOAEL of 50 mg/kg-bw/day for rats based on hematological and hepatic (focal necrosis) effects. An acute oral LD50 value of 11,000 mg/kg for rats was also found (Fishbein, 1974). The 5 wk mouse value was divided by a factor of 10 to estimate a chronic NOAEL, resulting in a TRV of 1.3 mg/kg-bw/day.

Aroclor 1248 - Medium Mammals, Mink, Rabbit (0.26 mg/kg-bw/day) - No data were found regarding medium mammal exposure to Aroclor 1248. This value was based on the Aroclor 1248 TRV for small mammals of 1.3 mg/kg-bw/day and divided by 5 to account for species extrapolation, resulting in a TRV of 0.26 mg/kg-bw/day for medium mammals. Use of an intertaxon UF of 10 would yield a TRV of 0.13 mg/kg-bw/day. Other data sources on the toxicity of Aroclor 1248 are available, but were not included in the risk assessment at this time.

Aroclor 1248 - Herons (5.58 mg/kg-bw/day) - This value was based on a 5 d LC50 value of 2,795 mg/kg reported for mallards exposed to Aroclor 1248 (Heath *et al.* 1972). This value was divided by 100 to estimate a chronic NOAEL and further divided by 5 to account for inter-taxon variability, resulting in a TRV of 5.58 mg/kg-bw/day. Use of an intertaxon UF of 10 would yield a value of 2.79 mg/kg-bw/day.

Aroclor 1248 - Raptors (0.45 mg/kg-bw/day) - This value was based on a 1.5 yr NOAEL of 0.45 mg/kg-bw/day for screech owls (McLane and Hughes, 1980). The NOAEL reported as 3 mg/kg dietary feed was multiplied by the estimated daily consumption of screech owls (15 percent of body wt.; Nagy, 1987) and then divided by the estimated body weight of adult screech owls (150 g; Terres, 1982) to achieve a NOAEL of 0.45 mg/kg-bw/day. The exposure encompassed two full breeding seasons and the endpoints measured included survival, egg production, egg hatchability, and eggshell thickness. It should be noted that 3.0 mg/kg was the only dose administered (plus controls) to the owls, thus the estimated NOAEL value obtained is likely conservative.

Aroclor 1248 - Chickens/Pheasants and Turkeys (2.3 mg/kg-bw/day) - This value was based on a 10 wk NOAEL of 2.3 mg/kg-bw/day for Japanese quail (Scott, 1977). The NOAEL reported as 20 mg/kg dietary feed was multiplied by the estimated daily consumption of Japanese quail (12 percent of body wt.; Nagy, 1987) and then divided by the estimated body weight of adult Japanese quail (180 g; Terres, 1982) to yield a NOAEL of 2.3 mg/kg-bw/day. Endpoints measured included survival, egg production, egg shell breaking strength and egg hatchability. LD50 values were also reported for ring-necked pheasant, bobwhite quail, and Japanese quail exposed to Aroclor 1248 for 5 d (Heath *et al.* 1972). Five day LD50 values of 1,310 mg/kg, 1,175 mg/kg, and 4,845 mg/kg were reported for ring-necked pheasant, bobwhite quail, and Japanese quail, respectively (Heath *et al.* 1972).

Aroclor 1248 - Passerine Birds, American Robin (0.46 mg/kg-bw/day) - No data were found regarding song bird exposure to Aroclor 1248. This value was based on the TRV for ground-feeding birds of 2.3 mg/kg-bw/day, the most rigorous study examining the effects of Aroclor 1248 on birds (*e.g.*, multiple dose levels). The ground-feeding bird TRV was divided by 5 to account for inter-taxon variability, resulting in a TRV of 0.46 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 0.23 mg/kg-bw/day.

Aroclor 1254 - Small Mammals, Mouse, Shrew (0.32 mg/kg-bw/day) - This value was based on a two generation study reporting a NOAEL of 0.32 mg/kg-bw/day for rats (Linder *et al.* 1974). The NOAEL was based on several reproductive endpoints, including number of litters, litter size, total pups per treatment group, pup survival, and mean body weight at weaning. A 2 yr National Cancer Institute (NCI) study examining the effects of Aroclor 1254 on rats was presented by Ward (1985) and Morgan *et al.* (1981). The NCI data indicated a 2 yr LOAEL of 25 mg/kg feed, or 1.125 mg/kg-bw/day, based on survival, growth, and incidence of neoplastic nodules and hepatocellular carcinomas (Ward, 1985; Morgan *et al.*, 1981). A 9 wk reproductive study reporting a LOAEL of 6.4 mg/kg-bw/day for rats was also found (Baker *et al.*, 1977) with maternal toxicity and fetal mortality as the endpoints. Collins and Capen (1980) reported a 60 d LOAEL (fetotoxic effects) of 50 mg/kg (2.5 mg/kg-bw/day) for rats. Pup weights were significantly reduced and ultrastructural lesions were found on thyroids of pups at 50 ppm.

Aroclor 1254 - Medium Mammals, Mink, Rabbit (0.15 mg/kg-bw/day) - This value was based on a 4-month NOAEL of 0.15 mg/kg-bw/day for mink exposed to Aroclor 1254 (Aulerich and Ringer, 1977). The NOAEL was based on adult mortality, number of females whelped, number of kits born, and kits per female. The dietary concentration of 1.0 mg/kg Aroclor 1254 was multiplied by the estimated mass of food consumed daily (0.15 kg/d) and then divided by the average mass of minks used (1.0 kg-bw) to yield 0.15 mg/kg-bw/day. Aulerich and Ringer (1977) also reported a 10 mo LOAEL of 0.30 mg/kg-bw/day (2 mg/kg feed) for mink exposed to Aroclor 1254. Endpoints included adult mortality, number of adult females mated and whelped, and kit survival and body weight. An 8-week LOAEL of 0.19 mg/kg-bw/day for mink exposed to Aroclor 1254 was reported by Aulerich *et al.* (1985). The LOAEL was based on body weight loss and reproductive success. The dietary concentration of 2.5 mg/kg Aroclor 1254 was multiplied by the estimated mass of food consumed daily (0.069 kg/d) and then divided by the average mass of minks used (0.9 kg-bw) to achieve 0.19 mg/kg-bw/day. Hornshaw *et al.* (1986) reported 28 d LC50 values for mink ranging from 49-58 mg/kg.

Aroclor 1254 - Songbirds, American Robin (2.54 mg/kg-bw/day) - This value was based on a 56 d LC50 of 254 mg/kg-bw/day for Bengalese finches exposed to Aroclor 1254 (Prestt *et al.*, 1970). The endpoints were mortality and body weight loss. The 56 d NOAEL values from the same study ranged from 12-36 mg/kg-bw/day. The LD50 value of 254 mg/kg-bw/day was reduced by a factor of 100 to estimate a chronic NOAEL of 2.54 mg/kg-bw/day.

Aroclor 1254 - Herons and Ducks (3.4 mg/kg-bw/day) - This value was based on a 1.5 yr NOAEL of 3.41 mg/kg-bw/day for mallards exposed to Aroclor 1254 (Heath *et al.*, 1972). The exposure encompassed two full breeding seasons, with the NOAEL based on mortality and several reproductive endpoints. The value reported by Heath *et al.* (1972) of 25 mg/kg feed was multiplied by the average amount of dry feed consumed daily by an adult mallard (0.15 kg; Welty, 1982) and divided by the weight of an adult mallard (1.1 kg; Terres, 1982) to achieve a NOAEL of 3.41 mg/kg-bw/day. This value was identical to the 3 mo NOAEL of 25 ppm Aroclor 1254 (diet) for mallards reported by Custer and Heinz (1980). Various reproductive endpoints were measured with no adverse effects observed at the NOAEL. A 5 d LC50 of 2,700 mg/kg was also reported for mallards exposed to Aroclor 1254 (Heath *et al.*, 1972).

Aroclor 1254 - Raptors (0.68 mg/kg-bw/day) - No data were found regarding raptor exposure to Aroclor 1254. This value was based on the heron TRV of 3.4 mg/kg-bw/day because it was the most rigorous avian exposure to Aroclor 1254 found. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.68 mg/kg-bw/day for raptors. Using an intertaxon UF of 10 would yield a TRV of 0.34 mg/kg-bw/day.

Aroclor 1260 - Small Mammals, Mouse, Shrew (7.4 mg/kg-bw/day) - This value was based on a two generation study reporting a NOAEL of 7.4 mg/kg-bw/day for rats (Linder *et al.*, 1974). The NOAEL was based on several reproductive endpoints, including number of litters, litter size, total pups per treatment group, pup survival, and mean body weight at weaning. A 29-month (full life cycle) LOAEL of 3.45 mg/kg-bw/day (100 mg/kg diet) for rats was reported by Norback and Weltman (1985). Liver lesions occurred mainly in female rats at 100 mg/kg and eventually progressed to hepatocellular carcinomas (carcinogenicity) in livers. The dietary level of 100 mg/kg Aroclor 1260 was converted to an intake of 5 mg/kg-bw/day by assuming that a rat consumes 5 percent of its body weight per day. This dosage was converted to a Time Weighted Average (TWA) dose of 3.45 mg/kg-bw/day to reflect the fact that rats received 100 mg/kg for 16 mo, 50 mg/kg for 8 mo, and 0 mg/kg for the last 5 mo. This TWA LOAEL was divided by 10 to estimate a chronic NOAEL (TRV) of 0.345 mg/kg-bw/day. Kimbrough (1975) reported a 21 mo LOAEL of 4.64 mg/kg-bw/day for rats. Mean final rat body weights and body weight gain were significantly reduced, and hepatocellular carcinomas formed in livers of 14 percent of treated rats (*vs.* 0.58 percent for controls) at a dietary level of 100 mg/kg. The dietary level of 100 mg/kg Aroclor 1260 was converted to a dose of 5 mg/kg-bw/day by assuming that a rat consumes 5 percent of its body weight per day. This dosage was converted to a Time Weighted Average (TWA) dose of 4.64 mg/kg-bw/day to reflect the fact that rats received 11.6 mg/kg-bw/day during the first week of exposure, 6.1 mg/kg-bw/day at 3 mo, and 4.3 mg/kg-bw/day at 21 mo due to fluctuating dietary ingestion rates.

Aroclor 1260 - Medium Mammals, Mink, Rabbit (0.15 mg/kg-bw/day) - This value was based on a 4 mo NOAEL of 0.15 mg/kg-bw/day for mink exposed to Aroclor 1254 (Aulerich *et al.*, 1977). The endpoints were survival, reproductive success and fetal mortality. This value was retained, as Aroclor 1254 and Aroclor 1260 have similar log Kow values (6.5 and 6.8, respectively), thus the bioaccumulation potential for Aroclor 1260 is expected to be similar to Aroclor 1254 (ATSDR 1991). The small and medium mammal data also suggest that Aroclors 1254 and 1260 affect these receptors at similar doses (ATSDR 1991). Further, mink are more sensitive to PCBs than most species of animals such as ferrets, mice, rats (Aulerich *et al.*, 1985). Thus, mink are expected to be protective of these and other mammalian species.

Aroclor 1260 - Chickens/Pheasants and Turkeys (4.7 mg/kg-bw/day) - This value was based on an 18 mo NOAEL of 100 mg/kg feed for chickens (Keplinger *et al.*, 1971). No effects on body weight, egg shell thickness, or egg hatchability were observed at the NOAEL dose. The value reported of 100 mg/kg feed was multiplied by the average amount of dry feed consumed daily by an adult chickens (0.085 kg; Welty, 1982) and divided by the weight of an adult domestic chicken (1.8 kg; Welty, 1982) to achieve a TRV of 4.7 mg/kg-bw/day. A 50 d LC50 value of 500 mg/kg for bobwhite quail was also found (Hurst *et al.*, 1973). Other LC50 values of 500 mg/kg for bobwhite quail were also reported for 28 and 39 d exposures (Hurst *et al.*, 1973). Five day LD50 values of 1,260 mg/kg, 745 mg/kg, and 2,185 mg/kg were also reported for ring-necked pheasant, bobwhite quail, and Japanese quail, respectively (Heath *et al.*, 1972).

Aroclor 1260 - Herons and Ducks (3.96 mg/kg-bw/day) - This value was based on a 5 d LC50 value of 1,975 mg/kg reported for mallards exposed to Aroclor 1260 (Heath *et al.*, 1972). This value was divided by 100 to estimate a chronic NOAEL and further divided by 5 to account for inter-taxon variation, resulting in a TRV of 3.96 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 1.98 mg/kg-bw/day.

Aroclor 1260 - Raptors and Songbirds (0.94 mg/kg-bw/day) - No data were found regarding raptor or songbird exposure to Aroclor 1260. This value was based on the TRV for chickens/pheasants and turkeys of 4.7 mg/kg-bw/day because it was the most rigorous avian exposure to zinc found. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.94 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 0.47 mg/kg-bw/day.

Arsenic - Small Mammals (0.75 mg/kg-bw/day) - This value was based on a 3 generation NOAEL of 0.75 mg/kg-bw/day for mice exposed to arsenic *via* drinking water (Schroeder and Mitchener 1971). The dietary dose of 5 mg/kg (*via* water) was multiplied by the estimated daily water intake of 0.003 kg/d (Calder and Braun 1983) and then divided by the estimated weight of an adult mouse (0.02 kg) to obtain 0.75 mg/kg-bw/day. The NOAEL was based on survival of offspring, number of litters, failure of adult mice to breed, and total population size at the end of the study. This was the only study found reporting population level effects (*i.e.*, reproduction) of arsenic on small mammals. Also found was a life-cycle (1200 d) NOAEL for rats of 0.34 mg/kg-bw/day based on a single dose level (Schroeder *et al.*, 1968). The NOAEL was based on cardiovascular and hematological abnormalities, life span, and body weight gain. Other chronic NOAEL values found ranged up to 12 mg/kg-bw/day (Byron *et al.*, 1967). Eisler (1988) also reported acute toxicity values for hamsters ranging from 1.5 to 5.0 mg/kg-bw/day; however, these values were based on acute exposures.

Arsenic - Medium Mammals, Mink, Rabbit (1.2 mg/kg-bw/day) - This value was based on a 2 yr NOAEL of 1.2 mg/kg-bw/day for dogs (Byron *et al.*, 1967). The endpoints included various respiratory, cardiovascular, gastrointestinal, hematological, hepatic, and renal effects. This value was similar to the chronic oral toxicity value found for domestic cats of 1.5 mg/kg-bw/day and lower than single oral dose values for rabbits, which ranged from 8-40 mg/kg-bw (Eisler, 1988).

Arsenic - Ducks (6.8 mg/kg-bw/day) - This value was based on a 32 d LD50 for mallard ducks (Eisler, 1988). The value reported in Eisler (1988) as 500 mg/kg diet was multiplied by the amount of dry feed consumed daily by an adult mallard (0.15 kg; Welty, 1982) and divided by the weight of an adult mallard (1.1 kg; Terres, 1982) to yield a TRV of 68.2 mg/kg-bw/day. Other toxicological values found were an acute (test duration not reported) LD50 of 323 mg/kg-bw and a 6 d LD50 of 1000 mg/kg diet (136 mg/kg-bw/day) for mallards. The 32 d LC50 of 68.2 mg/kg-bw/day was divided by 10 to estimate a chronic NOAEL, resulting in a TRV of 6.8 mg/kg-bw/day.

Arsenic - Herons (1.36 mg/kg-bw/day) - This value was based on the duck TRV of 6.8 mg/kg-bw/day. The duck TRV of 6.8 mg/kg-bw/day was divided by 5 to account for inter-taxon variability. Using an intertaxon UF of 10 would yield a TRV of 0.68 mg/kg-bw/day.

Arsenic - Raptors (1.26 mg/kg-bw/day) - No data were found regarding raptor exposure to arsenic. The chicken/pheasant TRV was used to extrapolate this TRV because it was the most rigorous avian exposure found. The raptor TRV was extrapolated from the chicken/pheasant TRV of 6.3 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability. Using an intertaxon UF of 10 would yield a TRV of 0.63 mg/kg-bw/day.

Barium - Small Mammals, Mouse, Shrew (11.6 mg/kg-bw/day) - This value was based on a 92 d NOAEL (115.8 mg/kg-bw/day) in mice (Dietz *et al.*, 1992). The NOAEL was based on survival, weight loss, various behavioral and reproductive endpoints, and lack of histopathologic lesions. This value was divided by 10 to estimate a chronic NOAEL of 11.6 mg/kg-bw/day. Rats were also exposed in the same study with similar results. The mouse value was similar to other values reported for barium chloride in ATSDR (1990). Rats exposed to barium chloride for 13 wk *via* water resulted in a NOAEL of 35 mg/kg-bw/day (ATSDR, 1990). However, studies reporting NOAEL values for serious effects in rats and mice exposed to barium acetate were considerably lower than those for barium chloride, ranging from 0.7 to 0.95 (ATSDR, 1990). As reported in ATSDR (1990), barium chloride is more commonly used in manufacturing processes than barium acetate. Hence, barium chloride exposure to terrestrial ROCs in NECOU are more likely to occur than exposure to barium acetate. Therefore, the chloride form of barium was used to develop the TRV.

Barium - Medium Mammals, Mink, Rabbit (2.32 mg/kg-bw/day) - No data were found regarding barium exposure to medium or large mammals. The medium mammal and deer TRVs were extrapolated from the small mammal TRV of 11.6 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability. Using an intertaxon UF of 10 would yield a TRV of 1.16 mg/kg-bw/day.

Barium - All Birds (ND) - No data were found regarding barium exposure to birds.

Cadmium - Small Mammals, Mice, Shrews (0.99 mg/kg-bw/day)- This value was based on a full lifespan NOAEL (1100-1200 d) of 5 mg/kg (0.99 mg/kg-bw/day) for rats exposed to lead acetate in drinking water (Schoeder *et al.*, 1965). The endpoints were visible signs of toxicity, lifespan and longevity. The dietary dose of 5 mg/kg (*via* water) was multiplied by the estimated daily water intake of 0.099 kg/d (Calder and Braun, 1983) and then divided by the estimated weight of an adult rat (1.0 kg) to obtain 0.495 mg/kg-bw/day. A 6 mo NOAEL of 1.9 mg/kg-bw/day for mice was also found (Schroeder and Michener, 1971). The endpoints were lack of congenital abnormalities and reproductive failure. These values are lower than other published intermediate and chronic NOAELs for rats, mice, and rabbits where serious sublethal effects (*e.g.*, reproduction) were reported (ATSDR, 1991).

Cadmium - Medium Mammals, Mink, Rabbit (0.75 mg/kg-bw/day) - This TRV was based on a 12 mo NOAEL value of 0.75 mg/kg-bw/day for dogs reported by Loser and Lorke (1977). The endpoints examined were not provided. This value was used for all medium mammals, as no other data were found.

Cadmium - Ducks (0.49 mg/kg-bw/day) - This value was based on a 12 wk NOAEL for young wood ducks reported by Mayack *et al.* (1981). The exposure duration was 12 wk and the endpoint was formation of kidney lesions. The TRV of 0.49 mg/kg-bw/day was calculated from the value reported in Mayack *et al.* (1981) by multiplying 6.61 mg/kg diet by 0.037 kg of food eaten daily (Nagy, 1987) and then dividing by 0.5 kg weight for the average wood duck exposed in the study. Cain *et al.* (1983) also exposed mallard ducklings to cadmium for 12 wk, with the endpoint of lack of formation of mild and severe kidney lesions. The NOAEL of 2.8 mg/kg-bw/day was calculated from the value reported in Cain *et al.* (1983) by multiplying 9.2 mg/kg in mallard duckling diet by 0.34 kg of food eaten daily (Welty, 1982) and then dividing by 1.1 kg weight for the average mallard duckling tested. A 90 d LOAEL and a 42 d NOAEL value for mallard ducks of 210 mg/kg (20 mg/kg-bw/day) and 150 mg/kg diet (17.0 mg/kg-bw/day) were also found in White and Finley (1978) and Di Giulio and Scanlon (1984), respectively.

Cadmium - All Other Birds (0.1 mg/kg-bw/day) - This value was based on the duck TRV of 0.49 mg/kg-bw/day. The duck TRV of 0.49 mg/kg-bw/day was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.1 mg/kg-bw/day for other birds. Using an intertaxon UF of 10 would yield a TRV of 0.05 mg/kg-bw/day.

Chromium - Small Mammals (0.99 mg/kg-bw/day) - This value was based on a 21 mo life span NOAEL value of 0.99 mg/kg-bw/day for mice exposed to chromic acetate (Schroeder *et al.*, 1963). The NOAEL was based on survival and growth. Dose calculation was based on a water ingestion rate of 0.004 kg/d and body weight of 0.05 kg supplied by the author. This was the lowest chronic NOAEL value found for small mammals exposed to chromium. This value is a factor of 10 to 1000 lower than other published NOAELs for both trivalent and hexavalent chromium to small mammals (ATSDR, 1991). As such, this value should be considered conservative.

Chromium - Medium and Large Mammals (0.48 mg/kg-bw/day) - This value was based on a 4 yr NOAEL value of 0.48 mg/kg-bw/day for dogs exposed to hexavalent chromium (Eisler 1986). The NOAEL was based on "no measurable effects," which were not specified by the author. Dose calculation was based on a dog drinking rate of 0.66 L/d (Calder and Braun 1983) and body weight of 8.3 kg (Gralla *et al.*, 1977).

Chromium - Ducks (6.4 mg/kg-bw/day) - This value was based on a 5 mo NOAEL for black ducks reported in Eisler (1986). No effects were observed with respect to survival, reproduction, and blood chemistry at this dose. A TRV of 6.36 mg/kg-bw/day was calculated from the 50 mg Cr/kg value reported in Eisler (1986) by multiplying by 0.15 kg of food eaten daily (Welty,

1982) and then dividing by 2.60 lb (1.18 kg) weight for an average adult black duck (Terres, 1982). This was the only value found for ducks exposed to chromium.

Chromium - All Other Birds (1.28 mg/kg-bw/day) - No data were found regarding other bird exposure to chromium. The duck TRV was used to extrapolate to other birds because it was the most rigorous (and only) avian exposure to chromium found. This TRV was extrapolated from the duck TRV of 6.4 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability, resulting in a TRV of 1.28 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 0.64 mg/kg-bw/day.

Hexachlorobenzene (HCB) Small Mammals, Mice, Shrews (2.80 mg/kg-bw/day) - This value was based on a 2 yr (4 generations) NOAEL of 2.80 mg/kg-bw/day for rats exposed to HCB (Grant *et al.*, 1977). The endpoints measured included lactation, fertility, and offspring viability indices and offspring birth weights. The NOAEL of 40 mg/kg dietary feed was multiplied by the estimated daily consumption of rats (0.014 kg; Nagy, 1987) and then divided by the average mass of an adult Norway rat (200 g; Burt and Grossenheider, 1976) to yield a NOAEL of 2.80 mg/kg-bw/day. This NOAEL is supported and supplemented by other data found for mice and hamsters. Cabral *et al.* (1979) reported a NOAEL of 6 mg/kg-bw/day for mice exposed to HCB for 105-120 weeks based on induction of liver-cell tumors. Cabral *et al.* (1977) also reported a LOAEL of 4 mg HCB/kg-bw/day (50 mg/kg) for life cycle exposures (70 weeks) of hamsters based on hepatoma formation and tumor incidence in liver.

Hexachlorobenzene (HCB) Medium Mammals (0.12 mg/kg-bw/day) - This value was based on a 331 d NOAEL of 0.12 mg/kg-bw/day for mink to HCB (Bleavins *et al.*, 1984). The endpoints included kit mortality and growth, litter size, and increased percentage of stillbirths. The average mass of HBC consumed for 331 d of 58.5 mg was divided by the number of days (331) and then divided by the average mass of adult minks (1.5 kg-bw; Hornshaw *et al.*, 1986) to yield 0.12 mg/kg-bw/day. Bleavins *et al.* (1984) also reported a 332 d NOAEL value for ferrets of 0.88 mg/kg-bw/day. Gralla *et al.* (1977) exposed beagle dogs to HCB for 1 yr, resulting in a NOAEL of 1.2 mg/kg-bw/day. The endpoints measured were mortality, body weight, and various gastrointestinal and hepatic effects (Gralla *et al.*, 1977). Since the key study by Bleavins *et al.* (1984) for mink provided a chronic NOAEL and is supported by other data, no uncertainty factors were applied.

Hexachlorobenzene (HCB) Chicken/Pheasant and Turkey (0.53 mg/kg-bw/day) - This value was based on a 90 d NOAEL of 0.50 mg/kg-bw/day for Japanese quail exposed to HCB (Vos *et al.*, 1971). The NOAEL reported as 5 mg/kg dietary feed was multiplied by the estimated daily consumption of Japanese quail (0.016 kg/d; Nagy, 1987) and then divided by the average body weight of quail used (150 g) to yield a NOAEL of 0.53 mg/kg-bw/day. At the NOAEL dose, egg hatchability, survival, egg production, and eggshell thickness were not affected, whereas significant increases of liver weights, fecal coprophorphyrin excretion and liver lesions were observed. Schwetz *et al.* (1974) reported a 90 d LOAEL of 4 mg/kg-bw/day (20 mg/kg feed) for Japanese quail exposed to HCB. The LOAEL was based on a significant decrease in the number of hatched chicks surviving for one week. However, no effects on body weight, food consumption, egg production, fertility and hatchability of eggs, or eggshell thickness were observed.

Hexachlorobenzene (HCB) All Birds (0.11 mg/kg-bw/day) - No data were found regarding other bird exposure to hexachlorobenzene. This value was based on the TRV for chicken/pheasant and turkey of 0.53 mg/kg-bw/day. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.11 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 0.055 mg/kg-bw/day.

Hexachlorobutadiene - Small Mammals, Shrews, Mice (0.2 mg/kg-bw/day) - This value was based on a chronic NOAEL of 0.2 mg/kg-bw/day for rats as reported in CH2M HILL (1994). Exposure duration and endpoints were not provided.

Hexachlorobutadiene - Medium Mammals, Mink, Rabbit (0.04 mg/kg-bw/day) - No data were found regarding medium mammal exposure to hexachlorobutadiene. The small mammal TRV of 0.2 mg/kg-bw/day was used to extrapolate to the medium mammal TRV by dividing by 5 to account for inter-taxon variability. Using an intertaxon UF of 10 would yield a TRV of 0.02 mg/kg-bw/day.

Hexachlorobutadiene (HCBD) - All Birds (1.2 mg/kg-bw/day) - This value was based on a 90 d NOAEL of 6 mg/kg-bw/day for Japanese quail (Schwetz *et al.*, 1974). At the NOAEL dose, no effects on body weight, food consumption, egg production, fertility and hatchability of eggs, survival of hatched chicks, or eggshell thickness were observed. No other data were found regarding bird exposure to HCBD. The NOAEL for Japanese quail was divided by 5 to extrapolate to other species of birds, yielding a TRV of 1.2 mg/kg-bw/day. Using an intertaxon UF of 10 would yield a TRV of 0.6 mg/kg-bw/day.

Lead - Small Mammals, Mice, Shrews (0.90 mg/kg-bw/day) - This value was based on a 9 mo NOAEL of 0.90 mg/kg-bw/day for rats (Grant *et al.*, 1980). At the NOAEL, no effects were observed with respect to general growth, health, neurobehavioral development, and structural/functional integrity of target organ systems. These data were supported by the findings of Kimmel *et al.* (1980), who observed a 90 d NOAEL of 0.90 mg/kg-bw/day for rats exposed to lead acetate. Rats were exposed *via* drinking water from weaning through mating, gestation, and lactation. At the NOAEL, no effects were observed on the ability of females to conceive, to carry a normal litter to term, to deliver offspring, length of term, or birth weights. No significant effects on embryo- or fetotoxicity, or teratogenicity were observed at the NOAEL. The only effects observed were a slight delay in time of vaginal opening and slight depression of body weight. A full life cycle (4 yr) NOAEL of 25 mg/kg (1.25 mg/kg-bw/day) for rats was reported by Schroeder *et al.* (1970) based on overall body weight, survival, and longevity. Other values were found for rats, mice, and guinea pigs but all were greater than the 0.90 mg/kg-bw/day TRV or used less serious endpoints such as increases in blood pressure (Eisler, 1988; ATSDR, 1990). A study examining the effects of lead on postnatal development of the bank vole was also found but was considerably higher than the other values found for small mammals (380 mg/kg-bw/day; Zakrzewska, 1988).

Lead - Medium Mammals, Mink, Rabbit (1.25 mg/kg-bw/day) - The most reliable chronic study found for medium mammals was a 2 yr LOAEL of 12.5 mg/kg-bw/day for dogs (ATSDR, 1990). Dogs were exposed to lead acetate in food and the endpoint was lack of neurological effects (not described). This value was divided by 10 to estimate a chronic NOAEL for medium mammals of 1.25 mg/kg-bw/day. This value was similar to another value found for dogs as reported by Sax (1984) for lead acetate. Sax (1984) reported a LD_{LO} (lowest dose expected to cause death) of 191 mg lead/kg for dog. If this value is divided by 100 to estimate a chronic NOAEL (1.91 mg/kg), it is consistent with the TRV of 1.25 mg/kg-bw/day.

Lead - Raptors (0.82 mg/kg-bw/day) - This value was based on red-tailed hawk NOAEL values ranging from 0.82 to 6.55 mg/kg-bw/day (Lawler *et al.*, 1991; Redig *et al.*, 1991). Lead exposure durations ranged from 21 to 24 d and had no adverse effects on gastrointestinal function, body weight, and other hematological functions (Lawler *et al.*, 1991; Redig *et al.*, 1991). A 5 mo

NOAEL for American kestrel (Franson *et al.*, 1983; Pattee, 1984) was also reported as 54 mg/kg feed. This value was multiplied by the amount of feed consumed daily by the kestrels (0.05 kg) and divided by the average weight of the exposed kestrels (0.135 kg) to achieve a TRV of 20.0 mg/kg-bw/day. No adverse effects were observed with respect to survival, egg laying, initiation of incubation, fertility, eggshell thickness (Pattee, 1984), histopathological lesions, body weights, or organ weights (Franson *et al.*, 1983). Ten day and 60 d LOAEL values for American kestrel of 25 and 448 mg/kg feed (9.3 and 166 mg/kg-bw/day), respectively, were also reported by Hoffman *et al.* (1985) and Custer *et al.* (1984). Based on these data, the TRV of 0.82 mg/kg-bw/day for raptors appears conservative.

Lead - Herons (0.19 mg/kg-bw/day) - This TRV was based on the data from Edens and Garlich (1983), who reported 10 wk (3.3 mg/kg-bw/day) and 17 wk (0.19 mg/kg-bw/day) LOAEL values for Leghorn hens and Japanese quail hens, respectively, and were based on significant decreases in egg production. A 64 wk LOAEL of 6.25 mg lead acetate/kg-bw/day (equivalent to 3.98 mg/kg-bw/day as lead) was also found for rock doves (Anders *et al.*, 1982). The endpoints were anemia, kidney pathology, and elevation in erythrocyte porphyrin. Damron and Wilson (1975) observed no adverse effects (body weight gain, mortality, feeding rate) in bobwhite quail exposed to lead for 6 wk at 187.5 mg/kg-bw/day. Morgan *et al.* (1975) reported a 5 wk NOAEL of 100 mg/kg feed (13 mg/kg-bw/day) for Japanese quail based on reduced growth and anemia. The 100 mg/kg feed value was multiplied by the amount of feed consumed daily by the quail (0.013 kg/d; Nagy 1987) and divided by the average weight of the exposed quail (0.1 kg) to achieve a NOAEL of 13.0 mg/kg-bw/day. Kendall and Scanlon (1981) reported a 11 wk NOAEL of 100 mg Pb/kg (7.9 mg/kg-bw/day) for ringed turtle doves. At the NOAEL, no adverse effects were observed on egg production or egg fertility (Kendall and Scanlon, 1981). With respect to the other data found for birds, the 0.19 mg/kg-bw/day value for Japanese quail appears quite conservative. As such, the TRV was set to 0.19 mg/kg-bw/day.

Lead - Passerine Birds (0.28 mg/kg-bw/day) - This value was based on an 11 d NOAEL value of 2.8 mg/kg-bw/day for starlings exposed to trialkyl lead (Osborn *et al.*, 1983). The NOAEL was based on survival, growth, and food consumption. The NOAEL was divided by 10 to estimate a chronic NOAEL, resulting in a TRV of 0.28 mg/kg-bw/day. No other data were found.

Mercury (Organic) - Small Mammals, Shrews, Mice (0.03 mg/kg-bw/day) - This value was based on 11-12 wk LOAELs for rats and mice of 0.302 and 0.636 mg/kg-bw/day, respectively (Ilback, 1991; Ilback *et al.*, 1991). Immunological and developmental effects observed at the LOAEL dose (3.9 mg/kg feed) included reduced natural killer T-cell activity, decreased thymus weight and cell number, decreased cell-mediated cytotoxicity, increased thymus lymphocyte activity in fetuses. These effects are not considered life-threatening but are the most scientifically sound data found for small mammal exposure to organic mercury compounds. No neurotoxic effects (*i.e.*, arched backs and ataxia) were observed at 1.0 mg/kg-bw/day (NOAEL) in mice exposed to methylmercuric chloride in drinking water for 110 d or mice exposed to mercuric chloride at 3 mg/kg-bw/day (NOAEL) for 400 d (Ganser and Kirschner, 1985). Khera (1973) reported a 95-125 d NOAEL of 0.1 mg/kg-bw/day for rats exposed to methyl mercuric chloride based on body weights and reproductive success. The LOAEL of 0.302 mg/kg-bw/day was divided by 10 to estimate a chronic NOAEL (TRV).

Mercury (Organic) - Medium Mammals, Mink, Rabbits (0.076 mg/kg-bw/day) - This value was based on a 93 d NOAEL of 0.076 mg/kg-bw/day for adult female mink exposed to methyl mercury chloride (Wobeser *et al.*, 1975). No obvious clinical signs of toxicity were observed (*e.g.*, anorexia, weight loss, ataxia, head tremors) at the NOAEL dose after 93 days. The NOAEL dose of 1.1 mg/kg feed was multiplied by the average daily feeding rate for mink (0.069 kg/d; Aulerich *et al.*, 1985) and then divided by the average weight of adult female mink (1.0 kg-bw; U.S. EPA, 1993) to obtain a TRV of 0.076 mg/kg-bw/day. Other authors have suggested, however, that the 0.076 value represents a LOAEL value, with an actual NOAEL of 0.0076 mg/kg-bw/day. Auerlich *et al.* (1974) examined the dietary effects of mercury and methylmercury (MeHg) on mink. Methylmercury was considerably more toxic than inorganic mercury to mink, with a LC100 of 5 mg MeHg/kg after 37 days of exposure, compared to a 5 mo NOAEL of 1.01 mg Hg/kg-bw/day as mercuric chloride (Auerlich *et al.*, 1974). Hanko *et al.* (1970) reported a 58 d LC50 value of 5 mg MeHg/kg for ferrets, similar to the Borg *et al.* (1974) MeHg value reported for mink. A 159-213 d LOAEL of 0.08-0.10 mg/kg-bw/day was reported for otters exposed to methyl mercury in the diet (2.0 mg MeHg/kg), with anorexia, ataxia, convulsions, and death as the endpoints (O'Connor and Nielson, 1980). A 2 yr NOAEL for domestic cats of 0.02 mg/kg-bw/day based on food consumption, body weight gain, and various neurological endpoints was found in Charbonneau *et al.* (1976). A LOAEL for dogs of 0.1 mg/kg-bw/day exposed during pregnancy was also found (endpoint was stillbirths) (Eisler, 1987). The mink value was used to generate the TRV because it is more taxonomically similar to ROCs than domestic cats or dogs.

Mercury (Organic) - Ducks (0.068 mg/kg-bw/day) - This value was based on a 12 mo NOAEL for mallard ducks (Heinz, 1974). The value reported in Heinz (1974) as 0.5 mg MeHg/kg feed (methylmercury dicyandiamide, or Morsodren) was multiplied by the amount of feed consumed daily by an adult mallard (0.15 kg; Welty, 1982; page 113) and divided by the weight of an adult mallard (2.4 lb or 1.1 kg; Terres, 1982) to achieve a TRV of 0.068 mg/kg-bw/day. The endpoints measured included mortality and reproductive success. This value was lower than the 21 wk NOAEL reported for mallard ducks (Scheuhammer, 1987) as 3.0 mg/kg feed (0.41 mg/kg-bw/day), the 85 d NOAEL value obtained by Haegele *et al.* (1974) of 6.2 mg/kg diet (0.75 mg/kg-bw/day), and the 214 d NOAEL of 0.28 mg/kg-bw/day by Pass *et al.* (1975) for mallards exposed to methyl mercury. Based on these supporting data, the TRV appears sufficiently protective.

Mercury (Organic) - Herons (0.014 mg/kg-bw/day) - No data were found for herons. This value was based on the TRV for ducks of 0.068 mg/kg-bw/day. The duck TRV of 0.068 mg/kg-bw/day was divided by 5 to account for inter-taxon variability, resulting in a TRV of 0.014 mg/kg-bw/day for herons. Using an intertaxon UF of 10 would yield a TRV of 0.007 mg/kg-bw/day.

Mercury (Organic) - Raptors (0.01 mg/kg-bw/day) - This value was based on a 47 d LC100 of 0.92-1.2 mg/kg-bw/day for goshawks exposed to methylmercury (MeHg) (Borg *et al.* (1970). The dietary dose of 10-13 mg MeHg/kg was multiplied by the average daily goshawk feeding rate of 0.093 kg/d and then divided by the average mass of the goshawks exposed (1.0 kg) to achieve 0.92-1.2 mg/kg-bw/day. This value was divided by 100 to estimate a chronic NOAEL of 0.01 mg/kg-bw/day. A LOAEL of unknown exposure duration of kestrels to mercury was also found (Scheuhammer, 1987). Considerable mortality was observed in kestrels exposed to 13 mg Hg/kg as feed. This value was multiplied by the amount of feed consumed daily by an adult kestrel (10 percent of body weight or 0.011 kg; Welty, 1982) and divided by the weight of an adult kestrel (0.113 kg; Terres, 1982) to achieve a LOAEL of 1.26 mg/kg-bw/day.

Mercury (Organic) - All Other Birds (0.023 mg/kg-bw/day) - This value was based on an 8 wk LOAEL of 0.23 mg/kg-bw/day for starlings (Nicholson and Osborn, 1984). The dietary dose of 1.1 mg/kg feed was multiplied by the estimated starling feeding rate of 0.0147 kg/d (Nagy, 1987) and then divided by the estimated mass of the starlings exposed (0.070 kg; Terres, 1982) to achieve 0.23

mg/kg-bw/day. The endpoint was the presence of numerous kidney lesions, although no outward signs of toxicity were observed. The value obtained by Nicholson and Osborn (1984) was divided by 10 to account for uncertainty, as there was only one dose level and only 10 birds were exposed.

Vanadium - Small Mammals, Mice, Shrews (0.7 mg/kg-bw/day) - This value was based on a chronic NOAEL of 0.7 mg/kg-bw/day for mice reported in CH2M HILL (1994). Exposure duration and endpoints were not provided.

Vanadium - Medium Mammals (0.14 mg/kg-bw/day) - No data were found regarding medium mammal exposure to vanadium. The small mammal TRV of 0.7 mg/kg-bw/day was used to extrapolate to the medium mammal TRV by dividing by 5 to account for inter-taxon variability. Using an intertaxon UF of 10 would yield a TRV of 0.007 mg/kg-bw/day.

Vanadium - All Birds (ND) - No data were found regarding vanadium exposure to birds.

5 Risk Characterization

5.1 Ecological Risk Characterization

Risks associated with doses of contaminants to receptors (Section 3) were evaluated by comparing them against reference doses (TRVs - Section 4) to calculate hazard quotients (HQs) following the method of Menzie *et al.* (1993) and U.S. EPA (1994b) as:

$$HQ = \frac{\text{Calculated Dose}}{\text{TRV}}$$

These HQs are presented for all species and zones in Tables 5-1 through 5-3 for exposures using: 1) mean media concentrations and area use factors (AUFs) as presented; 2) 95 percent UCL concentrations and AUFs as presented; and, 3) 95 percent UCLM concentrations and AUFs set equal to 1.0, respectively. Using this information, along with originally determined TRVs, hazard quotients (HQs) were calculated for each receptor, COC, and Zone (including reference or "background" locations BK1 and BK2) when sufficient information existed to do so. Information from background locations BK1 and BK2 was not always applied, however. Results based on original calculations are presented below. Use of EPA recommended uncertainty factors for intertaxon differences would yield higher HQ values than presented.

5.1.1 PCBs

Ecological risks due to PCBs are presented as the sum of results for the three Aroclors considered. These sums of hazard quotients based on mean exposure concentrations ("mean HQ") range from less than 0.01 to a maximum of 0.49 (Eastern Cottontail in Zone 3). The highest mean sum PCB hazard quotient calculated for reference locations is 0.19 (mink BK1) indicating that mean on-site risks are approximately twice those of the reference area. The maximum sum PCB HQ based on 95 percent UCLM of exposure concentrations ("95UCLM HQ") is 3.16 (Eastern Cottontail in Zone 2). The 95UCLM HQ assuming also AUFs of 1 generated an HQ of 9.96 (mink in Zone 2) for the sum of the Aroclors. These values for cottontails are being driven primarily by dietary contributions from soil (94 percent of the calculated dose) and are probably overestimated because it was assumed that PCBs in ingested soil are entirely bioavailable and that the measured soil PCB concentrations are representative of the concentrations actually in the cottontail diet that are obtained from dust on vegetation and grooming. The mink worst case HQ in Zone 2 presented above (AUF = 1) is conservative because Zone 2 is much smaller than the home range for mink (*e.g.*, 770 ha; U.S. EPA 1993a) and not all activities would be concentrated in that Zone. Use of conservative assumptions regarding home range and mean contaminant concentrations are warranted, however, due to the compositing of sample results and the need to be protective of the floodplain as a whole.

5.1.2 Arsenic

Mean hazard quotients for arsenic range from 0.01 to 1.13 (shrew in Zone 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 1.26 and is the same as the worst case HQ because the AUF for the shrew is 1.0 in all cases. These hazard quotients are not substantially above the value of 0.97 reported for the upstream reference area (Zone 4, shrew). Although comparisons with reference locations (BK1 and BK2) are not possible for all receptors because of data gaps (earthworm sample data lacking), HQs for mink, Red-tailed Hawk, Great Blue Heron, and Eastern Cottontail are all similar between on-site locations and reference locations and, in fact, reference location HQs (Zone 4, BK1, BK2; mean and 95 percent UCLM with AUFs as presented) are frequently higher than on-site HQs.

5.1.3 Barium

Available data for barium (analytical and TRV) permitted calculation of HQs only for mink in Zones 2 and 3. Even those calculations must be viewed with some skepticism because small mammal tissue concentrations were used to replace the missing fish tissue concentration values (mink diet was assigned as 92 percent small mammals and 8 percent soil in this case to bridge data gaps). Mean hazard quotients for barium range from 0.22 to 0.67 (Zones 2 and 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 2.74 and is 12.23 for the HQ with AUF = 1.0. Over half of the mink dose (59 percent) is from soil and these risks are probably overestimated because it was assumed that barium in ingested soil is entirely bioavailable and that the measured soil barium concentrations are representative of the concentrations actually in the mink diet that are obtained from dust on prey and grooming. Use of actual fish tissue data from the brook may also have yielded a more representative estimate of exposure. The mink HQ presented above for AUF = 1.0 is conservative because Zone 2 is much smaller than the home range for mink (*e.g.*, 770 ha; U.S. EPA 1993a) and not all activities would be concentrated in that Zone. Use of conservative assumptions regarding home range and mean contaminant concentrations are considered appropriate, however, due to the compositing of sample results and the need to be protective of the floodplain as a whole.

5.1.4 Cadmium

Mean hazard quotients for cadmium range from 0.01 to 2.66 (American Robin in Zone 2). The maximum HQ based on 95 percent UCLM of exposure concentrations is 2.99 and is the same for the most conservative scenario (2.98 reported due to rounding error) because robin AUFs are equal to 1.0 for all scenarios. Zone 4 (upstream reference) HQs are approximately half those of on-site locations (*e.g.*, 95 percent UCLM for American Robin in Zone 4 is 1.48 as compared to 2.99 for Zone 2). Although comparisons with reference locations (BK1 and BK2) are not possible for all receptors because of data gaps (earthworm sample data lacking), HQs for mink, Red-tailed Hawk, Great Blue Heron, and Eastern Cottontail are all higher at reference stations than at on-site locations (*e.g.*, HQ for 95 percent UCLM with AUFs as presented for Red-tailed Hawks at BK1 is 0.79 and is 0.19 in Zone 1).

5.1.5 Chromium

Mean hazard quotients for chromium range from 0.06 to 2.76 (shrew in Zone 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 5.42 and is the same for the most conservative scenario (reported as 5.38 due to rounding error) because shrew AUFs are equal to

1.0 for all scenarios. These values are probably conservative because 72 percent of the calculated shrew dose is from soil, it was assumed that all chromium in soil was in the more toxic hexavalent form while it is unknown what fraction of the chromium in soil is present in the less toxic trivalent form, and it was assumed that chromium in ingested soil is entirely bioavailable and that the measured soil chromium concentrations are representative of the concentrations actually in the shrew diet that are obtained from soil on prey and grooming. In addition, chromium risks for shrews from the upstream reference area (Zone 4) are calculated to be 1.62 which is two to three times lower than calculated on-site risks. Although comparisons with reference locations (BK1 and BK2) are not possible for all receptors because of data gaps (earthworm sample data lacking), HQs for mink, Red-tailed Hawk, and Great Blue Heron are all similar at reference stations and on-site locations.

5.1.6 Hexachlorobenzene

Mean hazard quotients for hexachlorobenzene range from 0.01 to 0.68 (American Robin in Zone 2). The maximum HQ based on 95 percent UCLM of exposure concentrations is 5.06 and is the same for the most conservative scenario (reported as 5.05 due to rounding error) because robin AUFs are equal to 1.0 for all scenarios. These values are probably conservative because 98 percent of the calculated robin dose is from soil, it was assumed that hexachlorobenzene in ingested soil is entirely bioavailable and that the measured soil hexachlorobenzene concentrations are representative of the concentrations actually in the robin diet that are obtained from dirt on prey and grooming. Robins are known to ingest soil during consumption of prey items, however. Calculated on-site risks are elevated relative to reference locations.

5.1.7 Hexachlorobutadiene

Mean hazard quotients for hexachlorobutadiene range from less than 0.01 to 2.08 (Eastern Cottontail in Zone 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 5.06 (Eastern Cottontail in Zone 2) and is the same for the most conservative scenario (reported as 5.00 due to rounding error) because rabbit AUFs are equal to 1.0 for all scenarios. These values are probably conservative because approximately ½ of the calculated rabbit dose is from soil, the remainder of the dose (from vegetation) is based entirely on non-detect values, it was assumed that hexachlorobutadiene in ingested soil is entirely bioavailable, and that the measured soil hexachlorobutadiene concentrations are representative of the concentrations actually in the rabbit diet that are obtained from soil on food and grooming. Although comparisons with reference locations (BK1 and BK2) are not possible for all receptors because of data gaps (earthworm sample data lacking), HQs for mink, Red-tailed Hawk, Great Blue Heron, and Eastern Cottontail at reference locations are within a factor of 2.5 (higher or lower) of those calculated for on-site locations (*e.g.*, HQ for 95 percent UCLM with AUFs as presented for Eastern Cottontail in BK1 and is 1.79 and in Zone 2 is 5.06; HQ for mink at BK2 is 1.92 and is 0.79 in Zone 2). Upstream reference (Zone 4) calculations are either higher than on-site locations (*i.e.*, mink) or within approximately a factor of 4 of those calculated at on-site locations.

5.1.8 Lead

Mean hazard quotients for lead range from 0.05 to 4.92 (short tailed shrew in Zone 2). The maximum HQ based on 95 percent UCLM of exposure concentrations is 5.10 and is the same for the most conservative scenario (reported as 5.13 due to rounding error) because shrew AUFs are equal to 1.0 for all scenarios. Although comparisons with reference locations are not possible for all receptors because of data gaps (earthworm sample data lacking), HQs for mink, Red-tailed Hawk, Great Blue Heron, and Eastern Cottontail at reference locations (BK1 and BK2) are generally higher than at on-site locations, when comparisons are made using mean values and UFs as presented. Comparisons of reference areas to onsite areas when calculations are based on 95 percent UCLM and a UF of 1, reveal elevated onsite values. HQs calculated for the upstream reference area (Zone 4) are within a factor of two of those calculated on-site (*e.g.*, HQ for 95 percent UCLM with AUFs as presented for shrew in Zone 4 is 2.88 and is 5.10 for Zone 2).

5.1.9 Mercury

Mean hazard quotients for mercury range from 0.03 to 9.60 (shrew in Zone 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 14.65 and is 26.81 using AUF = 1 for the most conservative scenario (Red-tailed Hawk in Zone 2). The hawk HQ presented above is conservative because Zone 2 is much smaller than the home range for these hawks (*e.g.*, 400 ha; Craighead and Craighead, 1969) and not all activities would be concentrated in that Zone. The other values are probably conservative because it was assumed that 100 percent of mercury ingested is in the bioavailable organo-mercury forms (*e.g.*, methyl mercury) while the actual case is probably much lower. Assimilation efficiency values for Hg were not set to 1, however, to account for these factors. Since Hg occurs in inorganic and methylated forms and the methylated forms are more bioavailable, it is important to distinguish between these forms when estimating bioavailability. For example, Bashor and Turri (1986) suggest that < 1 percent of all Hg in sediments would be present in a methylated form and further state that this would provide a conservative estimate. D'Itri (1990) presents field studies wherein the proportion present as CH_3Hg^+ ranges from 0.01 to 1.4 percent. This suggests that the HQs for mercury presented above may be grossly overestimated. A reference HQ for mercury to Red-tailed Hawks (BK1; 95 percent UCLM) was 2.14, again suggesting over-estimation. Upstream reference area (Zone 4) HQs are generally similar to on-site locations (*e.g.*, HQ for 95 percent UCLM with AUFs as presented for shrews in Zone 4 is 9.62 and is 14.65 in Zone 3), but the upstream reference may not be appropriate for all comparisons. Use of conservative assumptions regarding home range and mean contaminant concentrations are warranted due to the compositing of sample results and the need to be protective of the floodplain as a whole.

5.1.10 Vanadium

Available data for vanadium (analytical and TRV) permitted calculation of HQs only for mink in Zones 2 and 3. Even those calculations must be viewed with some skepticism because small mammal tissue concentrations were used to replace the missing fish tissue concentration values (mink diet was assigned as 92 percent small mammals and 8 percent soil for this calculation to bridge data gaps). Use of fish tissue values from the brook may have provided a higher estimate of risk. Mean hazard quotients for vanadium range from 1.08 to 2.00 (Zone 3). The maximum HQ based on 95 percent UCLM of exposure concentrations is 6.24 and is 23.08 for the worst case scenario with AUF = 1.0. The mink HQ presented above with AUF = 1.0 is conservative because Zone 2 is much smaller than the home range for mink (*e.g.*, 770 ha; U.S. EPA 1993a) and not all activities would be concentrated in that Zone. These values are probably conservative because 98 percent of the calculated mink dose is from soil, it was assumed that vanadium in ingested soil is entirely bioavailable and that the measured soil vanadium concentrations are representative of the concentrations actually in the mink diet that are obtained from dirt on prey and grooming. Use of conservative assumptions regarding home range and mean contaminant concentrations are considered to be warranted due to the compositing of sample results and the need to be protective of the floodplain as a whole.

5.2 Earthworm Bioassays

The toxicity and bioaccumulation assessment conducted using earthworms at Fields Brook is summarized in EA 1994. Mortality of earthworms in the 14 day bioaccumulation/toxicity tests ranged from as high as 100 percent to as little as zero percent within a Reach (Table 5-4). For example, all samples tested at Reach 4-1 were obtained at the same time and within 10 feet of each other, yet mortalities at this location were 0.0, 89.3, and 100 percent indicating that the responsible agent(s) may be unevenly distributed throughout the Fields Brook floodplains/wetlands. Survival rates of both control groups were within acceptable test ranges (100 percent and 95.3 percent).

Inspection of the analytical data on the earthworm tissues reveals no apparent relationship between concentrations of contaminants in tissues and observed mortality. In order to determine if the cause of the observed mortality was toxic compounds present in the tests, analytical data on exposure media were evaluated to determine if one or several of the analytes can be implicated. Soil samples were obtained directly from the test media that earthworm toxicity tests were performed on for all toxicity tests for which these concentrations are reported. Because of the 100 percent mortality of the earthworms in one of the Fall 1993 toxicity tests at Reach 4-1 earthworm tissues were not available for analysis and only the test medium was analyzed. This provides soils concentration data for four toxicity tests with mortalities of 100 percent, 100 percent, 12.3 percent, and 4.8 percent. These data are compared in Table 5-5 to determine if any of the analytes detected could be distinguished as being responsible for the observed mortality.

The only analyte that was substantially elevated in exposure media in high-mortality toxicity tests was potassium and only in one of the two high-mortality tests. This lack of correlation between analytes detected and mortality observed suggests that either the toxic agent was not one that was analyzed for, or, that the test results are not representative of actual conditions in the floodplain/wetland area. Although evidence for the cause of the toxicity is lacking, earthworms were found easily and in abundance in the floodplain/wetland area. Insufficient information exists from which to make a clear determination.

6 Uncertainty in Ecological Risk Assessment

Because the environmental risk assessment process is based on weight of evidence, it is important that limitations associated with analyses and their application be presented along with supporting documentation. Limitations associated with any risk assessment have a number of components, including degree of success in meeting objectives, the range of conditions over which conclusions can be applied, and the uncertainty with which conclusions can be drawn (U.S. EPA 1989a, pages 56 - 57).

In general, uncertainties are inherent in a number of parameters employed in the ecological risk quantitation. Under the hazard quotient approach as applied, both the exposure and toxicity evaluations contribute to risk estimation and uncertainty. Components of uncertainty in the exposure estimation include, in particular, actual distributions of exposure parameters relative to those used for assessment. Uncertainty in reference doses and toxicity reference values is associated with the degree of correspondence of toxicity test conditions with those at the site, with the variability in receptor sensitivity, and with the degree to which specific toxicity test values can be generalized.

To compensate for these sources of uncertainty, conservative choices were made in developing many of the risk assessment input values. Uncertainty has the greatest effect on decision-making near the threshold, that is, for risks near 1.0. Decision-making involving risks substantially greater or less than 1.0 are unlikely to be affected by uncertainty inherent in the risk assessment process.

Potential environmental effects associated with contaminants of concern detected in the Fields Brook FWA have been estimated through risk modeling. The resulting conclusions must be placed in perspective relative to the uncertainties associated with the evaluation. Consistent with standard risk assessment procedures, the risk characterization was based on generally conservative assumptions, although additionally conservative assumptions could also have been applied. Consequently, the estimated potential risk may be greater than the actual risk, or in some cases, lower than the actual risk. Conservative risk characterization assumptions applied in the assessment include:

- When more than one reference was available describing contaminant effects on receptors the lowest available value from a credible study provided the basis for TRVs.

- When interspecies conversion of a TRV was necessary the TRV was reduced to account for additional uncertainty, although this reduction could have been greater.

6.1 Applicable Range Of Conditions

Because this evaluation is based primarily on site data and not on non-site specific literature or generic information, the range of conditions over which conclusions are applicable is defined as (and constrained to) those present on site. This has the disadvantage that the findings of this report cannot be generalized beyond the site and its surrounding area. However, it has the powerful advantages that the findings by definition apply to the site, and the uncertainties of application and conclusions are defined by the site data. These findings are also defined by the receptor species selected for evaluation. Although species were selected to represent certain "guilds", some species groups were excluded from risk characterization. These included more aquatic species which are expected to be closely associated with the floodplain ecosystem.

6.2 Uncertainty

Uncertainty in risk estimation has both qualitative and quantitative components. Qualitative uncertainty analyses are recommended by guidance (for example, U.S. EPA 1988b, page 96), and contribute to the confidence with which risk assessment conclusions are drawn and applied (U.S. EPA 1989a, page 57, U.S. EPA 1992a, page 23). Where possible, quantitative uncertainty analyses provide objective measures of the relative confidence in conclusions and applications.

Uncertainty surrounding risk assessment conclusions has important implications for risk management (U.S. EPA 1988a, 1989a). However, "uncertainty" is not a single, generally applicable parameter. The uncertainty surrounding a risk estimate or application has a number of components, including parameter variability, calculation error and simplification, and the underlying reality of the exposure assumptions and pathways (U.S. EPA 1988b). It is important to understand that uncertainty includes both real variation (reflecting actual, behavioral, mechanistic response ranges) and error. Thus, because ecological systems are inherently uncertain, some component of variability in risk estimation is due to realistic reflection of environmental conditions. Another component is due to "error", uncertainty introduced by the analytical process. Assuming risk around some average intensity, the components of uncertainty may be expressed as:

$$\text{Risk} = \begin{matrix}\text{Avg.}\\ \text{Risk}\end{matrix} \pm \begin{matrix}\text{Natural}\\ \text{Variability}\end{matrix} \pm \text{Error}$$

For accurate estimation of site specific risks, the second term on the right must be accounted for as accurately as the data will allow, because this reflects underlying ecological processes. The third term, "error", is the term to be minimized, because this indicates uncertainty introduced in the assessment. In the following discussion of limitations and uncertainty associated with specific components of the analysis, we discuss ways in which this report accommodates actual processes and the degree to which conclusions are affected by error.

6.3 Qualitative Uncertainty Components

This section provides a qualitative, "judgmental" (U.S. EPA 1992a) evaluation of uncertainty, focusing on the implications of uncertainty for the scientific soundness of conclusions. In each case, we identify whether uncertainty is dominated by variability reflecting actual plasticity or by error introduced in the analysis, and whether this error as present is likely to bias conclusions.

6.4 Data Base Limitations

The principal uncertainty associated with the databases is the large number of non-detect values. Use of a value of ½ of the detection limit, although it is a standard technique, may lead to conclusions that are uncertain. Use of data derived from composite samples of plant and animal tissue may not be representative, thereby increasing uncertainty. Methods used to estimate parameter distributions and input values used in the calculation of risk also may contribute to uncertainty. For this reason application of the most conservative assumptions is warranted to allow for uncertainty in the analysis.

Another associated uncertainty is the variable bioavailability and bioaccessibility of contaminants. Quantification of presence of compounds in media within a receptor's exposure area does not necessarily indicate that receptors actually contact these contaminants, but for some species the potential for contact can be high. Assumption that receptors contact all contaminants identified within their exposure area may introduce error to the results.

The Phase II fish tissue samples used in the ecological risk assessment modeling were obtained from upstream reference locations and therefore do not provide an estimate of the current risk to ecological receptors such as the mink and great blue heron whose diet is composed of a significant portion of fish (see Table 3-1, mink 55 percent; heron 85 percent). Fish tissue samples were obtained from the downstream contaminated areas. PCBs bioaccumulate and biomagnify particularly in aquatic systems. A significant limitation is that the potential for PCBs to accumulate in aquatic food chains and in piscivorous birds and mammels was not evaluated in the ecological risk assessment for the entire site. The association of FWA species with Fields Brook aquatic species was excluded from the risk characterization which results in an underestimation of total site risk.

These uncertainty sources contribute to both natural variability and error terms. Of total uncertainty, that contributed by analytical processes contributes most directly to error but is likely relatively small. Real underlying natural variability contribute largely to bioavailability and bioaccessibility uncertainty, and these likely dominate total uncertainty in this risk estimation. It is impossible to quantify these contributions, but it is not expected that these sources of uncertainty bias conclusions toward either over- or under-estimation of risks.

6.5 TRV Limitations

Ecological exposures were deterministically modeled by calculating the dose which a receptor receives from its prey. This report presents the standard dose equation and tabularized appropriate feeding rates, fractional feeding, and body weights of the species. The Wildlife Exposure Factors Handbook (US EPA 1993a) was utilized for much of the information. However, the model itself, the scenario-specific variables, and iterative results are not included herein. Rather, the presentation is limited to an extended discussion of simulative and distributional statistics; data, results, and variables used to conduct the simulation are not presented herein, nor are the final doses used in the HQ calculations presented. A presentations of variables and results would be necessary to evaluate the procedures used to estimate doses, particularly since the dose is half the HQ equation. The other half of the equation, TRV derivation, is explained. Except for the intertaxon uncertainty factor of 5, the calculated TRVs are considered to provide a reasonable estimation of toxic exposure levels.

TRVs were derived from the best available and most applicable current scientific literature. However, the physiology and pharmacology of contaminants particularly in relation to the wildlife taxa identified as receptors is known only with some uncertainty. In particular, use of dose-based reference values eliminates highly uncertain pharmacokinetic issues and provides the best available estimate of toxicity for each compound. Uncertainties that could be reasonably accounted for were included in the TRV uncertainty factor approach, to some degree. For TRVs, conservative choices were made in reducing quantified critical endpoints to compensate for scientific uncertainty. This bias has an unquantifiable but likely large effect on risk estimates, because the TRV represents a full quantitative equivalent of the exposure estimate in the risk calculation. These conservative assumptions are considered justified, however, given the level of uncertainty associated with intertaxon variability and the current level of species-specific toxicity information. Additional uncertainty factors could have been applied which would have resulted in a greater estimate of risk.

The biased uncertainty cannot be quantified, but incorporates both error and natural variation. The latter is likely the largest component of TRV uncertainty, because receptors have highly variable responses to toxicants and extrapolation from laboratory studies to field estimates incorporates a high degree of natural plasticity (Cairns 1991). Current limitations on the ability to estimate a receptor's response to multiple contaminant exposures, which is expected at the Fields Brook site, adds to the uncertainty of the risk estimate and provides additional justification for the use of conservative assumptions.

6.6 Data Limitations: Conclusions

In general, limitations of this analysis will not substantively affect the validity of quantitative or qualitative conclusions. All sources of uncertainty are unbiased except those associated with estimates of contaminant tissue concentration TRV derivation. TRV uncertainty may contribute to overestimation of risks, but this affect cannot be quantified. Of the other limitations, uncertainties resulting from real natural variability likely dominate. On a quantitative basis, the use of site-specific data is clearly preferable to, and more accurate than, other potential approaches relying primarily on non-site specific data or generic values.

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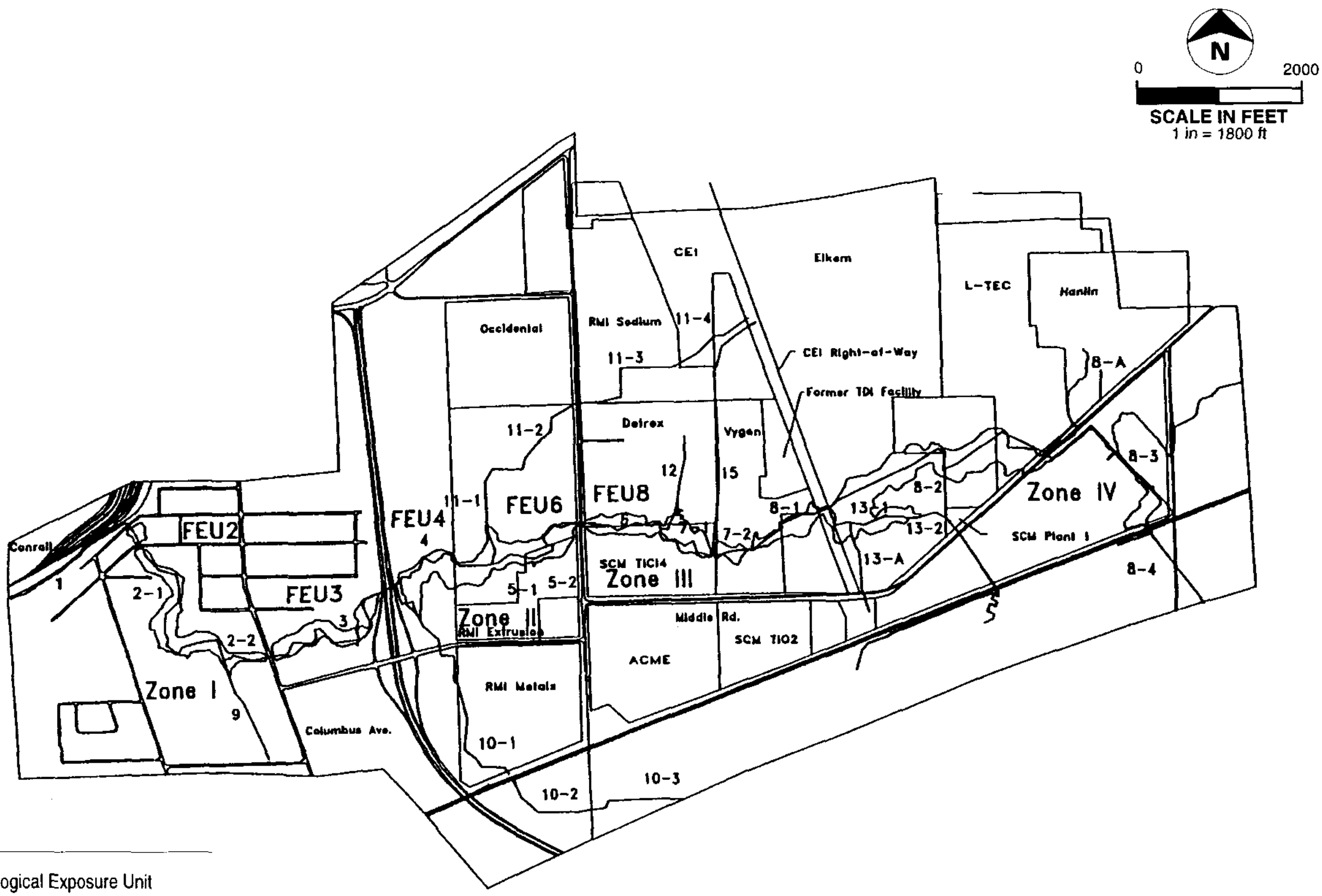
FIGURES



LEGEND

Zone 1 Ecological Exposure Unit

FEU2 Floodplain Exposure Unit Number

1 Reach Number

Source: Woodward-Clyde Consultants

FIGURE ES-1
Ecological and Floodplain Exposure Units
Fields Brook - Ashtabula, Ohio

CH2MHILL

104141.PD.PH Fig ES-1 5-14-96 jam

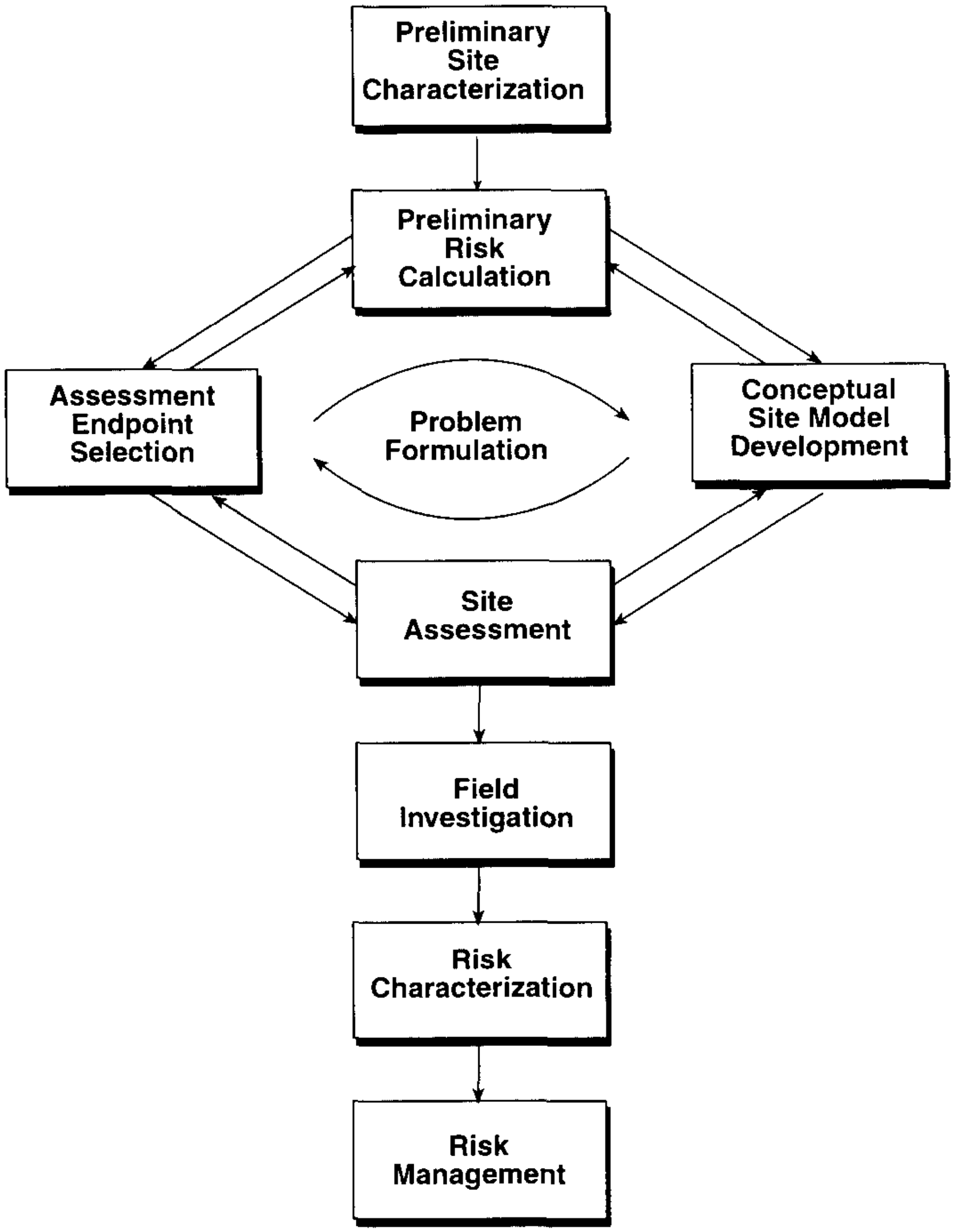
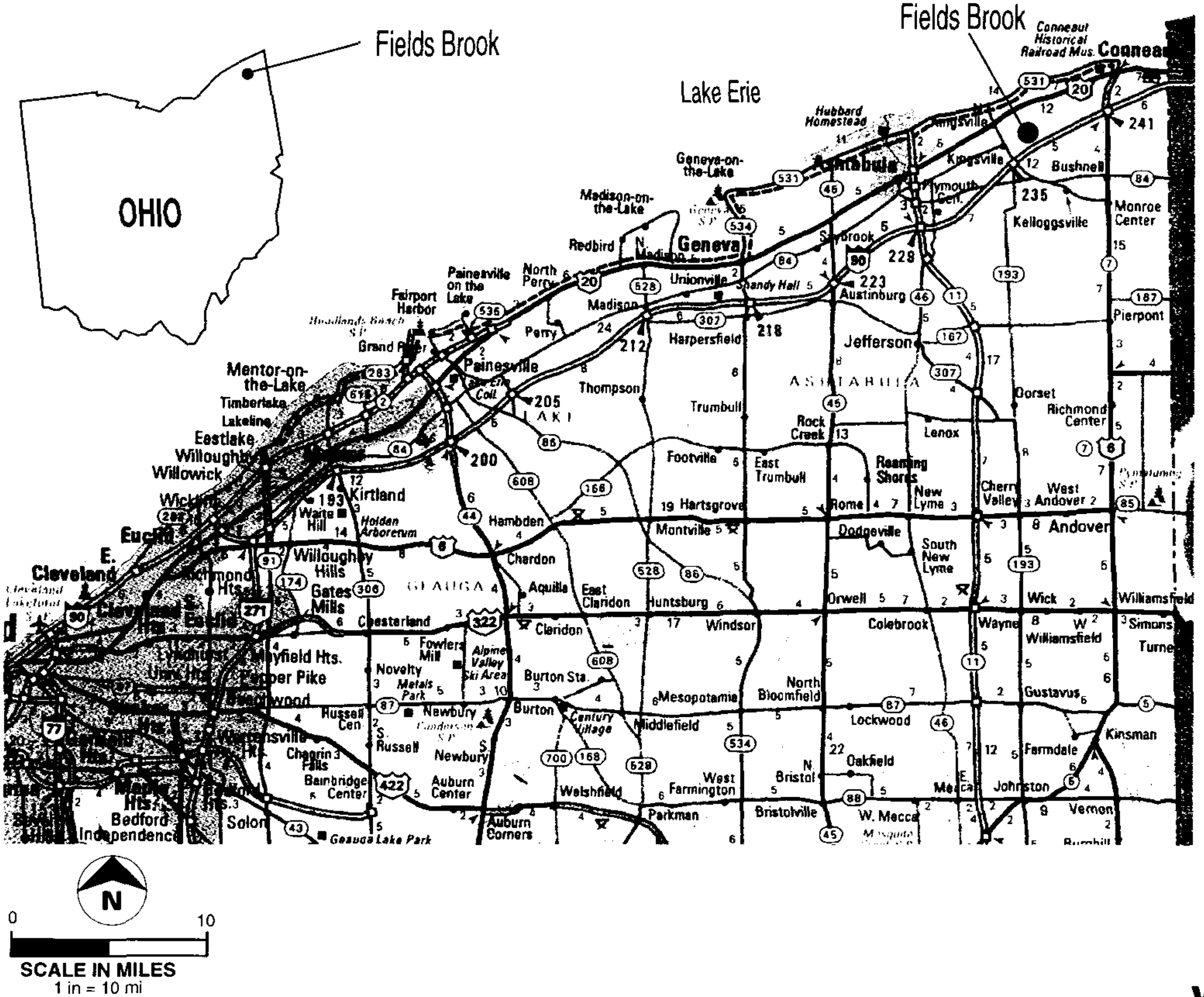


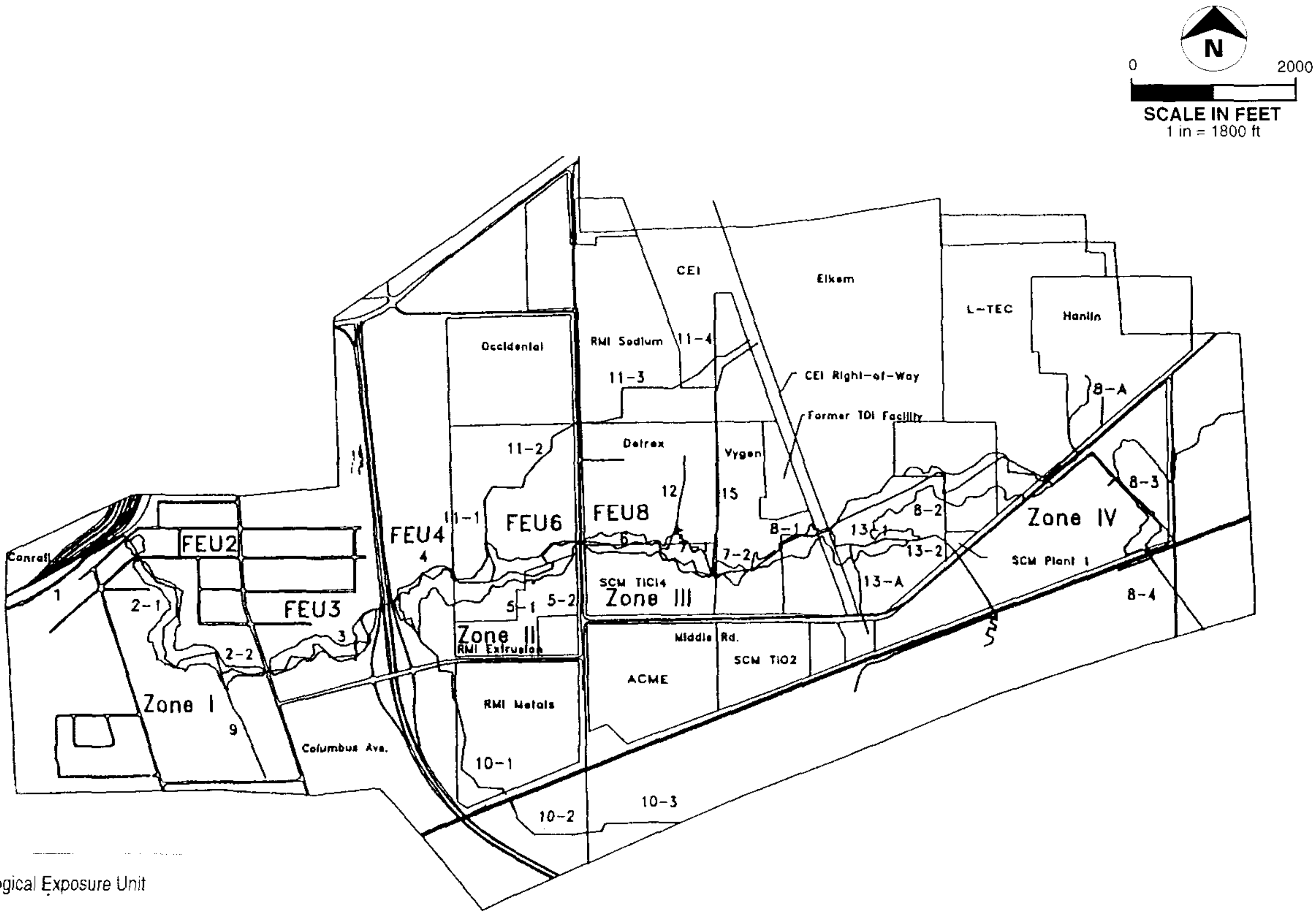
FIGURE 1-1
Draft 1994 USEPA Site Screening Risk Assessment Process
Fields Brook - Ashtabula, Ohio

Source: Woodward-Clyde Consultants



Source: Rand McNally & Company Map and Travel Centers

FIGURE 2-1
Vicinity Map
Fields Brook - Ashtabula, Ohio
CH2MHILL



LEGEND

Zone 1 Ecological Exposure Unit

FEU2 Floodplain Exposure Unit Number

1 Reach Number

Source: Woodward-Clyde Consultants

FIGURE 2-2
Ecological and Floodplain Exposure Units
Fields Brook - Ashtabula, Ohio

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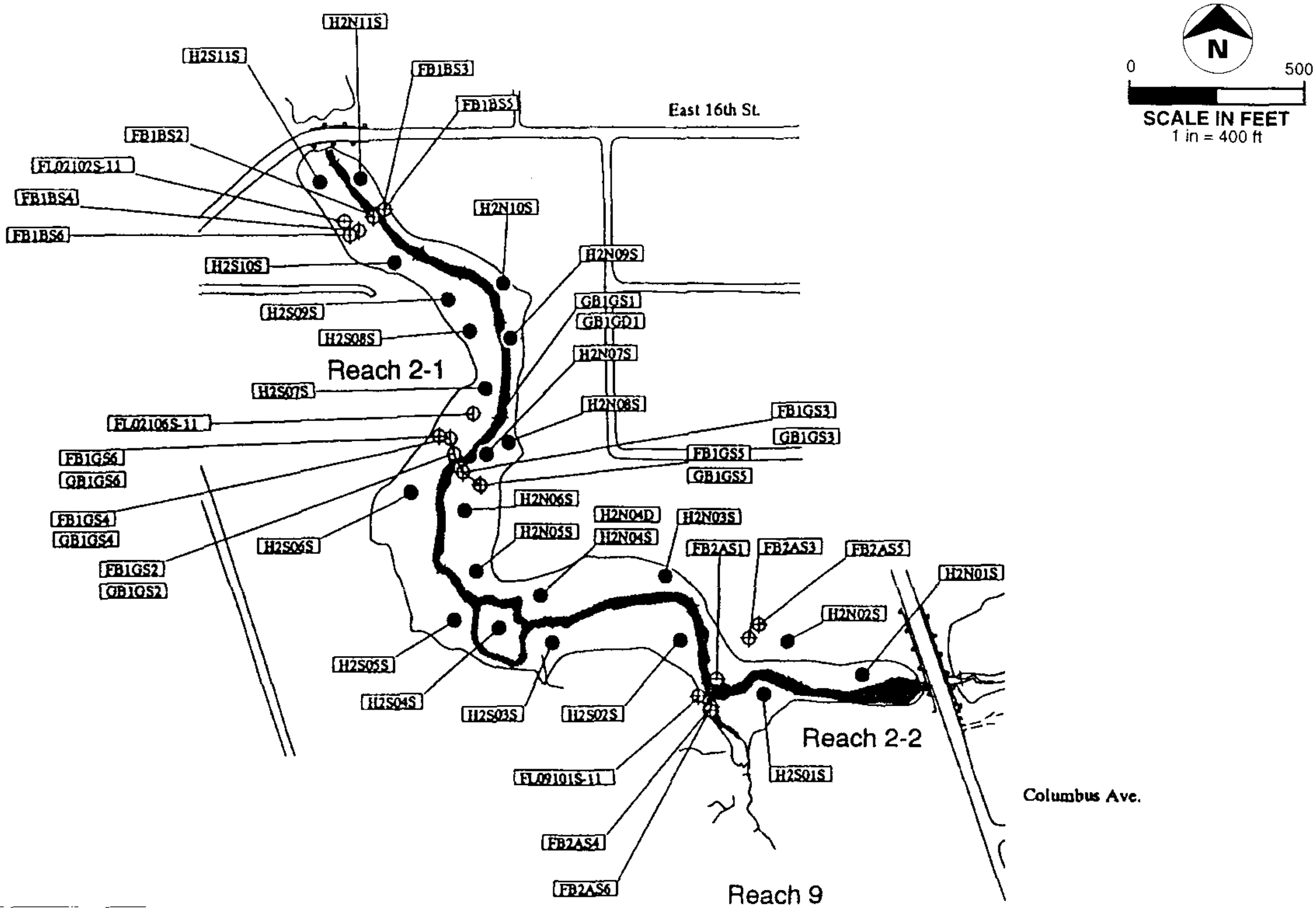

LEGEND

- ⌽ Boring
- ● Sample: Phase III Floodplain Soil

Source: Woodward-Clyde Consultants

FIGURE 2-3
Phase I,II,and III Floodplain Sample Locations Floodplain Exposure Unit 2
Fields Brook - Ashtabula, Ohio

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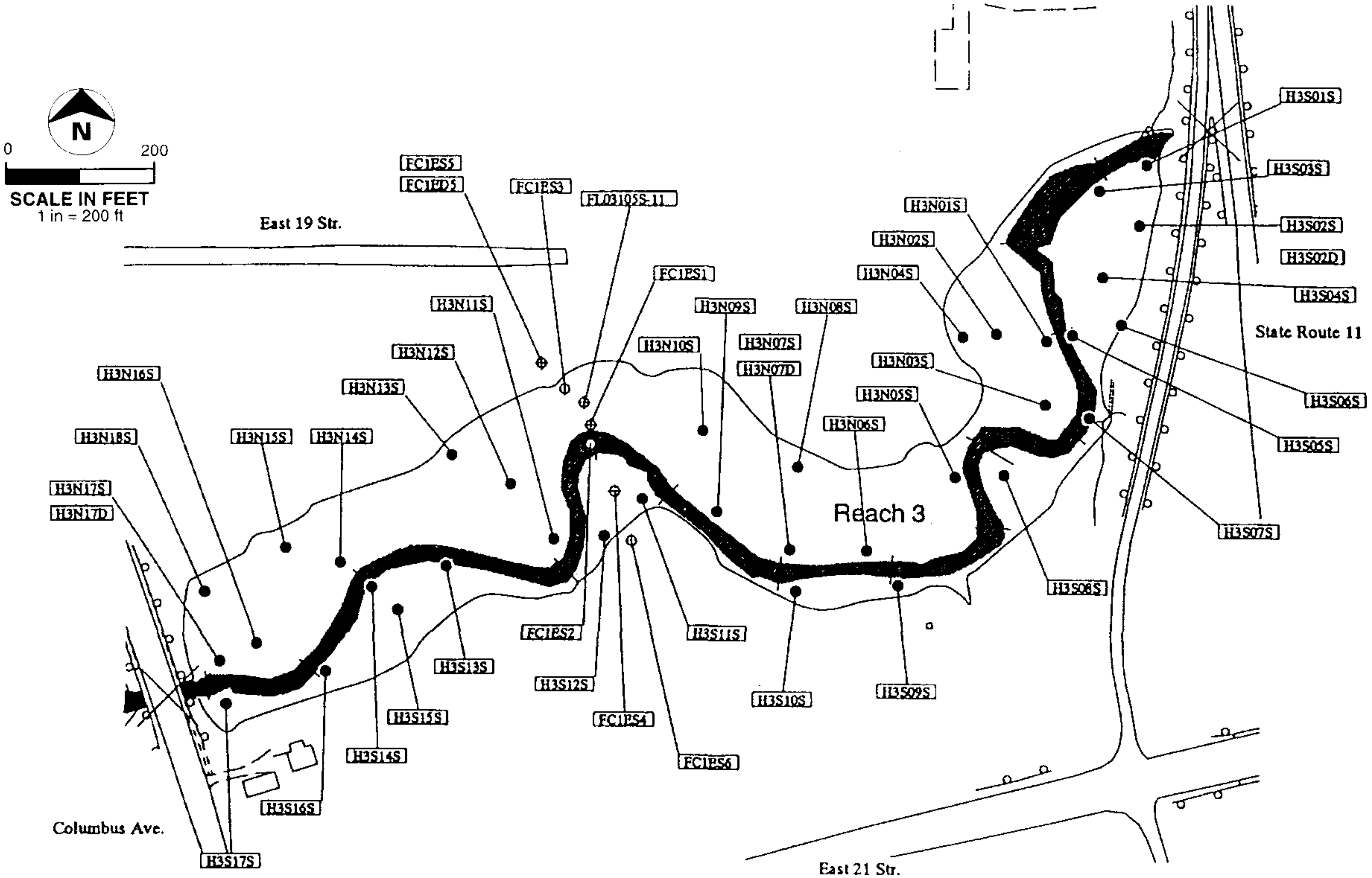
104141 PD PH Fig 2-3 5-14-96 jam



LEGEND

Φ Boring

● Sample: Phase III Floodplain Soil

Source: Woodward-Clyde Consultants

FIGURE 2-4
Phase I,II,and III Floodplain Sample Locations Floodplain Exposure Unit 3
Fields Brook - Ashtabula, Ohio

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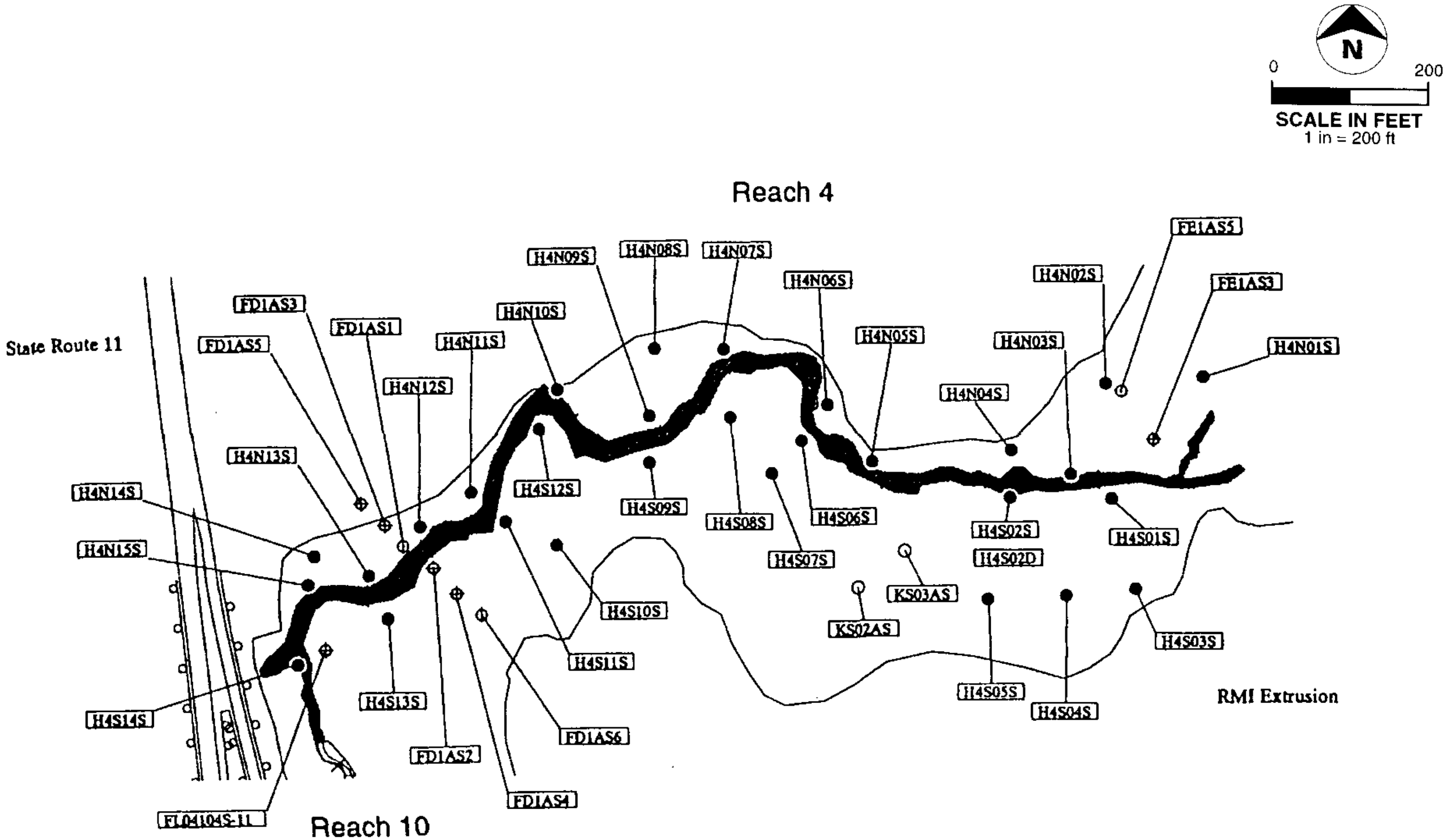

LEGEND

- Φ Boring
- ● Sample: Phase III Floodplain Soil
- ○ Sample: Surface Soil

Source: Woodward-Clyde Consultants

FIGURE 2-5
Phase I,II, III and SCRI Floodplain Sample Locations Floodplain Exposure Unit 4
Fields Brook - Ashtabula, Ohio

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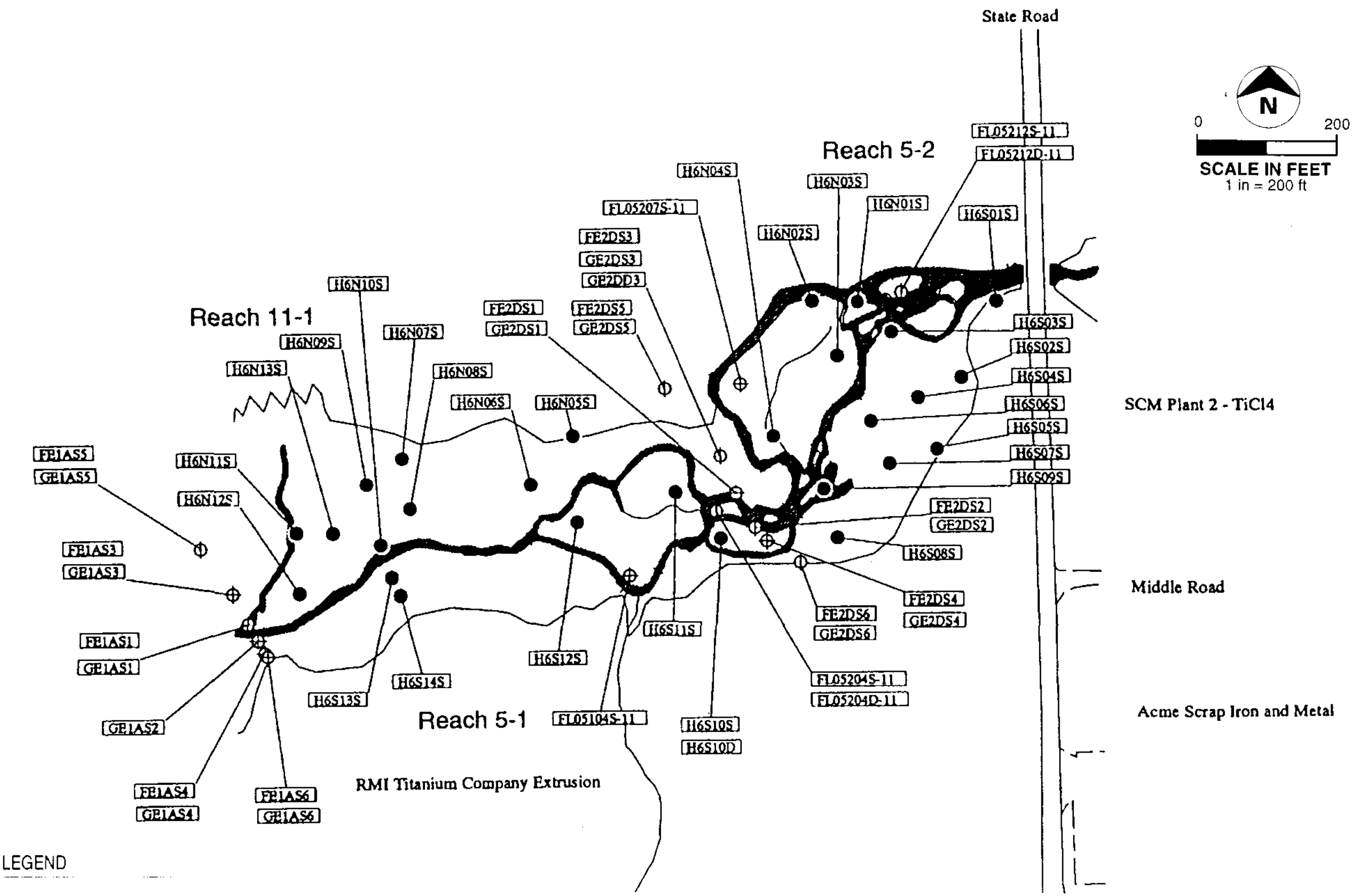

LEGEND

- Φ Boring
- ● Sample: Phase III Floodplain Soil

Source: Woodward-Clyde Consultants

FIGURE 2-6
Phase I,II, and III
Floodplain Sample Locations
Floodplain Exposure Unit 6
Fields Brook - Ashtabula, Ohio

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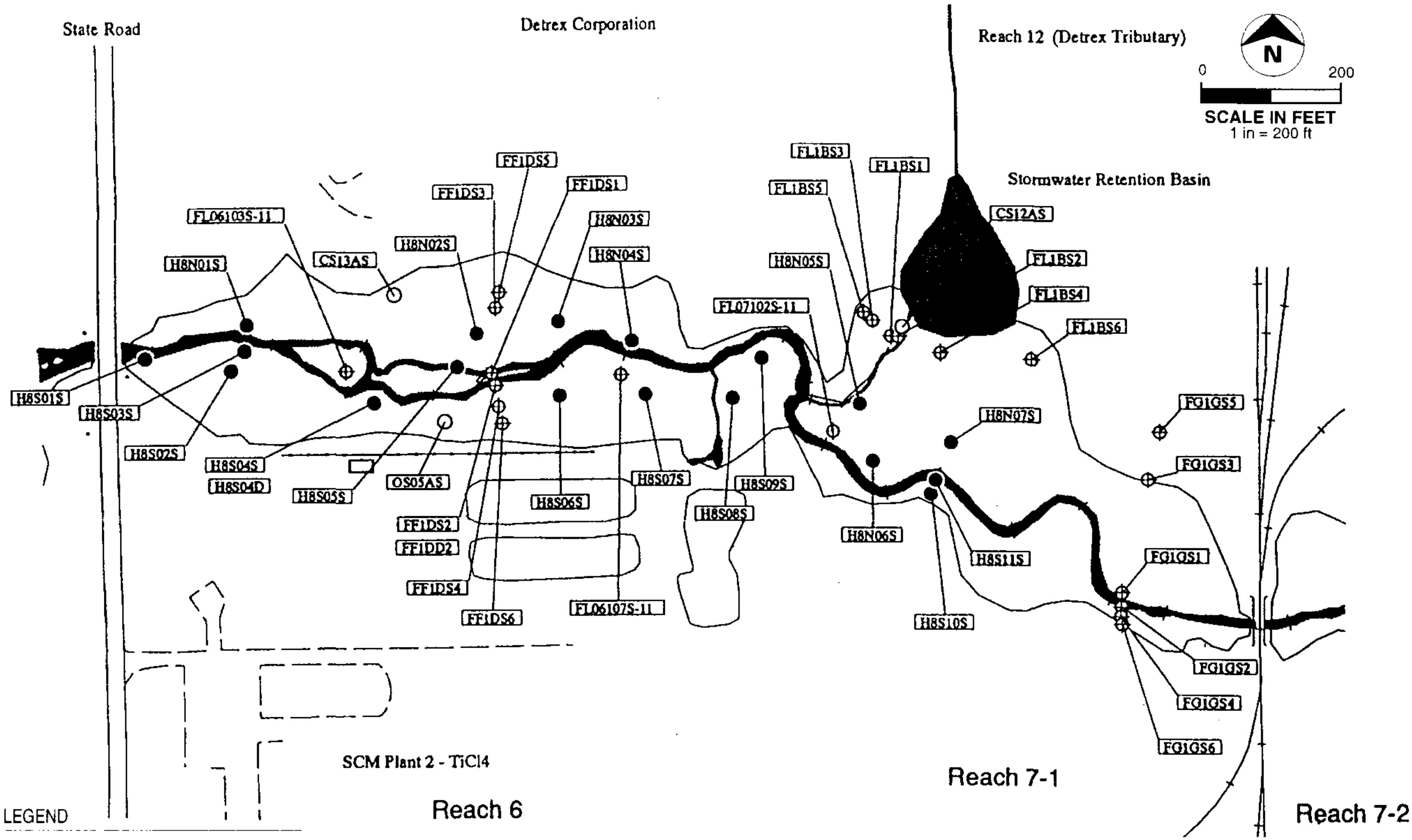

LEGEND

- Φ Boring
- ● Sample: Phase III Floodplain Soil
- ○ Sample: Surface Soil

Source: Woodward-Clyde Consultants

104141 PD PH Fig 2-7 5-14-96 jam

FIGURE 2-7
Phase I,II, III and SCRI Floodplain Sample Locations Floodplain Exposure Unit 8F
Fields Brook, - Ashtabula, Ohio

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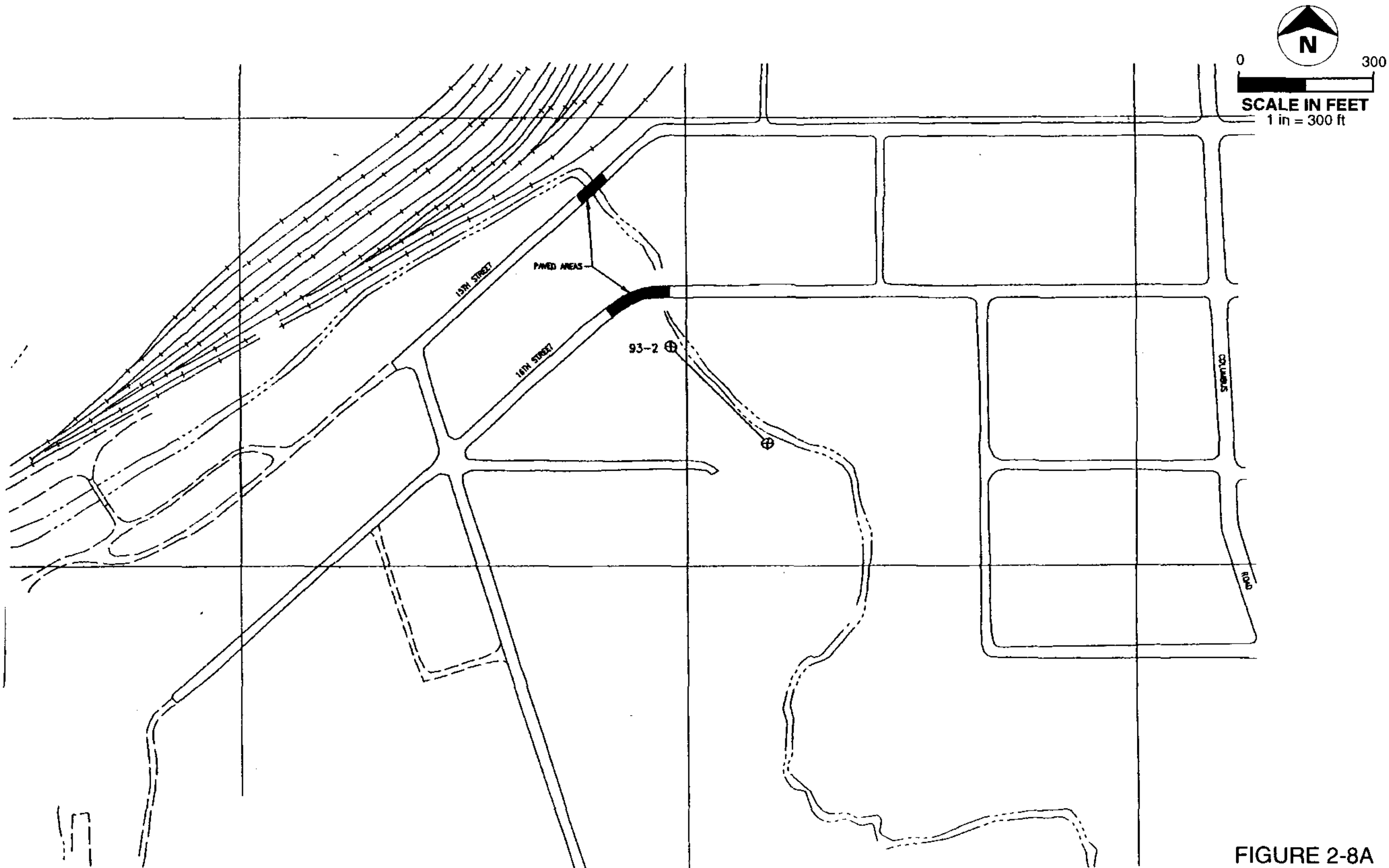

FIGURE 2-8A
Trap Line Map of the Lower Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

104141.PD.PH Fig 2-8A 5-14-96 jam

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FIGURE 2-8B
Trap Line Map of the Lower-Middle Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

CH2MHILL

104141.PD.PH Fig 2-8B 5-14-96 jam

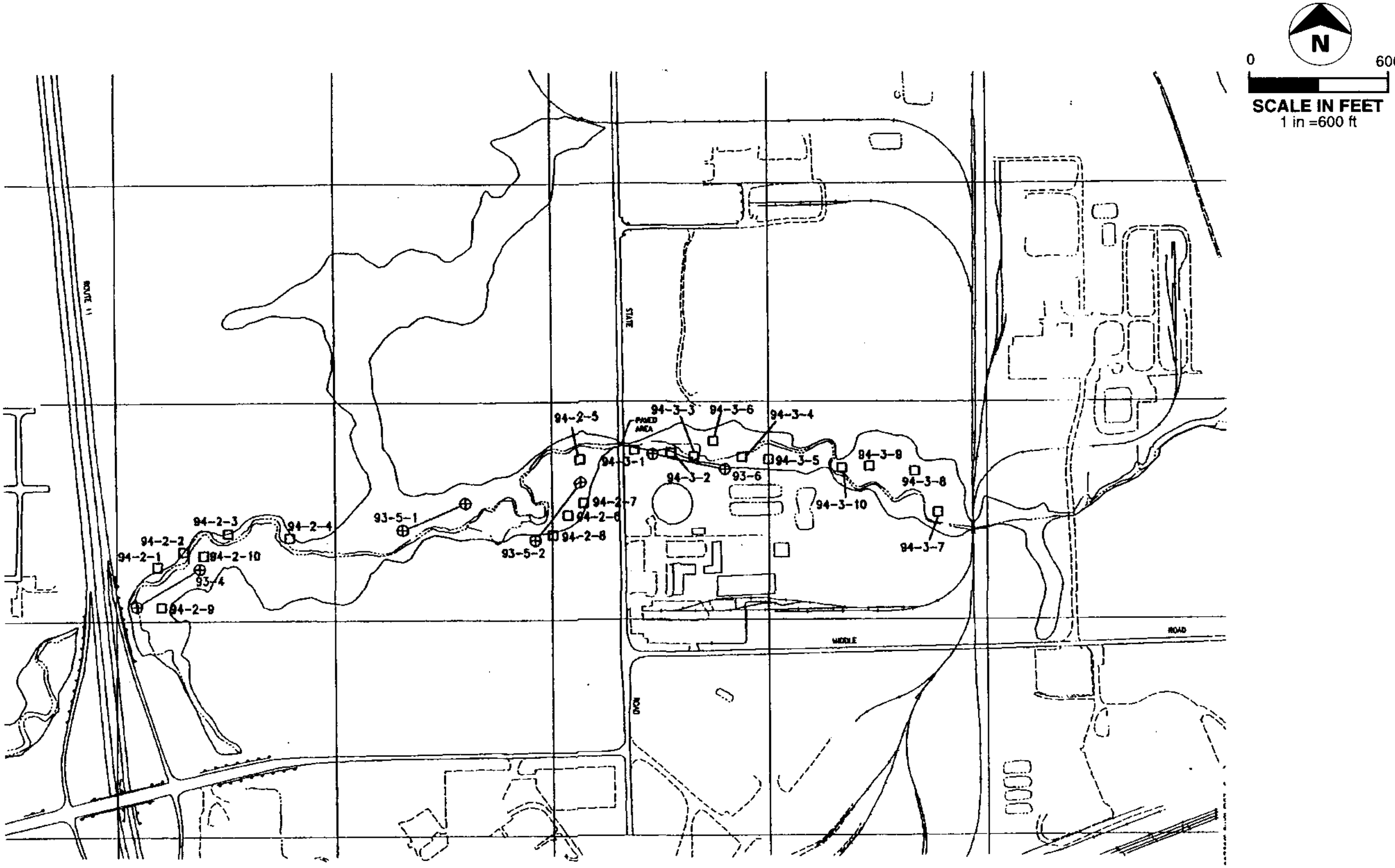


FIGURE 2-8C
Trap Line Map of the Middle-Upper Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

CH2MHILL

104141.PD.PH Fig 2-8C 5-14-96 jam

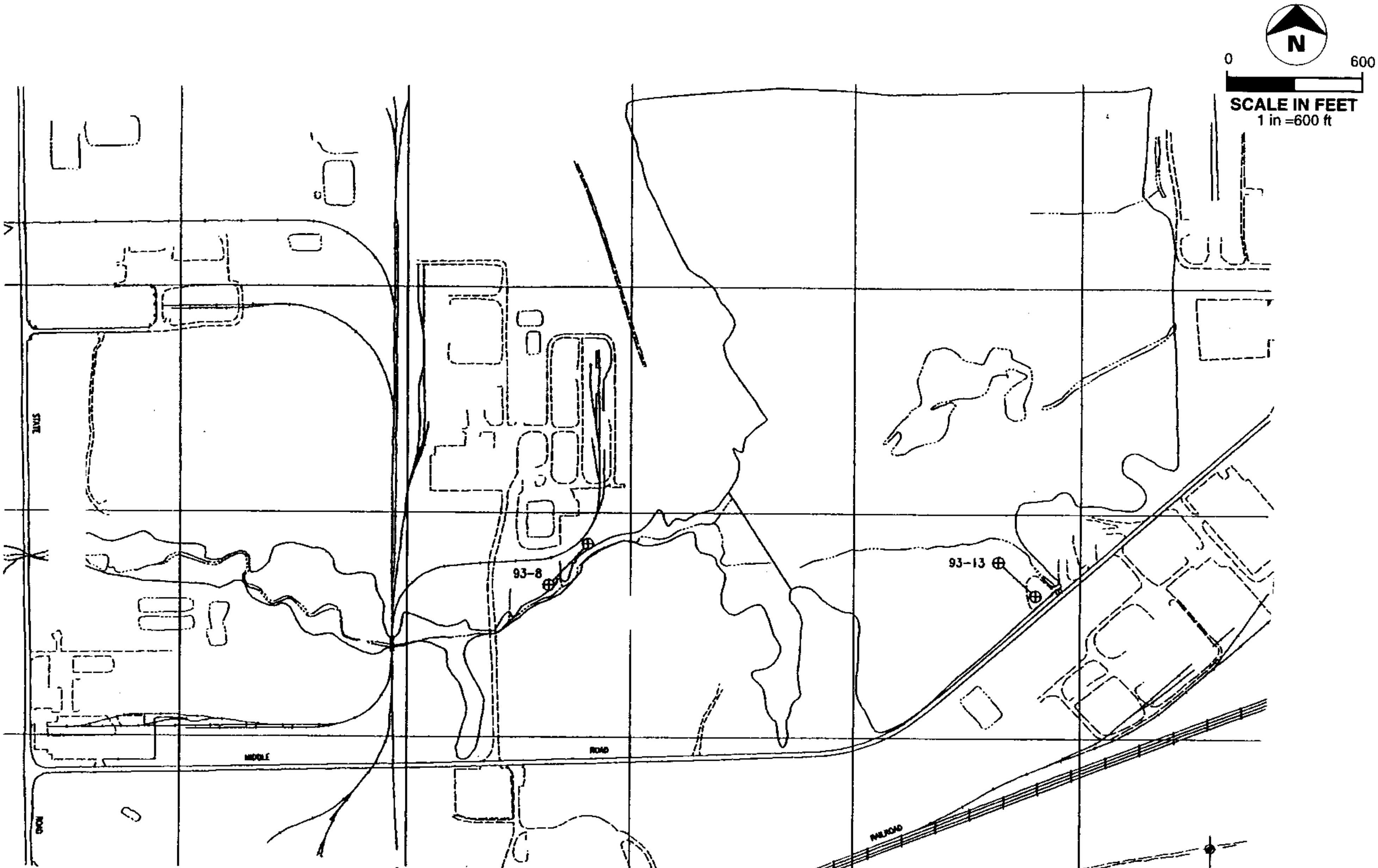


FIGURE 2-8D
Trap Line Map of the Upper Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

CH2MHILL

Source: Engineering, Science, and Technology, Inc.

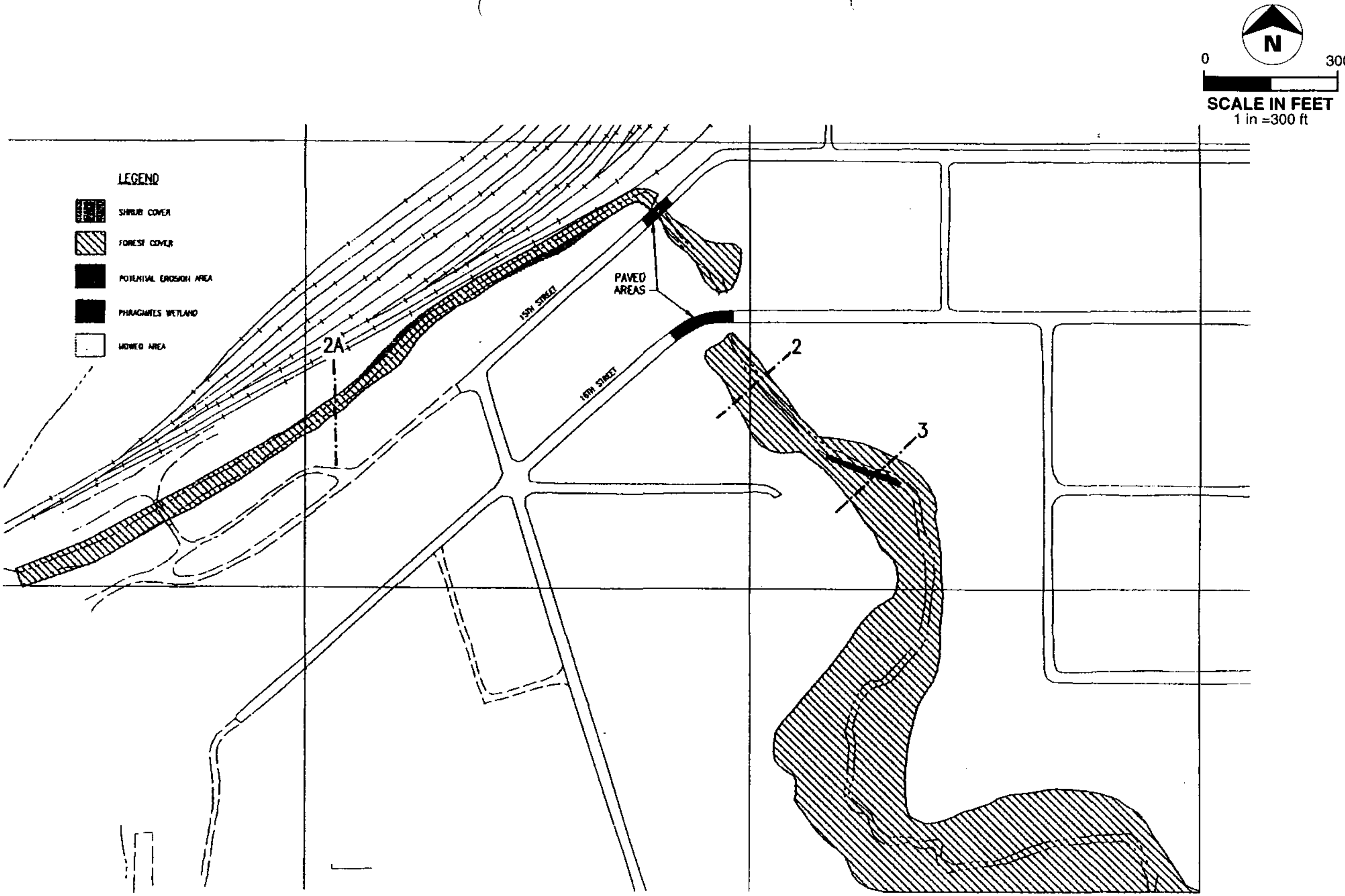


FIGURE 2-9A
Habitat Quality Map of the Lower Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

CH2MHILL

104141.PD.PH Fig 2-9A 5-14-96 jam

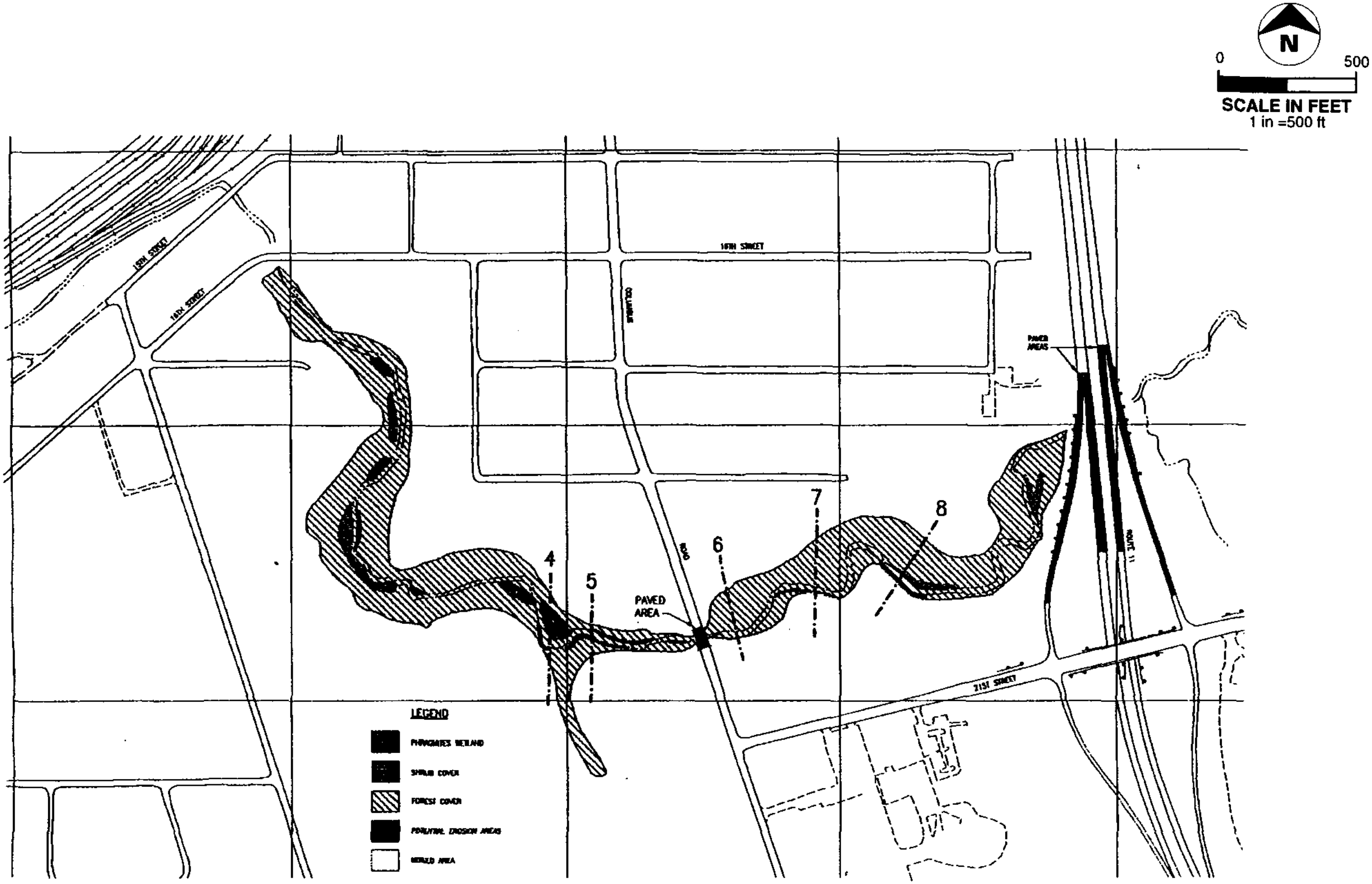


FIGURE 2-9B
Habitat Quality Map of the Lower-Middle Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

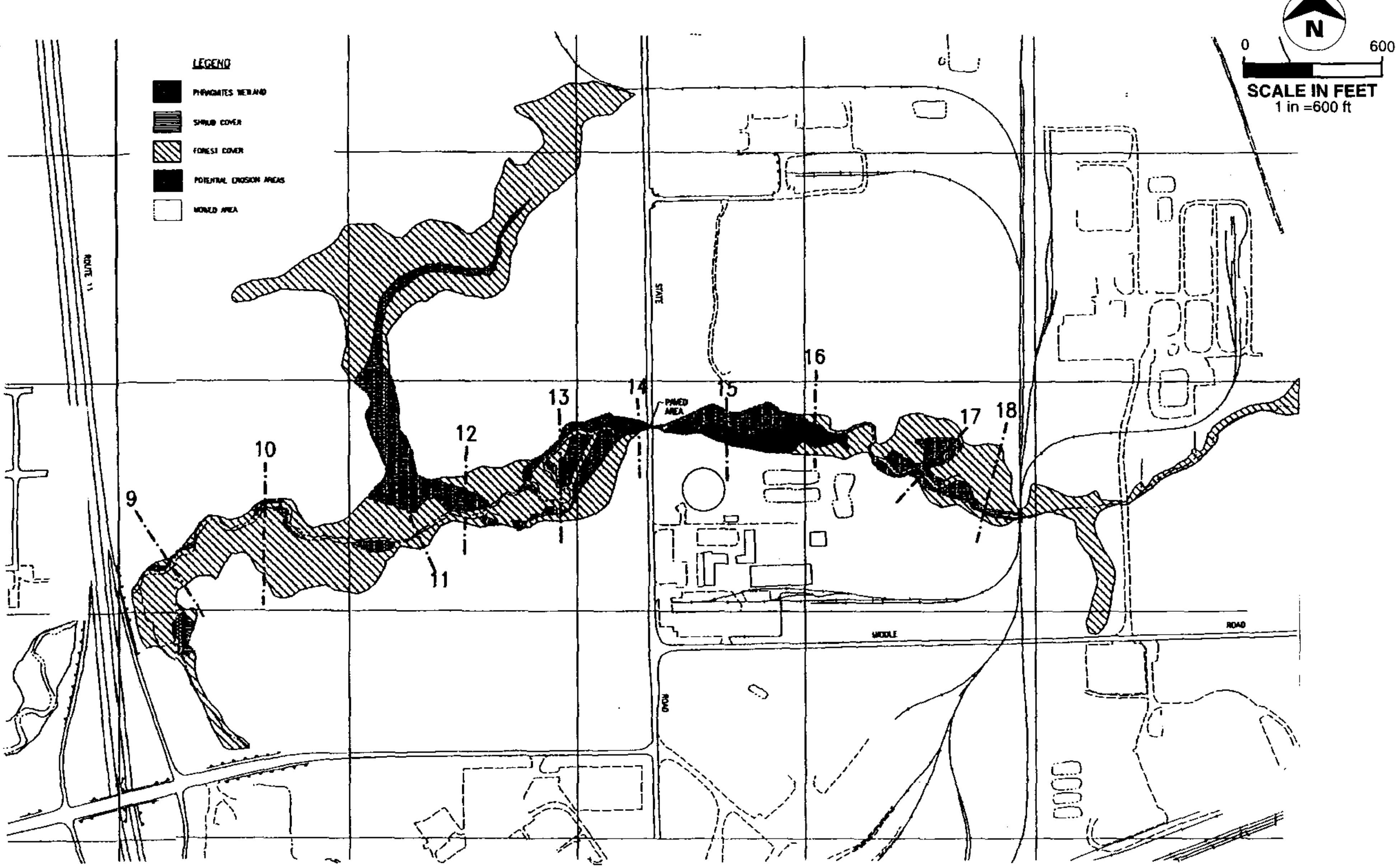


FIGURE 2-9C
Habitat Quality Map of the Middle-Upper Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio
CH2MHILL

Source: Engineering, Science, and Technology, Inc.

104141.PD.PH Fig 2-9C 5-14-96 jam

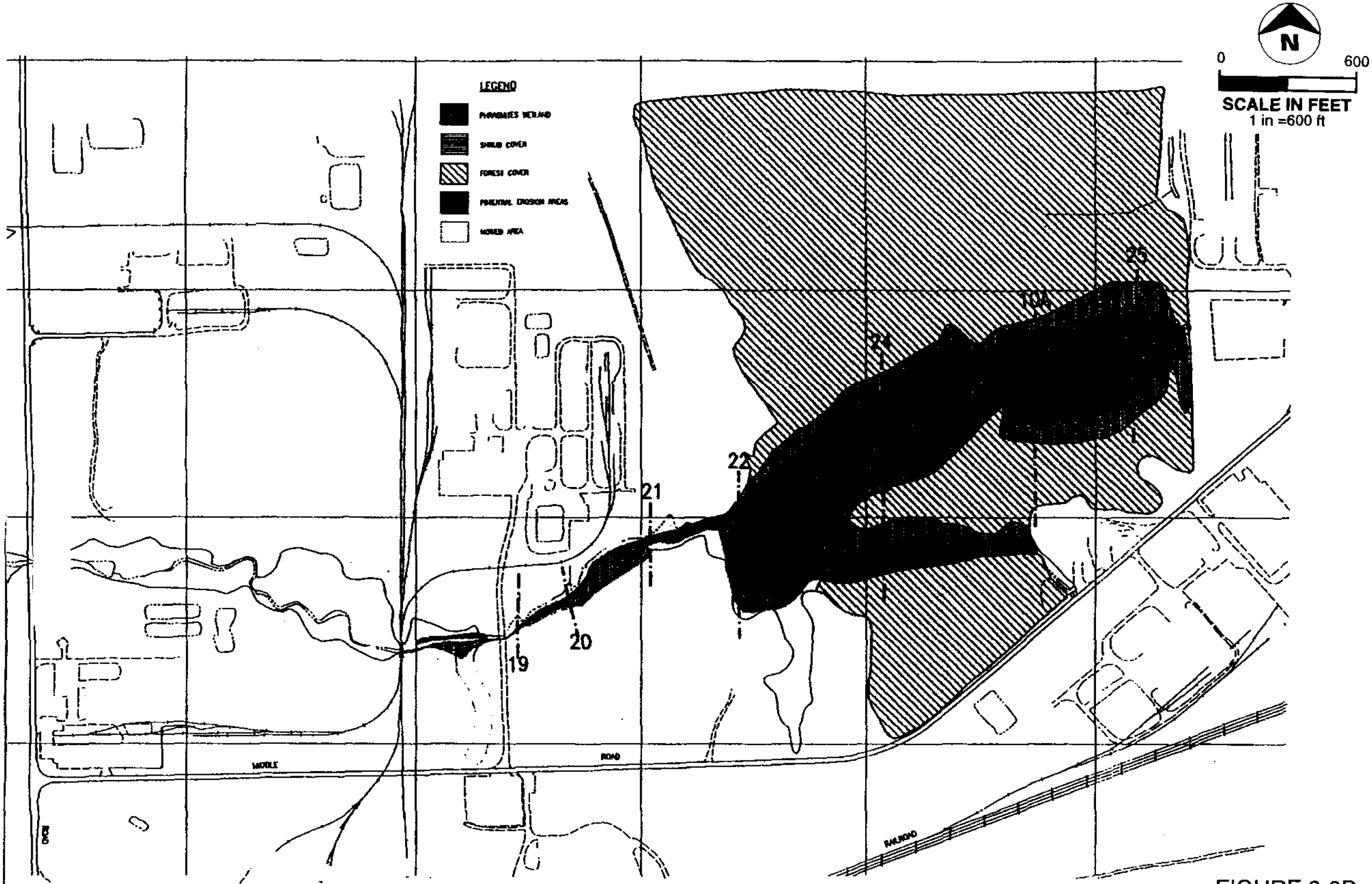
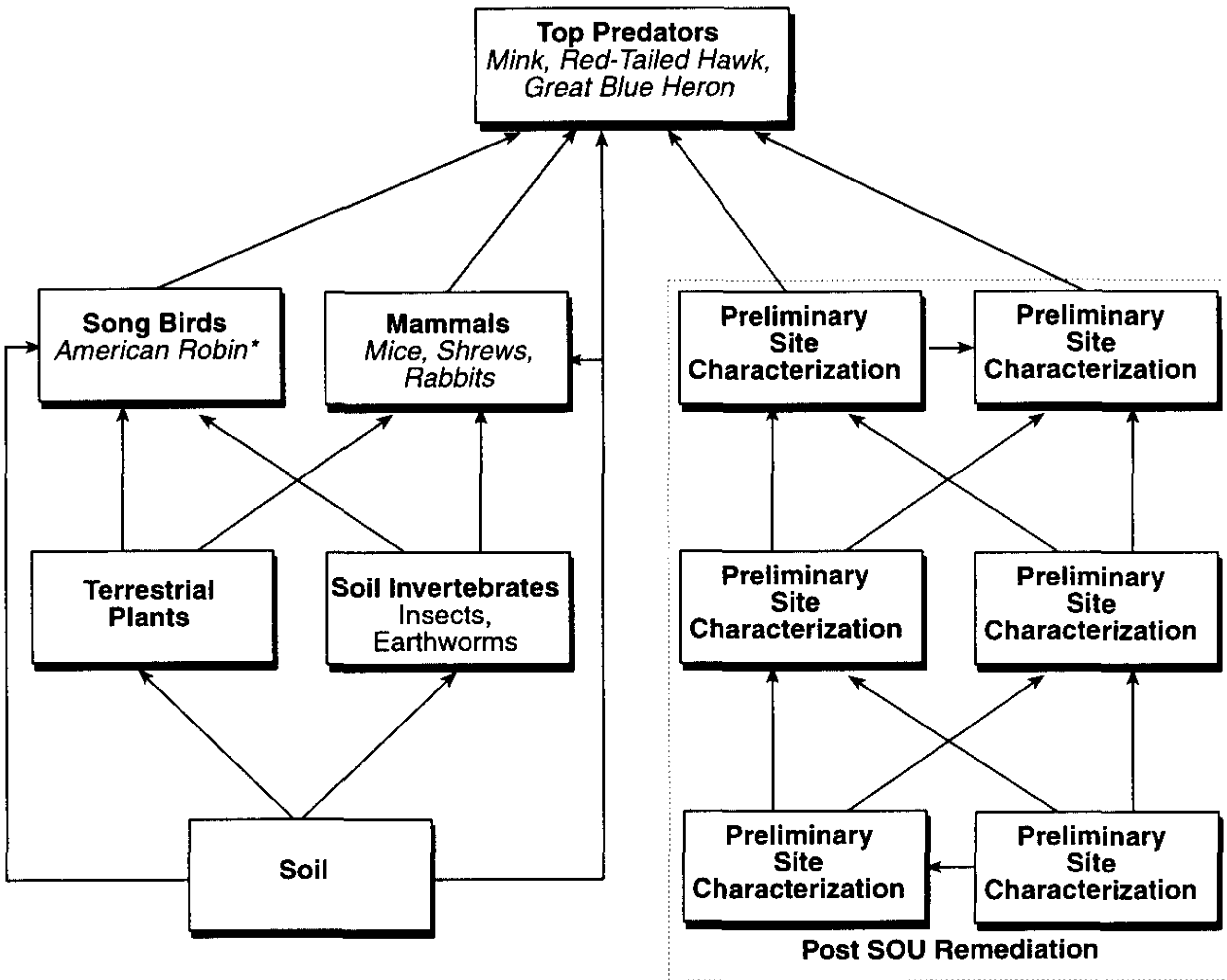


FIGURE 2-9D
Habitat Quality Map of the Upper Reaches of Fields Brook
Fields Brook - Ashtabula, Ohio

Source: Engineering, Science, and Technology, Inc.

CH2MHILL

104141.PD.PH Fig 2-9D 5-14-96 jam



Italics indicate ROC
Source: Woodward-Clyde Consultants

FIGURE 2-10
Conceptual Ecological Food-Web Model
Fields Brook - Ashtabula, Ohio
CH2MHILL

104141.PD.PH Fig 2-10 5-14-96 jam

TABLES

Table ES-1
Fields Brook FWA
Contaminants of Concern for the Fields Brook FWA Risk Assessment.

Chemical	Human Health	Ecological
Arsenic	X	X
Barium		X
Benzo(a)pyrene	X	
Beryllium	X	
Cadmium		X
Chromium		X
Hexachlorobenzene	X	X
Hexachlorobutadiene	X	X
Hexachloroethane	X	
Lead		X
Mercury		X
Polychlorinated Biphenyls	X	X
1,1,2,2-Tetrachloroethane	X	
Tetrachloroethene	X	
Trichloroethene	X	
Vanadium		X
Vinyl Chloride	X	

Table ES-2
Fields Brook FWA
Contaminant Concentrations (Phase I, II, and III Surface Soil Data) for COCs Evaluated in the Human Health Risk Assessment (mg/kg) *

Chemical	Residential		Occupational		
	FEU2	FEU3	FEU4	FEU6	FEU8
Arsenic	15	13	13	13	15
	19	16	16	15	19
	0.64	0.61	0.44	0.58	0.67
Benzo(a)pyrene	0.21	0.32	0.93	0.94	0.44
	0.33	0.32	1.1	1.2	0.56
	0.85	0.54	0.67	0.73	0.76
Beryllium	0.67	0.64	0.99	1.1	1.3
	1.4	0.95	1.1	2.1	2.2
	0.67	0.78	0.56	0.83	0.76
Hexachlorobenzene	14	6.4	29	33	30
	303	14	565	220	132
	0.85	0.59	0.81	0.98	0.83
Hexachlorobutadiene	0.81	2.8	9.2	11	1.2
	1.4	1.9	25	46	1.9
	0.67	0.34	0.75	0.80	0.52
Hexachloroethane	0.25	0.43	0.95	1.2	0.48
	0.29	0.40	1.02	1.8	0.69
	0.21	0.10	0.19	0.38	0.31
Polychlorinated Biphenyls	24	29	63	76	34
(Total)	284	473	2188	1633	238
	0.97	0.76	0.94	0.85	0.79
1,1,2,2-Tetrachloroethane	0.025	0.013	0.67	0.48	0.66
	0.019	0.013	1.5	2.1	0.67
	0.33	0.24	0.53	0.58	0.40
Tetrachloroethene	0.077	0.052	1.5	7.0	0.49
	0.053	0.092	7.9	648	0.46
	0.62	0.68	0.72	0.85	0.55
Trichloroethene	0.19	0.028	0.46	4.4	0.78
	0.068	0.043	1.6	172	1.6
	0.46	0.49	0.72	0.78	0.62
Vinyl Chloride	0.032	ND	ND	0.35	ND
	0.015	ND	ND	0.45	ND
	0.03	ND	ND	0.05	ND

Notes:

* = *First entry is the arithmetic mean, second is the 95% UCLM, third is the detection frequency. All data reported to two significant figures.*

ND = *Indicates chemical not detected in this EU. All contaminant concentrations were assumed to be lognormally distributed in each EU. The arithmetic mean may be larger than the 95%UCLM (calculated based on a lognormal distribution) if the data are not truly lognormal.*

Table ES-2
Fields Brook FWA
Contaminant Concentrations (Phase I, II, and III Surface Soil Data) for
COCs Evaluated in the Ecological Risk Assessment (mg/kg). *

Chemical	ZONE I FEU2/FEU3	ZONE II FEU4/FEU6	ZONE III FEU8/OTHER	ZONE IV OTHER
Aroclor 1248	27	69	26	0.037
	300	1100	590	0.048
	0.84	0.88	0.71	0.06
Aroclor 1254	2.1	5.6	5.0	0.037
	6.0	27	16	0.049
	0.05	0.05	0.16	0.12
Aroclor 1260	2.1	5.6	5.2	ND
	6.5	31	27	ND
	0.01	1	0.10	ND
Arsenic	14	13	16	9.9
	16	15	19	12
	0.63	0.51	0.71	1
Barium	2500	2200	280	270
	5300	4300	350	380
	1	1	1	1
Cadmium	2.7	3.9	1.6	ND
	4.2	6.5	2.1	ND
	0.49	0.72	0.51	ND
Chromium	81	140	230	29
	96	170	380	37
	1	1	1	1
Hexachlorobenzene	10	31	26	ND
	46	190	82	ND
	0.72	0.89	0.76	ND
Hexachlorobutadiene	1.8	10	1.08	ND
	1.3	22	1.4	ND
	0.51	0.78	0.45	ND
Lead	55	58	57	32
	60	65	66	38
	1	1	1	1
Mercury	2.09	4.05	11	4.3
	5.08	11	94	11
	0.99	0.97	0.98	1

Table ES-2 (Continued)
Fields Brook FWA
Contaminant Concentrations (Phase I, II, and III Surface Soil Data) for COCs Evaluated in the Ecological Risk Assessment (mg/kg). *

Chemical	ZONE I FEU2/FEU3	ZONE II FEU4/FEU6	ZONE III FEU8/OTHER	ZONE IV OTHER
Vanadium	120	220	380	77
	140	290	630	120
	1	1	1	1

Notes:

*	=	*First entry is the arithmetic mean, second is the 95% UCLM, third is the detection frequency.*
OTHER	=	*Indicates that portions of Fields Brook FWA other than the human health EUs were considered in the ecological risk assessment.*
ND	=	*Indicates chemical not detected in this EU.*

All data reported to two significant figures.

All contaminant concentrations were assumed to be lognormally distributed in each EU. The arithmetic mean may be larger than the 95%UCLM (calculated based on a lognormal distribution) if the data are not truly lognormal.

Table ES-3
Fields Brook FWA
Abbreviated Summary of Flora and Fauna Observations in the FWA
Fields Brook FWA, Ashtabula, Ohio

Category	Common Names of Major Taxa Observed
Terrestrial Fauna	Beaver, Geese, Starling, Sparrow, Crow, Bluejay, Robin, Woodcock Mouse, Shrew, Vole, Squirrel, Muskrat, Oppossum, Raccoon, Deer Rabbit, Snake, Toad
Aquatic Fauna	Snake, Frog, Largemouth Bass, Creek Chub, White Sucker, Crayfish Turtles, Tadpoles.
Terrestrial Flora	Maple, Elder, Birch, Walnut, Spurce, Sycamore, Apple, Cottonwood Cherry, Ash, Oak, Multiflora Rose, Honeysuckle, Dogwood, Locust Willow, Elm, Blackberry, Raspberry, Ferns, Loosetrife, Golden Rod Poison Ivy, Grasses, Viburnum.
Aquatic Flora	Maiden-hair Algae, Arrowhead, Curly Leaf Pondweed, Cattail, Wate Plaintain, Reeds.
Soil Fauna	Arachnids, Insects, Nematodes, Oligochaetes, Gastropods, Earthworms

Table 2-1
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 2

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
1,1,2,2-Tetrachloroethane	13	39	33.33	0.58	0.025	0.092	0.019
1,1,2-Trichloroethane	2	39	5.13	0.0060	0.031	0.15	0.015
1,2,4-Trichlorobenzene	14	39	35.90	1.1	0.31	0.26	0.42
1,2-Dichlorobenzene	5	39	12.82	0.38	0.24	0.075	0.28
1,2-Dichloroethene (total)	9	39	23.08	0.21	0.014	0.034	0.014
1,3-Dichlorobenzene	12	39	30.77	3.2	0.32	0.50	0.48
1,4-Dichlorobenzene	9	39	23.08	0.36	0.25	0.16	0.34
2-Butanone	21	39	53.85	0.054	0.034	0.15	0.020
2-Hexanone	1	39	2.56	0.0020	0.032	0.15	0.015
2-Methylnaphthalene	29	39	74.36	1.2	0.16	0.21	0.29
2-Methylphenol	1	39	2.56	0.026	0.27	0.15	0.32
4,4'-DDT	7	39	17.95	0.12	0.11	0.37	0.25
Acenaphthene	6	39	15.38	0.070	0.25	0.17	0.46
Acenaphthylene	13	39	33.33	0.13	0.21	0.19	0.59
Acetone	23	39	58.97	8.1	0.24	1.3	0.097
Anthracene	21	39	53.85	0.15	0.17	0.20	0.35
Aroclor-1248	36	39	92.31	360	24	60	565
Aroclor-1254	3	39	7.69	0.22	2.03	3.8	12
Aroclor-1260	1	39	2.56	0.21	2.03	3.8	15
Benzo(a)anthracene	31	39	79.49	0.82	0.22	0.16	0.30
Benzo(a)pyrene	33	39	84.62	0.60	0.21	0.13	0.33
Benzo(b)fluoranthene	38	39	97.44	1.7	0.47	0.36	0.88
Benzo(g,h,i)perylene	17	39	43.59	0.64	0.20	0.11	0.28
Benzo(k)fluoranthene	2	39	5.13	0.67	0.29	0.16	0.31
Butylbenzylphthalate	13	39	33.33	0.14	0.21	0.19	0.47
Carbazole	7	37	18.92	0.12	0.24	0.17	0.42
Carbon Disulfide	1	39	2.56	0.010	0.032	0.15	0.015
Chlorobenzene	5	39	12.82	0.023	0.032	0.15	0.019
Chloroform	2	39	5.13	1.7	0.051	0.27	0.018
Chrysene	37	39	94.87	0.61	0.21	0.15	0.33
Di-n-butylphthalate	14	39	35.90	0.19	0.21	0.19	0.37
Di-n-octylphthalate	1	39	2.56	0.0060	0.27	0.15	0.38
Dibenz(a,h)anthracene	2	39	5.13	0.18	0.25	0.055	0.28
Dibenzofuran	13	39	33.33	0.46	0.20	0.12	0.49
Dieldrin	8	38	21.05	0.067	0.12	0.38	0.28
Diethylphthalate	6	39	15.38	0.024	0.24	0.17	0.63
Dimethylphthalate	5	39	12.82	0.090	0.25	0.16	0.36
Endosulfan I	10	39	25.64	0.038	0.06	0.19	0.15
Endosulfan II	1	39	2.56	0.10	0.11	0.37	0.22
Endosulfan sulfate	5	39	12.82	0.043	0.11	0.37	0.21
Endrin	4	39	10.26	0.065	0.11	0.37	0.25
Endrin ketone	6	39	15.38	0.027	0.11	0.37	0.20

Table 2-1
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 2

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Ethyl Benzene	5	39	12.82	0.0030	0.031	0.15	0.017
Fluoranthene	38	39	97.44	1.2	0.32	0.25	0.50
Fluorene	7	39	17.95	0.076	0.24	0.17	0.43
Heptachlor	3	39	7.69	1.5	0.16	0.33	1.7
Heptachlor epoxide	7	39	17.95	0.015	0.14	0.65	0.19
Hexachlorobenzene	33	39	84.62	97	14	22	303
Hexachlorobutadiene	26	39	66.67	6.30	0.81	1.2	1.4
Hexachloroethane	8	39	20.51	0.30	0.25	0.16	0.29
Indeno(1,2,3-c,d)pyrene	24	39	61.54	0.76	0.20	0.14	0.30
Methoxychlor	3	39	7.69	0.079	0.57	1.9	0.98
Methylene Chloride	21	38	55.26	7.1	0.20	1.1	0.044
Naphthalene	27	39	69.23	0.74	0.14	0.15	0.28
Phenanthrene	37	39	94.87	1.1	0.25	0.24	0.42
Phenol	1	39	2.56	0.051	0.28	0.15	0.31
Pyrene	38	39	97.44	1.1	0.30	0.26	0.48
Styrene	11	39	28.21	0.062	0.0070	0.010	0.012
Tetrachloroethene	24	39	61.54	2.5	0.077	0.40	0.053
Toluene	32	39	82.05	0.28	0.027	0.051	0.088
Total PCBs	38	39	97.44	360	24	60	284
Trichloroethene	18	39	46.15	6.8	0.19	1.1	0.068
Vinyl Chloride	1	39	2.56	0.0050	0.032	0.15	0.015
Xylenes (total)	22	39	56.41	0.62	0.021	0.10	0.015
alpha-BHC	3	39	7.69	0.061	0.060	0.19	0.14
alpha-Chlordane	3	39	7.69	0.0059	0.057	0.19	0.097
beta-BHC	19	39	48.72	4.4	0.27	0.95	0.53
bis(2-Ethylhexyl)phthalate	37	39	94.87	16	1.5	2.7	4.0
delta-BHC	13	39	33.33	2.8	0.13	0.45	0.53
gamma-BHC (Lindane)	14	39	35.90	0.47	0.090	0.20	0.56
gamma-Chlordane	12	39	30.77	0.15	0.13	0.55	0.42
Aluminum	39	39	100	23800	14562	3965	15928
Antimony	1	39	2.56	1.2	5.4	1.6	6.7
Arsenic	25	39	64.10	40	15	10	19
Barium	39	39	100	16500	3877	5179	19215
Beryllium	26	39	66.67	1.8	0.67	0.47	1.4
Cadmium	28	39	71.79	11	3.8	3.3	8.4
Calcium	39	39	100	59300	16368	14764	24357
Chromium	39	39	100	517	104	111	150
Cobalt	39	39	100	36	17	6.6	19
Copper	39	39	100	103	50	20	57
Cyanide	13	17	76.47	0.58	0.23	0.14	0.40
Iron	39	39	100	65600	37608	8198	39695
Lead	39	39	100	147	66	26	75

Table 2-1
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 2

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Magnesium	39	39	100	16200	5106	2337	5610
Manganese	39	39	100	2630	868	530	1004
Mercury	39	39	100	11	3.2	3.3	17
Nickel	39	39	100	157	67	36	82
Potassium	39	39	100	3170	1846	550	2029
Selenium	8	39	20.51	9.6	4.3	3.3	12
Silver	22	39	56.41	13	3.5	3.4	5.5
Sodium	24	39	61.54	1350	320	254	398
Thallium	6	39	15.38	1.3	3.5	2.7	8.5
Vanadium	39	39	100	902	149	189	226
Zinc	39	39	100	297	182	66	206

Table 2-2
Summary of Phase I, II and III Data For
Fields Brook FWA Surface Soils
Floodplain Exposure Unit 3

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
1,1,1-Trichloroethane	2	41	4.88	0.0030	0.0076	0.0047	0.0082
1,1,2,2-Tetrachloroethane	10	41	24.39	0.22	0.013	0.034	0.013
1,1,2-Trichloroethane	2	41	4.88	0.0060	0.0069	0.0014	0.0077
1,2,4-Trichlorobenzene	9	41	21.95	0.98	0.41	1.1	0.43
1,2-Dichlorobenzene	1	41	2.44	0.19	0.40	1.1	0.35
1,2-Dichloroethene (total)	11	41	26.83	0.041	0.0094	0.0079	0.011
1,3-Dichlorobenzene	3	41	7.32	4.2	0.49	1.2	0.45
1,4-Dichlorobenzene	2	41	4.88	0.87	0.41	1.1	0.37
2-Butanone	23	41	56.10	0.066	0.0080	0.010	0.0087
2-Methylnaphthalene	4	41	9.76	0.080	0.38	1.1	0.40
4,4'-DDT	1	6	16.67	0.080	0.025	0.034	4.1
4-Methyl-2-pentanone	2	41	4.88	0.0020	0.0075	0.0047	0.0088
Acenaphthylene	1	41	2.44	0.0050	0.40	1.1	0.43
Acetone	28	41	68.29	2.5	0.12	0.40	0.11
Anthracene	1	41	2.44	0.0060	0.40	1.1	0.42
Aroclor-1248	31	41	75.61	530	29	92	539
Aroclor-1254	1	41	2.44	0.048	2.2	6.5	6.2
Benzene	2	41	4.88	0.0020	0.0068	0.0016	0.0084
Benzo(a)anthracene	5	41	12.20	0.17	0.39	1.1	0.36
Benzo(a)pyrene	22	41	53.66	0.33	0.32	1.1	0.32
Benzo(b)fluoranthene	27	41	65.85	0.67	0.37	1.1	0.38
Benzo(g,h,i)perylene	9	41	21.95	0.14	0.36	1.1	0.34
Butylbenzylphthalate	6	41	14.63	0.041	0.37	1.1	0.43
Carbon Disulfide	3	41	7.32	0.037	0.0082	0.0066	0.0090
Carbon Tetrachloride	1	41	2.44	0.0030	0.0077	0.0046	0.0082
Chlorobenzene	4	41	9.76	0.10	0.0092	0.014	0.0093
Chloroform	15	41	36.59	0.023	0.0072	0.0056	0.0085
Chrysene	13	41	31.71	0.24	0.36	1.1	0.43
Di-n-butylphthalate	18	41	43.90	0.071	0.32	1.1	0.34
Dibenzofuran	1	41	2.44	0.0040	0.40	1.1	0.44
Ethyl Benzene	7	41	17.07	0.011	0.0070	0.0051	0.011
Fluoranthene	32	41	78.05	0.30	0.30	1.1	0.36
Fluorene	1	41	2.44	0.0030	0.40	1.1	0.46
Hexachlorobenzene	24	41	58.54	99	6.4	18	14
Hexachlorobutadiene	14	41	34.15	47	2.8	9.5	1.9
Hexachloroethane	4	41	9.76	2.0	0.43	1.1	0.40
Indeno(1,2,3-c,d)pyrene	11	41	26.83	0.16	0.35	1.1	0.34
Methylene Chloride	35	41	85.37	0.37	0.06	0.079	0.094
Naphthalene	3	41	7.32	0.055	0.39	1.1	0.43
Phenanthrene	23	41	56.10	0.24	0.31	1.1	0.34
Pyrene	30	41	73.17	0.25	0.29	1.1	0.29
Styrene	10	41	24.39	0.0030	0.0055	0.0026	0.0088

Table 2-2
Summary of Phase I, II and III Data For
Fields Brook FWA Surface Soils
Floodplain Exposure Unit 3

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Tetrachloroethene	28	41	68.29	0.64	0.052	0.12	0.092
Toluene	35	40	87.50	0.047	0.0047	0.0079	0.0060
Total PCBs	31	41	75.61	530	29	92	473
Trichloroethene	20	41	48.78	0.19	0.028	0.047	0.043
Xylenes (total)	32	41	78.05	0.050	0.006	0.00839	0.0080
beta-BHC	3	6	50.00	0.24	0.045	0.10	9.3
bis(2-Ethylhexyl)phthalate	31	41	75.61	9.6	0.60	1.6	1.2
Aluminum	41	41	100.00	24200	15231	3758	16392
Arsenic	25	41	60.98	24	13	7.1	16
Barium	41	41	100.00	21500	1234	3433	1855
Beryllium	32	41	78.05	1.7	0.64	0.33	0.95
Cadmium	11	41	26.83	9.7	1.7	2.4	2.3
Calcium	41	41	100.00	23500	4983	5311	7677
Chromium	41	41	100.00	470	61	90	71
Cobalt	41	41	100.00	40	14	4.6	14
Copper	41	41	100.00	79	27	14	31
Cyanide	5	6	83.33	0.32	0.18	0.085	0.33
Iron	41	41	100.00	50400	31098	5439	32450
Lead	41	41	100.00	97	44	19	49
Magnesium	41	41	100.00	8620	3977	1080	4259
Manganese	41	41	100.00	951	546	195	630
Mercury	40	41	97.56	9.2	1.1	1.8	2.1
Nickel	41	41	100.00	147	42	31	48
Potassium	41	41	100.00	3040	1797	527	1976
Silver	11	41	26.83	12	2.2	2.7	2.8
Sodium	35	41	85.37	484	200	81	222
Thallium	1	41	2.44	0.62	4.7	1.9	8.7
Vanadium	41	41	100.00	842	92	154	106
Zinc	39	41	95.12	621	135	105	152

Table 2-3
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 4

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
1,1,2,2-Tetrachloroethane	19	36	53	15	0.67	2.5	1.5
1,1,2-Trichloroethane	6	36	17	0.0040	0.18	0.36	0.52
1,1-Dichloroethene	2	36	6	0.11	0.16	0.34	0.32
1,2,4-Trichlorobenzene	17	36	47	3.5	0.96	2.0	1.7
1,2-Dichlorobenzene	1	36	3	0.04	1.0	2.3	1.1
1,2-Dichloroethene (total)	22	36	61	9.1	0.40	1.5	0.72
1,3-Dichlorobenzene	13	36	36	3.0	0.88	1.9	1.0
1,4-Dichlorobenzene	6	36	17	0.36	0.99	2.3	1.2
2-Butanone	23	36	64	2.4	0.24	0.53	0.54
2-Hexanone	1	36	3	0.0020	0.18	0.36	0.41
2-Methylnaphthalene	17	36	47	0.045	0.89	2.3	2.4
2-Methylphenol	1	36	3	0.031	1.0	2.3	1.1
4,4'-DDT	1	7	14	0.011	0.048	0.094	1.0
4-Methylphenol	3	36	8	0.21	1.0	2.3	1.1
Acenaphthylene	10	36	28	0.033	0.95	2.3	4.8
Acetone	20	36	56	2.7	0.30	0.61	0.74
Anthracene	17	36	47	0.11	0.90	2.3	2.8
Aroclor-1248	34	36	94	560	63	133	3168
Aroclor-1254	3	36	8	0.27	4.5	9.2	35
Aroclor-1260	1	36	3	0.53	4.5	9.2	45
Benzene	1	36	3	0.041	0.16	0.34	0.26
Benzo(a)anthracene	26	36	72	0.31	0.90	2.3	1.2
Benzo(a)pyrene	24	36	67	0.37	0.93	2.3	1.1
Benzo(b)fluoranthene	31	36	86	1.6	0.63	1.4	0.91
Benzo(g,h,i)perylene	17	36	47	0.22	0.94	2.3	1.2
Benzo(k)fluoranthene	9	36	25	0.38	0.98	2.3	1.2
Butylbenzylphthalate	6	36	17	0.094	0.98	2.3	1.8
Carbazole	5	35	14	0.084	1.0	2.3	2.0
Carbon Disulfide	5	35	14	0.01	0.19	0.36	0.58
Carbon Tetrachloride	1	36	3	0.0010	0.18	0.36	0.44
Chlorobenzene	7	36	19	0.032	0.18	0.36	0.51
Chloroform	10	36	28	2.1	0.23	0.54	0.55
Chrysene	28	36	78	0.33	0.90	2.3	1.1
Di-n-butylphthalate	17	36	47	1.1	1.0	2.3	2.0
Dibenz(a,h)anthracene	1	36	3	0.038	1.0	2.3	1.1
Dibenzofuran	5	36	14	0.013	0.98	2.3	2.4
Diethylphthalate	6	36	17	0.090	0.98	2.3	2.2
Dimethylphthalate	5	36	14	0.23	0.99	2.3	1.2
Ethyl Benzene	1	36	3	0.0010	0.18	0.36	0.44
Fluoranthene	33	36	92	1.1	0.69	1.9	0.75
Fluorene	7	36	19	0.061	0.96	2.3	2.2
Hexachlorobenzene	29	36	81	230	29	46	565

Table 2-3
Summary of Phase I, II, and III Data For Fields Brook FWA Surface Soils Flood Plain Exposure Unit 4

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Hexachlorobutadiene	27	36	75	190	9.2	32	25
Hexachloroethane	7	36	19	5.9	0.95	2.1	1.0
Indeno(1,2,3-c,d)pyrene	17	36	47	0.26	0.94	2.3	1.1
Methylene Chloride	27	36	75	2.2	0.23	0.53	0.45
Naphthalene	14	36	39	0.031	0.92	2.3	3.8
Phenanthrene	32	36	89	0.72	0.60	1.8	0.65
Pyrene	30	36	83	1.1	0.67	1.9	0.72
Styrene	8	36	22	0.10	0.13	0.30	0.31
Tetrachloroethene	26	36	72	38	1.5	6.3	7.9
Toluene	23	36	64	0.22	0.072	0.20	0.11
Total PCBs	34	36	94	560	63	133	2188
Trichloroethene	26	36	72	8.6	0.46	1.5	1.6
Xylenes (total)	22	36	61	3.9	0.18	0.68	0.21
bis(2-Ethylhexyl)phthalate	36	36	100	15	1.6	3.0	5.0
Aluminum	36	36	100	43400	18565	6879	20368
Arsenic	16	36	44	38	13	9.1	16
Barium	36	36	100	11000	2452	2666	6983
Beryllium	20	36	56	6.4	0.99	1.0	1.1
Cadmium	24	36	67	20.60	3.8	4.3	8.0
Calcium	33	33	100	40600	13554	11668	23330
Chromium	36	36	100	620	123	144	186
Cobalt	36	36	100	69	18	10	20
Copper	36	36	100	290	51	47	60
Cyanide	3	7	43	1.5	0.29	0.54	3.3
Iron	33	33	100	62300	38882	8859	41685
Lead	36	36	100	161	60	27	69
Magnesium	33	33	100	7420	4070	949	4360
Manganese	36	36	100	2720	825	493	1001
Mercury	32	33	97	19	3.9	4.3	15
Nickel	36	36	100	199	65	48	82
Potassium	32	33	97	3220	1864	595	2103
Selenium	2	36	6	2.7	6.3	3.2	15
Silver	16	36	44	9.4	2.6	2.4	3.9
Sodium	27	33	82	895	376	175	442
Thallium	2	36	6	0.98	6.3	4.9	14
Vanadium	36	36	100	949	192	231	306
Zinc	31	36	86	621	158	97	191

Table 2-4
Summary of Phase I, II, and III Data For Fields Brook FWA Surface Soils Flood Plain Exposure Unit 6

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
1,1,2,2-Tetrachloroethane	23	40	58	7.2	0.48	1.3	2.1
1,1,2-Trichloroethane	12	40	30	0.13	0.13	0.30	0.23
1,1-Dichloroethene	9	40	23	0.84	0.13	0.27	0.25
1,2,4-Trichlorobenzene	24	40	60	4.3	1.3	2.9	1.8
1,2-Dichlorobenzene	15	40	38	0.52	1.1	2.9	1.4
1,2-Dichloroethene (total)	27	40	68	110	4.1	18	63
1,3-Dichlorobenzene	16	40	40	0.73	0.94	2.8	0.91
1,4-Dichlorobenzene	15	40	38	0.52	1.0	2.9	1.1
2-Butanone	12	40	30	8.7	0.40	1.4	0.59
2-Methylnaphthalene	22	40	55	0.61	1.0	2.9	2.3
2-Methylphenol	1	40	3	0.015	1.1	2.8	1.3
4,4'-DDE	2	14	14	0.47	0.86	1.4	334
4,4'-DDT	1	14	7	0.0050	0.68	1.3	110
Acenaphthene	2	40	5	0.13	1.1	2.85	1.2
Acenaphthylene	8	40	20	0.037	1.1	2.86	2.6
Acetone	30	40	75	1.9	0.26	0.50	0.60
Anthracene	13	40	33	0.34	1.1	2.9	1.8
Aroclor-1242	1	40	3	22	6.7	11	61
Aroclor-1248	33	40	83	610	74	131	1940
Aroclor-1254	1	40	3	0.27	6.6	11	53
Benzo(a)anthracene	17	40	43	1.8	1.2	2.9	1.7
Benzo(a)pyrene	29	40	73	1.4	0.94	2.8	1.2
Benzo(b)fluoranthene	36	40	90	2.2	1.1	2.8	1.9
Benzo(g,h,i)perylene	18	40	45	1.1	1.1	2.9	1.2
Benzo(k)fluoranthene	1	40	3	0.032	1.1	2.8	1.2
Butylbenzylphthalate	7	40	18	0.62	1.1	2.9	2.0
Carbazole	3	36	8	0.051	0.76	1.4	1.3
Carbon Disulfide	3	40	8	0.045	0.14	0.33	0.22
Carbon Tetrachloride	1	40	3	0.19	0.13	0.32	0.18
Chlorobenzene	6	40	15	11	0.51	1.9	0.53
Chloroform	6	40	15	0.55	0.14	0.33	0.21
Chrysene	27	40	68	3.2	1.1	2.9	1.4
Di-n-butylphthalate	13	40	33	0.23	1.1	2.9	1.6
Dibenz(a,h)anthracene	6	40	15	0.39	1.1	2.9	1.3
Dibenzofuran	7	40	18	0.10	1.1	2.9	2.1
Diethylphthalate	14	40	35	0.67	1.0	2.8	1.9
Dimethylphthalate	14	40	35	1.7	1.0	2.8	2.7
Endosulfan II	2	14	14	0.43	0.60	1.3	89
Endosulfan sulfate	1	14	7	0.19	0.58	1.3	75
Endrin ketone	1	14	7	0.034	0.57	1.3	58
Ethyl Benzene	7	40	18	0.015	0.14	0.33	0.24
Fluoranthene	34	40	85	1.8	0.95	2.8	1.2

Table 2-4
Summary of Phase I, II, and III Data For Fields Brook FWA Surface Soils Flood Plain Exposure Unit 6

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Fluorene	6	40	15	0.42	1.1	2.9	1.3
Heptachlor	1	14	7	1.0	0.48	0.74	250
Hexachlorobenzene	39	40	98	320	33	72	220
Hexachlorobutadiene	32	40	80	170	11	31	46
Hexachloroethane	15	40	38	4.3	1.2	2.9	1.8
Indeno(1,2,3-c,d)pyrene	18	40	45	0.47	1.1	2.9	1.3
Methylene Chloride	29	40	73	0.45	0.12	0.26	0.22
Naphthalene	15	40	38	0.23	1.0	2.9	2.3
Phenanthrene	32	40	80	3.5	1.0	2.8	1.4
Pyrene	27	40	68	4.3	1.0	2.9	1.4
Styrene	12	40	30	0.15	0.12	0.31	0.34
Tetrachloroethene	34	40	85	89	7.0	18	648
Toluene	25	40	63	0.10	0.11	0.30	0.23
Total PCBs	34	40	85	610	76	131	1633
Trichloroethene	31	40	78	56	4.4	11	172
Vinyl Chloride	2	40	5	8.5	0.35	1.4	0.45
Xylenes (total)	23	40	58	0.44	0.09	0.26	0.16
alpha-BHC	1	14	7	0.19	0.30	0.69	48
alpha-Chlordane	1	14	7	0.018	0.29	0.69	31
beta-BHC	5	14	36	4.5	0.65	1.3	204
bis(2-Ethylhexyl)phthalate	30	40	75	11	2.3	3.6	7.1
delta-BHC	1	14	7	0.072	0.30	0.69	36
gamma-BHC (Lindane)	1	14	7	0.25	0.30	0.69	48
gamma-Chlordane	1	14	7	0.027	0.38	0.76	101
Aluminum	40	40	100	26300	14465	5105	16452
Arsenic	23	40	58	33	13	8.0	15
Barium	40	40	100	9620	2053	2422	4416
Beryllium	33	40	83	6.0	1.1	1.3	2.1
Cadmium	31	40	78	12.10	4.0	3.4	7.8
Calcium	40	40	100	128000	26193	30628	59331
Chromium	40	40	100	1080	147	213	221
Cobalt	38	40	95	29	14	5.6	16
Copper	40	40	100	116	48	25	57
Cyanide	10	14	71	0.77	0.22	0.23	0.38
Iron	40	40	100	130000	36593	19619	40425
Lead	40	40	100	231	56	39	67
Magnesium	40	40	100	8550	3556	1163	3943
Manganese	40	40	100	3070	947	668	1224
Mercury	39	40	98	22	4.2	4.5	16
Nickel	40	40	100	484	74	84	90
Potassium	36	40	90	3100	1385	756	1773
Selenium	5	40	13	3.4	4.8	3.1	13

Table 2-4
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 6

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Silver	24	40	60	13	2.5	2.8	3.8
Sodium	28	40	70	1410	342	244	423
Thallium	5	40	13	5.6	4.2	2.6	8.7
Vanadium	40	40	100	1780	237	354	390
Zinc	40	40	100	339	146	65	168

Table 2-5
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 8

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
1,1,1-Trichloroethane	1	42	2	0.00050	0.094	0.28	0.073
1,1,2,2-Tetrachloroethane	17	42	40	12	0.66	2.2	0.67
1,1,2-Trichloroethane	2	42	5	0.034	0.095	0.28	0.068
1,1-Dichloroethane	3	42	7	0.0030	0.094	0.28	0.076
1,1-Dichloroethene	1	42	2	0.0020	0.094	0.28	0.066
1,2,4-Trichlorobenzene	18	42	43	1.3	0.50	1.0	0.72
1,2-Dichlorobenzene	12	42	29	0.19	0.46	0.99	0.55
1,2-Dichloroethene (total)	18	42	43	47	1.3	7.2	0.80
1,3-Dichlorobenzene	8	42	19	0.52	0.48	0.99	1.1
1,4-Dichlorobenzene	17	42	40	0.53	0.43	1.0	0.63
2-Butanone	15	42	36	9.0	0.38	1.6	0.16
2-Methylnaphthalene	31	42	74	0.76	0.37	1.0	0.41
4,4'-DDE	1	24	4	0.54	0.71	2.1	4.2
4,4'-DDT	1	24	4	0.0047	0.67	2.1	3.6
4-Chloro-3-methylphenol	1	42	2	0.007	0.51	0.98	0.62
4-Nitrophenol	1	42	2	0.022	1.3	2.4	1.6
Acenaphthene	17	42	40	0.092	0.41	1.0	0.75
Acenaphthylene	20	42	48	0.061	0.38	1.0	0.68
Acetone	20	42	48	7.2	0.32	1.2	0.23
Anthracene	22	42	52	0.21	0.40	1.0	0.48
Aroclor-1242	1	42	2	0.46	5.7	16	20
Aroclor-1248	31	42	74	270	30	53	399
Aroclor-1254	4	42	10	3.6	5.8	16	17
Aroclor-1260	5	42	12	9.4	6.0	16	25
Benzo(a)anthracene	28	42	67	0.85	0.47	1.0	0.53
Benzo(a)pyrene	32	42	76	0.79	0.44	1.0	0.56
Benzo(b)fluoranthene	38	42	90	1.4	0.38	0.32	0.52
Benzo(g,h,i)perylene	15	42	36	0.28	0.45	0.99	0.48
Benzo(k)fluoranthene	11	42	26	0.56	0.48	0.99	0.56
Bromoform	1	42	2	0.00030	0.094	0.28	0.077
Butylbenzylphthalate	21	42	50	0.056	0.38	1.0	0.59
Carbazole	17	39	44	0.17	0.44	1.0	0.56
Carbon Disulfide	7	42	17	0.52	0.085	0.26	0.062
Carbon Tetrachloride	3	42	7	0.01	0.094	0.28	0.071
Chlorobenzene	7	42	17	0.98	0.10	0.29	0.078
Chloroform	4	42	10	1.2	0.11	0.32	0.089
Chrysene	31	42	74	1.0	0.47	1.0	0.56
Di-n-butylphthalate	15	42	36	0.21	0.46	0.99	0.45
Dibenz(a,h)anthracene	3	42	7	0.037	0.50	0.98	0.58
Dibenzofuran	20	42	48	0.10	0.40	1.0	0.64
Dibromochloromethane	1	42	2	0.00030	0.094	0.28	0.077
Diethylphthalate	26	42	62	0.66	0.43	1.0	0.65
Dimethylphthalate	29	42	69	1.9	0.54	1.0	0.90
Ethyl Benzene	9	42	21	0.12	0.052	0.19	0.049
Fluoranthene	37	42	88	2.1	0.49	0.55	0.66
Fluorene	20	42	48	0.17	0.41	1.0	0.49
Hexachlorobenzene	35	42	83	480	30	95	132
Hexachlorobutadiene	22	42	52	17	1.2	2.8	1.9
Hexachloroethane	13	42	31	2.4	0.48	0.99	0.69

Table 2-5
Summary of Phase I, II, and III Data For
Fields Brook FWA Surface Soils
Flood Plain Exposure Unit 8

Parameter	Number Detects	Number Samples	Percent Detected (%)	Maximum Detect (mg/kg)	Arithmetic Mean (mg/kg)	Standard Deviation	95% UCLM (mg/kg)
Indeno(1,2,3-c,d)pyrene	20	42	48	0.42	0.45	0.99	0.50
Methylene Chloride	18	42	43	0.74	0.057	0.15	0.060
N-nitrosodiphenylamine	6	42	14	0.12	0.48	0.99	0.61
Naphthalene	29	42	69	0.056	0.34	1.0	0.44
Phenanthrene	36	42	86	4.6	0.63	0.87	0.92
Pyrene	38	42	90	1.9	0.47	0.52	0.64
Tetrachloroethene	23	42	55	8.2	0.49	1.8	0.46
Toluene	25	42	60	0.17	0.033	0.09	0.056
Total PCBs	33	42	79	270	34	58	238
Trichloroethene	26	42	62	11	0.78	2.4	1.6
Xylenes (total)	18	42	43	0.30	0.036	0.10	0.044
beta-BHC	7	24	29	2.4	0.51	1.1	14
bis(2-Ethylhexyl)phthalate	31	42	74	67	5.7	11	14
trans-1,3-Dichloropropene	1	42	2	0.00040	0.094	0.28	0.074
Aluminum	41	41	100	31500	17053	4933	18686
Antimony	1	42	2	21	5.8	3.2	7.8
Arsenic	28	42	67	43	15	11	19
Barium	42	42	100	1370	297	279	375
Beryllium	32	42	76	19	1.3	3.0	2.2
Cadmium	25	42	60	9.7	1.8	2.0	2.5
Calcium	42	42	100	74100	15225	15261	22286
Chromium	42	42	100	1580	266	345	466
Cobalt	42	42	100	29	14	4.9	16
Copper	42	42	100	147	49	30	59
Cyanide	21	24	88	0.66	0.23	0.13	0.29
Iron	42	42	100	58400	36702	10364	40274
Lead	42	42	100	263	62	39	71
Magnesium	42	42	100	5470	3513	947	3839
Manganese	42	42	100	12900	1418	2000	1797
Mercury	41	42	98	58	13	15	128
Nickel	42	42	100	90	44	17	51
Potassium	40	42	95	3930	1796	742	2127
Selenium	16	42	38	1.8	3.8	3.9	8.4
Silver	27	42	64	17	3.8	4.3	7.1
Sodium	19	42	45	798	274	167	342
Thallium	12	42	29	16	3.5	3.8	7.8
Vanadium	42	42	100	2280	430	584	764
Zinc	39	42	93	420	194	95	235

Table 2-6
Fields Brook FWA
Species of Biota Collected at Fields Brook During Phases II and III

Sample #	Zone	Matix	Taxa
			Phase II
BIBK1003S3	BK1	Fish	8 Creek Chub
BIBK1004S3	BK1	Fish	2 White Sucker
BIBK2002S3	BK1	Fish	31 Creek Chub
BIBK1006S3	BK1	Mice	4 Peromyscus leucopus, 1 Peromyscus maniculatus
BIBK1007S3	BK1	Mice	4 Peromyscus leucopus
BIBK1008S3	BK1	Shrews	5 Blarina brevicauda
BIBK1012S3	BK1	Mice	5 Peromyscus leucopus
BIBK1013S3	BK1	Shrews	4 Blarina brevicauda
BIBK2005S3	BK2	Mice	2 Peromyscus sp.
BI021002S3	1	Mice	1 Mus musculus, 3 Peromyscus leucopus, 1 Peromyscus maniculatus
BI021006S3	1	Shrews	3 Blarina brevicauda
BI031001S3	1	Mice	1 Peromyscus maniculatus
BI031002S3	1	Mice	2 Mus musculus
BI041001S3	2	Mice	2 Peromyscus maniculatus
BI041004S3	2	Shrews	3 Blarina brevicauda
BI041005S3	2	Mice	1 Mus musculus, 2 Peromyscus leucopus, 1 Microtus pennsylvanicus
BI051002S3	2	Mice	2 Microtus pennsylvanicus
BI051003S3	2	Mice	1 Peromyscus leucopus, 4 Microtus pennsylvanicus, 1 Neozapus insignis
BI051006S3	2	Shrews	4 Blarina brevicauda
BI051007S3	2	Mice	1 Peromyscus leucopus, 2 Microtus pennsylvanicus, 2 Zapus hudsonius
BI052001S3	2	Mice	2 Microtus pennsylvanicus
BI052004S3	2	Mice	2 Microtus pennsylvanicus
BI052005S3	2	Mice	4 Microtus pennsylvanicus
BI052006S3	2	Mice	4 Peromyscus leucopus
BI052008S3	2	Shrews	5 Blarina brevicauda
BI052009S3	2	Mice	5 Peromyscus sp., 1 Zapus hudsonius
BI052010S3	2	Mice	5 Peromyscus sp.
BI061002S3	3	Mice	4 Microtus pennsylvanicus
BI061003S3	3	Mice	2 Peromyscus leucopus, 2 Microtus pennsylvanicus
BI061004S3	3	Mice	3 Microtus pennsylvanicus
BI061006S3	3	Shrews	5 Blarina brevicauda, 1 Sorex cinereus
BI081002S3	3	Mice	4 Peromyscus sp.
BI081006S3	3	Mice	4 Peromyscus leucopus
BI082004S3	3	Mixed	2 Blarina brevicauda, 1 Microtus pennsylvanicus
BI134002S3	4	Shrews	5 Blarina brevicauda
BI134003S3	4	Mice	3 Peromyscus leucopus, 1 Peromyscus maniculatus, 1 Zapus hudsonius
BI134006S3	4	Mice	1 Peromyscus sp., 2 Peromyscus leucopus, 1 Peromyscus maniculatus

Table 2-6 (Continued)
Fields Brook FWA
Species of Biota Collected at Fields Brook During Phases II and III

Sample #	Zone	Matix	Taxa
BI134009S3	4	Shrews	4 Blarina brevicauda
BI082002S3	4	Fish	2 Largemouth Bass
BIBK1005S3	BK1	Vegetation	Impatiens, Viburnum
BIBK2003S3	BK2	Vegetation	Spicebush, Multi-flore Rose, Bush Honeysuckle, Ferns, Asian Knotweed, Sassafras, Solidago
BI021001S3 BI021007S3	1	Vegetation	Solidago, Reed Canary Grass, Poa, Cottonwood, Dogwood, Multi-flore Rose
BI031004S3, BI031009S3, BI031010S3	1	Vegetation	Multi-flore Rose, False Nettle, Privet, Viburnum, Leatherwood, Poison Ivy, Honeysuckle
BI041003S3 BI041008S3	2	Vegetation	Ironwood, Poison Ivy, Multi-flore Rose, Privet, Solidago, Poa, Muscadine Grape, Sedge, Red Oak
BI051001S3 BI051008S3	2	Vegetation	Curly Dock, Thistle, Mint, Poa, Solidago, Leatherwood
BI052003S3 BI052011S3	2	Vegetation	Solidago, Leatherwood, Silky Dogwood, Reed Canary Grass, Poa
BI061001S3 BI061007S3	3	Vegetation	Reed Canary Grass, Solidago, Multi-flore Rose, Dogwood
BI081001S3 BI081008S3	3	Vegetation	Cattails, Phragmites, Reed Canary Grass, Multi-flore Rose
BI082003S3 BI082010S3	3	Vegetation	Viburnum, Phragmites, Honeysuckle, Leatherwood, Poison Ivy, Rubus
BI134001S3	3	Vegetation	Ragweed, Solidago, Rubus, Dogwood, Reed Canary Grass, Nightshade, Muscadine Grape
Phase III			
BI002002S4	2	Individual	P. Maniculatus
BI002003S4	2	Individual	P. Maniculatus
BI002005S4	2	Individual	P. Maniculatus
BI002006S4	2	Individual	P. Maniculatus
BI002007S4	2	Individual	P. Maniculatus
BI002008S4	2	Individual	P. Maniculatus
BI002009S4	2	Individual	P. Maniculatus
BI002010S4	2	Individual	P. Maniculatus
BI002011S4	2	Individual	B. Brevicauda
BI002012S4	2	Individual	B. Brevicauda
BI002013S4	2	Individual	P. Leucopus
BI002014S4	2	Individual	P. Maniculatus
BI002015S4	2	Individual	P. Maniculatus
BI002016S4	2	Individual	P. Leucopus
BI002017S4	2	Individual	M. Pennsylvanicus
BI002018S4	2	Individual	B. Brevicauda
BI002019S4	2	Individual	M. Pennsylvanicus

Table 2-6 (Continued)
Fields Brook FWA
Species of Biota Collected at Fields Brook During Phases II and III

Sample #	Zone	Matix	Taxa
BI002020S4	2	Individual	M. Pennsylvanicus
BI002021S4	2	Individual	P. Maniculatus
BI002022S4	2	Individual	P. Maniculatus
BI002023S4	2	Individual	M. Pennsylvanicus
BI002024S4	2	Individual	P. Maniculatus
BI002025S4	2	Individual	P. Maniculatus
BI002026S4	2	Individual	B. Brevicauda
BI002027S4	2	Individual	P. Maniculatus
BI002028S4	2	Individual	B. Brevicauda
BI002029S4	2	Individual	P. Maniculatus
BI002030S4	2	Individual	P. Maniculatus
BI002031S4	2	Individual	P. Maniculatus
BI002032S4	2	Individual	P. Maniculatus
BI002033S4	2	Individual	P. Maniculatus
BI003002S4	3	Individual	M. Pennsylvanicus
BI003003S4	3	Individual	M. Pennsylvanicus
BI003004S4	3	Individual	P. Maniculatus
BI003005S4	3	Individual	M. Pennsylvanicus
BI003006S4	3	Individual	M. Pennsylvanicus
BI003007S4	3	Individual	M. Pennsylvanicus
BI003008S4	3	Individual	B. Brevicauda
BI003009S4	3	Individual	P. Maniculatus
BI003010S4	3	Individual	P. Maniculatus
BI003011S4	3	Individual	M. Pennsylvanicus
BI003012S4	3	Individual	B. Brevicauda
BI003013S4	3	Individual	M. Pennsylvanicus
BI003014S4	3	Individual	C. gapperi
BI003015S4	3	Individual	M. Pennsylvanicus
BI003016S4	3	Individual	M. Pennsylvanicus
BI003017S4	3	Individual	B. Brevicauda
BI003018S4	3	Individual	B. Brevicauda
BI003019S4	3	Individual	M. Pennsylvanicus
BI003020S4	3	Individual	M. Pennsylvanicus
BI003021S4	3	Individual	P. Maniculatus
BI003022S4	3	Individual	P. Maniculatus
BI003023S4	3	Individual	M. Pennsylvanicus
BI003024S4	3	Individual	B. Brevicauda
BI003025S4	3	Individual	M. Pennsylvanicus
BI003026S4	3	Individual	M. Pennsylvanicus
BI003027S4	3	Individual	P. Maniculatus

Table 2-6 (Continued)
Fields Brook FWA
Species of Biota Collected at Fields Brook During Phases II and III

Sample #	Zone	Matix	Taxa
BI003028S4	3	Individual	P. Maniculatus
BI003029S4	3	Individual	B. Brevicauda
BI003030S4	3	Individual	P. Maniculatus
BI003031S4	3	Individual	B. Brevicauda
BI003032S4	3	Individual	M. Pennsylvanicus
BI003033S4	3	Individual	B. Brevicauda
BI003034S4	3	Individual	M. Pennsylvanicus
BI003035S4	3	Individual	M. Pennsylvanicus
BI003036S4	3	Individual	M. Pennsylvanicus
BI003037S4	3	Individual	P. Maniculatus

Note:

BK1 and BK2 are off-site reference locations.

Table 2-7
Fields Brook FWA
Bird Species Potentially Present at Fields Brook

Podicipedidae
Pied-billed grebe

Ardeidae
Least bittern
Black crowned night heron
Cattle egret
Green backed heron
Yellow crowned night heron
American bittern
Great egret
Great blue heron
Common merganser
Northern pintail

Anatidae
Canada goose
Mallard
American black duck
Lesser scaup
Common goldeneye
Gadwall
Ruddy duck
Canvasback
Redhead
Wood duck
Ring necked duck
Green winged teal
Blue-winged teal
Hooded merganser
American wigeon

Rallidae
King rail
Virginia rail
Sora
Gallinule
Coot

Charadriidae
Killdeer

Scolopacidae
Spotted sandpiper
Common snipe
American woodcock

Accipitridae
Bald eagle
Northern goshawk
Rough-legged hawk
Sharp shinned hawk
Coopers hawk
Marsh hawk
Red-tailed hawk
Red-shouldered hawk
Broad winged hawk

Cathartidae
Turkey vulture

Pandionidae
Osprey

Falconidae
American kestrel
Merlin

Laridae
Ring billed gull
Common tern
Black tern
Herring gull

Tetraonidae
Ruffed grouse

Phasianidae
Ring-necked pheasant
Bobwhite

Melagrididae
Wild turkey

Columbidae
Rock dove
Mourning dove

Cuculidae
Yellow billed cuckoo
Black-billed cuckoo

Table 2-7 (Continued)
Fields Brook FWA
Bird Species Potentially Present at Fields Brook

Tytoridae
Barn owl

Strigidae
Great horned owl
Short-eared owl
Barred owl
Northern saw-whet owl

Caprinalgidae
Whip-poor-will
Common nighthawk

Apodidae
Chimney swift

Trochilidae
Ruby throated hummingbird

Alcediridae
Kingfisher

Picidae
Northern flicker
Red bellied woodpecker
Yellow bellied sapsucker
Red-headed woodpecker
Downy woodpecker
Hairy woodpecker
Pileated woodpecker

Tyrannidae
Eastern kingbird
Great crested flycatcher
Olive sided flycatcher
Eastern wood-peewee
Eastern phoebe
Least flycatcher
Acadian flycatcher
Willow flycatcher
Alder flycather

Alaudidae
Horned lark

Hirundinidae
Swallows
Purple martin

Corvidae
Blue jay
American crow

Paridae
Tufted titmouse
Black capped chickadee

Certhiidae
Brown creeper

Sittidae
White-breasted nuthatch
Red-breasted nuthatch

Troglodytidae
House wren
Marsh wren
Sedge wren
Winter wren
Carolina wren

Sylviidae
Blue-grey gnatcatcher

Muscicapidae
Eastern bluebird
Golden crowned kinglet
Wood thrush
Veery
Swainsons thrush
Hermit thrush
American robin

Laniidae
Loggerhead shrike
Northern shrike

Mimidae
Grey catbird
Brown thrasher
Northern mockingbird

Bombycillidae
Cedar waxwing

Table 2-7 (Continued)
Fields Brook FWA
Bird Species Potentially Present at Fields Brook

Sturnidae
European starling

Vireonidae
Red-eyed vireo
Solitary vireo
Werbling vireo
Yellow-throated vireo

Emberizidae
Blue winged warbler
Golden winged warbler
Canada warbler
American redstart
Yellow-breasted chat
Nashville warbler
Panula warbler
Chestnut sided warbler
Black-throated blue warbler
Black-throated green warbler
Blackburnian warbler
Pine warbler
Prairie warbler
Palm warbler
Black and White warbler
Prothonatory warbler
Worm-eating warbler
Ovenbird
Northern waterthrush
Louisiana waterthrush
Kentucky warbler
Mourning warbler
Common yellowthroat
Cardinal
Indigo bunting
Rufous-sided towhee
Bachman's sparrow
Chipping sparrow
Field sparrow
Vesper sparrow
Lark sparrow
Savannah sparrow
Grasshopper sparrow
Henslow's sparrow
Fox sparrow
Song sparrow
Swamp sparrow
White-throated sparrow
White-crowned sparrow
Dark-eyed junco
McCown's longspur
Lapland longspur
Snow bunting
Bobolink
Red-winged blackbird
Western meadowlark
Eastern meadowlark
Common grackle
Brown-headed cowbird
Orchard oriole
Baltimore oriole

Passeridae
House sparrow

Fringillidae
Purple finch
House finch
Rose breasted grosbeak
Pine grosbeak
Red crossbill
White-winged crossbill
Common redpoll
Pine siskin
American goldfinch
Evening grosbeak

Table 2-8
Fields Brook FWA
Mammal Species Potentially Present at Fields Brook

Didelphidae
Opossum

Soricidae
Shorttail shrew
Least Shrew
Masked shrew
Smokey shrew

Talpidae
Starnose mole
Eastern mole
Hairytale mole

Vespertilionidae
Keen myotis
Little brown myotis
Indiana myotis
Small-footed myotis
Silver-haired bat
Eastern pipistrel
Hoary bat
Evening bat
Red bat
Big brown bat

Procyonidae
Raccoon

Mustelidae
Least weasel
Longtail weasel
Mink
River otter
Striped skunk

Canidae
Coyote
Red fox
Grey fox

Sciuridae
Eastern grey squirrel
Eastern fox squirrel
Red squirrel
Southern flying squirrel
Woodchuck
Eastern chipmunk

Castoridae
Beaver

Cricetidae
White-footed mouse
Deer mouse
Southern bog lemming
Meadow vole
Pine vole
Woodlands jumping mouse
Muskrat

Muridae
Norway rat
House mouse

Leporidae
Eastern Cottontail

Zapodidae
Meadow jumping mouse

Cervidae
Whitetail deer

Table 2-9
Fields Brook FWA
Fish Species Potentially Present at Fields Brook

Petromyzontidae
Northern brook lamprey
American brook lamprey

Cyprinidae
Common carp
Goldfish
Redside dace
Southern redbelly dace
Blacknose dace
Longnose dace
Sand shiner
emerald shiner
Redfin shiner
Striped shiner
Spottail shiner
Mimic shiner
Rosyface shiner
Common shiner
Spotfin shiner
Silverjaw minnow
Bluntnose minnow
Fathead minnow
Silver chub
Creek chub
Hornyhead chub
River chub
Bigeye chub
Central stoneroller

Gasterosteidae
Brook stickleback

Cottidae
Mottled sculpin

Clupeidae
Gizzard shad

Osmeridae
Rainbow smelt

Catostomidae
White sucker
Northern hog sucker
Golden redhorse
Black redhorse

Ictaluridae
Channel catfish
Brown bullhead
Black bullhead
Yellow bullhead
Stonecat
Brindled madtom
Tadpole madtom

Umbridae
Central mudminnow

Esocidae
Grass pickerel
Chain pickerel
Northern pike

Cyprinodontidae
Banded killifish

Atherinidae
Brook silverside

Percichthyidae
White bass

Table 2-9 (Continued)
Fields Brook FWA
Fish Species Potentially Present at Fields Brook

Centrarchidae
Largemouth bass
Smallmouth bass
Warmouth
Green sunfish
Pumpkinseed
Bluegill
Longear sunfish
Rock bass
White crappie
Black crappie

Percidae
Blackside darter
Channel darter
Logperch
Johnny darter
Eastern sand darter
Rainbow darter
Barred fantail darter
Greenside darter

Table 2-10
Fields Brook FWA
Reptile and Amphibian Species Potentially Present at Fields Brook

Colubridae
Northern water snake
Queen snake
Northern brown snake
Midland brown snake
Northern red-bellied snake
Eastern garter snake
Northern ribbon snake
Eastern hognose snake
Northern black racer
Northern ringneck snake
Eastern smooth green snake
Black rat snake
Eastern milk snake

Bufonidae
American toad
Fowler's toad

Hylidae
Blanchard's cricket frog
Northern spring peeper
Western chorus frog
Gray treefrog

Ranidae
Bullfrog
Green frog
Wood frog
Northern leopard frog
Pickerel frog

Ambystomatidae
Marbled salamander
Small-mouthed salamander
Jefferson salamander
Spotted salamander

Plethodontidae
Northern dusky salamander
Slimy salamander
Four-toed salamander
Northern red salamander
Northern two-lined salamander
Red-backed salamander

Chelydridae
Snapping turtle

Kinosternidae
Stinkpot

Emydidae
Spotted turtle
Map turtle
Midland painted turtle
Blanding's turtle

Trionychidae
Eastern spiny softshell

Salamandridae
Red-spotted newt

Scincidae
Five-lined skink

Necturidae
Mudpuppy

Table 2-11
Fields Brook FWA
Vegetation Identified at the Fields Brook Site, Ashtabula, Ohio, 10-12 November 1992

Scientific Name
Common Name
Hydrophytic Status[(a)]

TREES

Acer negundo
Box elder
FAC

Acer rubrum
Red maple
FAC

Acer saccharinum
Silver maple
FACW

Acer saccharum
Sugar maple
FACW

Betula nigra
River birch
FACW

Betula populifolio
Gray birch
FACW

Carpinus caroliniana
American hornbeam
FAC

Catalpa speciosa
Catalpa
FAC

Celtis occidentalis
Hackberry
FACU

Cornus florida
Dogwood
FACU

Crataegus sp.
Hawthorn
FACU

Fraxinus pennsylvania
Green ash
FACW

Juglans nigra
Black walnut
FACU

Morus rubra
Red mulberry
FACU

Picea pungens
Norway spruce

Platanus occidentalis
American sycamore
FACW

Pyrus malus
Apple
FACW

Populus deltoides
Eastern cottonwood
FAC

Prunus serotina
Black cherry
FACU

Prunus pennsylvanica
Pin cherry
FACU

Quercus alba
White oak
FACU

Quercus palustris
Pin oak
FACW

Quercus rubra
Northern red oak
FACU

Scientific Name
Common Name
Hydrophytic Status[(a)]

Robina psuedo-acacia
Black locust
FACU

Salix nigra
Black willow
FACW

Salix sp.
Willow
FACW

Ulmus americana
American elm
FACW

Table 2-11 (Continued)
Fields Brook FWA
Vegetation Identified at the Fields Brook Site, Ashtabula, Ohio, 10-12 November 1992

SHRUBS

Cephalanthus occidentalis
Buttonbush
OBL
Cornus amomum
Silky dogwood
FACW
Cornus stolonifera
Red osier dogwood
FACW
Cornus racemosa
Red pannicled dogwood
FACW
Lonicera tatarica
Tartarian honeysuckle
FACU
Rhus typhina
Staghorn sumac
UP*
Rosa multiflora
Multiflora rose
FACU
Rosa palustris
Swamp rose
OBL
Rubus hispidus
Bristly blackberry
FACW
Rubus occidentalis
Black raspberry
UP*
Vaccinium arboreum
Sparkle berry
FACW
Vaccinium corymbosum
Highbush blueberry
FACW
Viburnum acerfolium
Maple-leaved viburnum
UP*
Viburnum dentatum
Arrow-wood
FAC

VINES

Celastrus scandens
Bittersweet
FACU
Lonicera japonica
Japanese honeysuckle
FAC
Mitchella repens
Partridge-berry
FACU
Rhus radicans
Poison ivy
FAC
Smilax rotundifolia
Greenbrier
FAC
Vitis sp.
Grape
FAC

FERNS AND FERN ALLIES

Onoclea sensibilis
Sensitive fern
FACW
Sphagnum sp.
Peat moss
OBL

GRASSES, SEDGES, AND RUSHES

Carex sp.
Fox sedge
OBL
Juncus effusus
Soft rush
FACW
Panicum capillare
Witch grass
FAC
Phalaris arundinacea
Reed canary grass
FACW
Phragmites australis
Common reed
FACW

Table 2-11 (Continued)
Fields Brook FWA
Vegetation Identified at the Fields Brook Site, Ashtabula, Ohio, 10-12 November 1992

HERBS

Arctium minus
  Burdock
  UP*
Aster sp.
  Aster
  FAC
Barbarea vulgaris
  Yellow rocket
  FACU
Daucus carota
  Queen Anne's Lace
  UP*
Iris versicolor
  Blue flag
  OBL
Lythrum salicaria
  Purple loosestrife
  FACW
Polygonum sp.
  Smartweed
  FACW
Solidago sp.
  Goldenrod
  FAC
Typha latifolia
  Broad-leaf cattail
  OBL

(a) Hydrophytic status follows Reed, P.B. Jr. (1988), "The U.S. Fish and Wildlife National List of Plant Species That Occur in Wetlands," unless indicated otherwise. Abbreviations:

OBL = Obligate (found in wetlands in more than 99% of all findings)
FACW = Faculative wetland (66-99%)
FAC = Faculative (33-66%)
FACU = Faculative upland (1-33%)
UP = Upland (<1%)

Note: * Hydrophytic status not reported; status presented is based on professional judgment and is supported by appropriate literature.

Table 2-12
Fields Brook FWA
Summary of Wildlife Observed at Fields Brook, 10-12 November, 1992

Zone	Transect	Beaver Signs	Deer Signs	Squirrel Nest	Raccoon Signs	Bee Nest	Animal Sighted or Heard	Woodpecker Signs	Muskrat Hole	Rabbit Signs
1	2A			X						
	2	X								
	3	X						X	X	
	4	X		X				X	X	
	5	X		X						
	6		tree rubs	X			squirrel			X
	7		trail				bluejay			X
	8									
2	9	dam								
	10	X	tree rubs							
	11	dam	tree rubs, tracks	X			woodcock			
	12		tracks	X						
	13	X	tree rubs							
	14									
3	15			X			mouse/vole, deer, dead rat, and muskrat			
	16									
	17				X		Canada geese			X
	18		X		X		cottontail			X
	19									
	20						swans			
	21						swans			
	22	X	X				woodcocks, toad			
4	10A	X	X	X			tree frog			
	24	X	X							
	25	X				X	Canada geese			

Table 2-13
Fields Brook FWA
Soil Fauna Pitfall Trap Samples Collected at Fields Brook
(Values Presented are Arithmetic Mean ± Standard Errort - Numver of Samples is in Parentheses

	Zone 1		Zone 2			Zone 3		Zone 4	
Taxon	2-1	3-1	4-1	5-1	5-2	6-1	8-1	8-2	13
Acarina (Mite)	28.0 ±60.3 (3)	10.0 ±64.0 (2)	8.6 ±1.4 (3)	8.0 ±4.3 (3)	4.3 ±8.1 (3)	6.3 ±2.1 (3)	6.6 ±7.4 (3)	1.6 ±0.4 (3)	1.6 ±0.1 (3)
Aphididae (Aphid)	1.0 (1)		1.5 ±0.2 (2)	2.0 (2)	2.0 (1)	2.3 ±0.4 (3)			1.5 ±0.2 (2)
Arachnida (Spider)		1.0 (1)							
Araneae (Spider)	7.6 ±4.7 (3)	3.5 ±0.2 (2)	1.6 ±0.4 (3)	7.3 ±0.1 (3)	4.6 ±0.1 (3)	2.0 (2)	6.0 ±2.3 (3)	2.3 ±0.4 (3)	2.6 ±0.1 (3)
Chilopoda (Centipede)									1.0 (1)
Cicadellidae (Leafhopper)	4.3 ±0.7 (3)	2.0 (1)	1.0 (1)	4.6 ±2.7 (3)	3.5 ±2.2 (2)	7.5 ±6.2 (2)			
Coleoptera (Beetle)	3.6 ±2.1 (3)	3.3 ±2.1 (3)	2.5 ±0.2 (2)	4.0 ±4.3 (3)	3.6 ±0.4 (3)	1.6 ±0.4 (3)	5.6 ±3.4 (3)	4.0 ±4.0 (2)	1.0 (1)
Collembola (Springtail)	69.6 ±54.1 (3)	5.0 ±1.0 (3)	101.3 ±162.1 (3)	67.0 ±377.3 (3)	104.0 ±1416.3 (3)	98.3 ±157.4 (3)	20.3 ±16.7 (3)	9.0 ±2.3 (3)	19.6 ±28.7 (3)
Diplopoda (Millipede)	1.0 (1)	1.0 (2)							1.0 (1)
Diptera (Fly)	15.2 ±30.7 (4)	22.3 ±301.7 (3)	27.0 ±12 (3)	19.6 ±4.7 (3)	31.6 ±110.1 (3)	60.0 ±121.3 (3)	64.3 ±635.4 (3)	24.3 ±40.4 (3)	1.0 (2)
Formicidae (Ant)	1.0 (3)	2.5 ±2.2 (2)	8.6 ±0.7 (3)		1.0 (1)		1.6 ±0.4 (3)	5.0 ±1.3 (3)	6.6 ±1.7 (3)
Gryllidae (Cricket)	1.0 (1)		1.0 (1)	2.5 ±0.2 (2)	1.0 (1)		1.0 (2)		4.5 ±0.2 (2)
Hemiptera (True Bug)	6.3 ±6.7 (3)	1.0 (1)	1.0 (1)	1.0 (1)			1.0 (1)		
Homoptera (Cicada)		1.0 (1)	1.0 (1)		1.0 (1)				
Hymenoptera (Wasp)	2.5 ±2.2 (2)	1.0 (1)	1.0 (2)	1.0 (1)	2.0 ±1.0 (2)	1.0 (2)	4.6 ±0.7 (3)	1.6 ±0.1 (3)	2.6 ±0.4 (3)
Isopoda (Pill Bug)	2.5 ±0.2 (2)	2.0 (3)			3.0 ±1.3 (3)	1.0 (1)		1.0 (1)	
Lepidoptera (Butterfly, Moth)	1.0 (1)			1.0 (1)			1.0 (1)		
Locustidae (Grasshopper)					1.0 (2)				1.0 (1)
Nematoda *(Round worm)*									
Oligochaeta (Worm)	1.3 ±0.1 (3)	1.0 (1)	1.0 (1)	2.0 (1)			1.0 (2)	1.0 (2)	
Opilione (Daddy		2.0	1.0			1.0		2.0	3.0

Table 2-13 (Continued)
Fields Brook FWA
Soil Fauna Pitfall Trap Samples Collected at Fields Brook
(Values Presented are Arithmetic Mean ± Standard Errort - Numver of Samples is in Parentheses

	Zone 1		Zone 2			Zone 3		Zone 4	
Taxon	2-1	3-1	4-1	5-1	5-2	6-1	8-1	8-2	13
Longleg Spider)		(2)	(1)			(1)		±1.0 (2)	(1)
Pulmonata (Slug)	2.0 (1)	7.0 ±2.3 (3)		5.5 ±12.2 (2)	2.0 ±1.0 (3)	1.5 ±0.2 (2)			1.0 (1)
Tettigoniidae (Meadow Grasshopper)					1.0 (1)				
Thysanoptera (Thrip)	4.0 (1)		1.0 (1)			2.0 (1)	2.0 (1)		1.3 ±0.1 (3)
Total Number of Individuals	151.9	65.6	159.1	125.5	165.6	184.5	115.0	51.8	50.3
Total Number of Taxa	17	16	15	13	15	12	12	10	16

Table 2-14
Fields Brook FWA
Ecological Assessment and Measurement Endpoints for the Fields Brook Investigation

Measurement Endpoints	Avian Carnivore	Mammalian Carnivore	Mammalian Omnivore	Mammalian Herbivore	Avian Omnivore
(1)Doses of bioaccumulative organics	Disruption of growth, reproduction, metabolism, and behavior; Eggshell thinning; Survival	Reproductive failure in small mammals, anorexia, kidney degeneration, muscular incoordination, morbidity Affect hibernation Growth inhibition	Disruption of reproduction Eye problems Growth inhibition	Disruption of reproduction Eye problems Growth inhibition	Morbidity Tremors, muscular incoordination Eggshell thinning Survival Reproductive effects
(2)Doses of nonbioaccumulative organics	Potential tumor production; mutagenesis	Production of skin tumors	Tumor production	Tumor production	Potential tumor production; mutagenesis
(3)Doses of bioaccumulative inorganics (mercury)	Acute toxicity Affects muscular coordination, growth, development, reproduction, metabolism, behavior; Mortality	Reproduction, survival Teratogenic, mutagenic, and carcinogenic effects	Survival	Survival	Acute toxicity in birds Affects muscular coordination; Survival
(4)Doses of nonbioaccumulative inorganics (non-mercury metals)	Reduced survival Impaired reproduction Inhibits growth	Survival Metabolism Inhibits growth	Survival Metabolism Inhibits growth	Survival Metabolism Inhibits growth	Inhibits growth

References:

- *Eisler, R. 1986. Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Report 85(1.7). Patuxent Wildlife Research Center, Laurel, Maryland.*
- *Eisler, R. 1987. Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Report 85(1.10). Patuxent Wildlife Research Center, Laurel, Maryland.*
- *Eisler, R. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.11). Patuxent Wildlife Research Center, Laurel, Maryland.*
- *Eisler, R. 1990. Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.21).*
- *Eisler, R. 1993. Zinc Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Report 10.*

Table 3-1
Fields Brook FWA
Biological Parameters Used for Ecological Risk Assessment Modeling

Receptor Group	Fraction of Diet	Ingestion Rate (kg/kg/day)	Body Weight (kg)	Foraging Range (Ha)
Mink	0.422 Sm. Mammals (1)	0.220 Food (2)	0.930 (4)	211 (5)
	0.550 Fish (1)	0.075 Water (3)		
	0.028 Soil (1)			
Red-Tailed Hawk	0.918 Sm. Mammals (1)	0.110 Food (1)	1.260 (6)	400 (7)
	0.082 Soil (1)	0.056 Water (3)		
Great Blue Heron	0.850 Fish (2)	0.180 Food (2)	2.900 (6)	422 (8)
	0.040 Sm. Mammals (9)	0.041 Water (3)		
	0.110 Soil (2 - Wood Duck)			
American Robin	0.344 Invertebrates (10)	0.144 Food (2 - allometric equation)	0.075 (6)	0.81 (2)
	0.574 Plants (10)	0.133 Water (3)		
	0.082 Soil (2 - Canada Goose)			
Eastern Cottontail	0.937 Plants (2)	0.094 Food (2 - allometric equation)	1.500 (2)	3.0 (2)
	0.063 Soil (2 - Jackrabbit)	0.142 Water (3)		
Deer Mouse	0.690 Plants (11)	0.190 Food (1)	0.021 (2)	100% in each zone (13)
	0.230 Invertebrates (11)	0.140 Water (3)		
	0.080 Soil (12)			
Short-tailed Shrew	0.767 Invertebrates (1)	0.490 Food (1)	0.015 (2)	100% in each zone (13)
	0.208 Plants (1)	0.150 Water (3)		
	0.025 Soil (1)			

Table 3-4 (Continued)
Fields Brook FWA
Biological Parameters Used for Ecological Risk Assessment Modeling

Notes:

(1) *United States Environmental Protection Agency (U.S. EPA). 1993. Wildlife exposure factors handbook. EPA-600-R-93-187a-b.*
(2) *United States Environmental Protection Agency (U.S. EPA). 1995. Final report Fields Brook Site, Ashtabula, Ohio. USEPA Contract #68-C4-0022.*
(3) *Calder, W.A. and E.J. Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 244: R601-R606.*
(4) *Burt, W.H. and R.P. Grossenheider. 1976. A Field Guide to the Mammals, Third Edition. Houghton Mifflin, Co., Boston, MA. 287pp.*
(5) *Assumed equal to site size.*
(6) *Terres, J.K. 1982. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knoff, Inc. NY, 1109pp.*
(7) *Craighead, J.J. and F.C. Craighead. 1969. Hawks, Owls, and Wildlife. Dover Publications, New York, NY. 443 P.*
(8) *Assumed ½ time on site because Brook length is much less than reported foraging distances (e.g., (1)).*
(9) *By difference: 1.00 - (0.85+0.11) = 0.04.*
(10) *Wheelwright (1986) in: (1). Annual.*
(11) *Whitaker (1966) in: (1). Annual.*
(12) *Palmer, E.L. and H.S. Fowler. 1975. Fieldbook of Natural History. 2nd ed. McGraw-Hill Book Company, New York, NY. 779 P.*
(13) *Assumed 100% of time in each zone.*

Table 3-2
Fields Brook FWA
Fraction of Receptor Exposure from Individual Zones (Area Use Factors)

Receptor	Range (Ha)	Zone 1	Zone 2	Zone 3	Zone 4	Total
Mink	211	0.31	0.21	0.27	0.21	1.00
Hawk	400	0.16	0.11	0.14	0.11	0.52
Heron	422	0.15	0.11	0.13	0.11	0.50
Robin	*	1.00	1.00	1.00	1.00	*
Rabbit	*	1.00	1.00	1.00	1.00	*
Mouse	*	1.00	1.00	1.00	1.00	*
Shrew	*	1.00	1.00	1.00	1.00	*

Notes:

* *Assumed that these receptors forage 100% of time in study area.*

Table 3-3
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Aroclor-1248	1	Fish	F	0.017	0.000	0.017	----
Aroclor-1248	1	Mammals	N	0.125	0.127	0.165	----
Aroclor-1248	1	Soil	L	26.469	76.967	40.704	1.723
Aroclor-1248	1	Vegetation	N	0.091	0.086	0.165	----
Aroclor-1248	1	Water	F	0.001	0.000	0.001	----
Aroclor-1248	1	Worm	F	0.120	0.000	0.120	----
Aroclor-1248	2	Fish	F	0.017	0.000	0.017	----
Aroclor-1248	2	Mammals	N	0.123	0.110	0.165	----
Aroclor-1248	2	Soil	L	68.927	131.298	94.012	8.583
Aroclor-1248	2	Vegetation	N	0.091	0.081	0.165	----
Aroclor-1248	2	Water	F	0.001	0.000	0.001	----
Aroclor-1248	2	Worm	F	0.440	0.000	0.440	----
Aroclor-1248	3	Fish	F	0.017	0.000	0.017	----
Aroclor-1248	3	Mammals	N	0.124	0.103	0.165	----
Aroclor-1248	3	Soil	L	25.823	49.991	37.803	2.625
Aroclor-1248	3	Vegetation	N	0.098	0.078	0.165	----
Aroclor-1248	3	Water	F	0.001	0.000	0.001	----
Aroclor-1248	3	Worm	F	0.047	0.000	0.047	----
Aroclor-1248	4	Fish	F	0.017	0.000	0.017	----
Aroclor-1248	4	Mammals	F	0.165	0.000	0.165	----
Aroclor-1248	4	Soil	L	0.037	0.028	0.049	0.031
Aroclor-1248	4	Vegetation	N	0.091	0.105	0.165	----
Aroclor-1248	4	Water	F	0.001	0.000	0.001	----
Aroclor-1248	4	Worm	F	0.017	0.000	0.017	----
Aroclor-1248	BK1	Fish	N	0.036	0.028	0.056	----
Aroclor-1248	BK1	Mammals	N	0.091	0.086	0.165	----
Aroclor-1248	BK1	Soil	F	0.025	----	0.025	----
Aroclor-1248	BK1	Vegetation	F	0.017	----	0.017	----
Aroclor-1248	BK1	Water	M	----	----	----	----
Aroclor-1248	BK1	Worm	M	----	----	----	----
Aroclor-1248	BK2	Fish	F	0.165	----	0.165	----
Aroclor-1248	BK2	Mammals	M	----	----	----	----
Aroclor-1248	BK2	Soil	F	0.021	----	0.021	----
Aroclor-1248	BK2	Vegetation	F	0.165	----	0.165	----
Aroclor-1248	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Aroclor-1248	BK2	Insect	F	0.021	----	0.021	----
Aroclor-1254	1	Fish	F	0.017	0.000	0.017	----
Aroclor-1254	1	Mammals	N	0.125	0.127	0.165	----
Aroclor-1254	1	Soil	L	2.109	5.289	3.087	0.300
Aroclor-1254	1	Vegetation	N	0.091	0.086	0.165	----
Aroclor-1254	1	Water	F	0.001	0.000	0.001	----
Aroclor-1254	1	Worm	F	0.017	0.000	0.017	----
Aroclor-1254	2	Fish	F	0.017	0.000	0.017	----
Aroclor-1254	2	Mammals	N	0.123	0.110	0.165	----
Aroclor-1254	2	Soil	L	5.589	10.195	7.536	1.085
Aroclor-1254	2	Vegetation	N	0.091	0.081	0.165	----
Aroclor-1254	2	Water	F	0.001	0.000	0.001	----
Aroclor-1254	2	Worm	F	0.017	0.000	0.017	----
Aroclor-1254	3	Fish	F	0.017	0.000	0.017	----
Aroclor-1254	3	Mammals	N	0.124	0.103	0.165	----
Aroclor-1254	3	Soil	L	4.987	15.091	8.604	0.667
Aroclor-1254	3	Vegetation	N	0.091	0.086	0.165	----
Aroclor-1254	3	Water	F	0.001	0.000	0.001	----
Aroclor-1254	3	Worm	F	0.017	0.000	0.017	----
Aroclor-1254	4	Fish	F	0.017	0.000	0.017	----
Aroclor-1254	4	Mammals	F	0.165	0.000	0.165	----
Aroclor-1254	4	Soil	L	0.037	0.030	0.050	0.031
Aroclor-1254	4	Vegetation	N	0.091	0.105	0.165	----
Aroclor-1254	4	Water	F	0.001	0.000	0.001	----
Aroclor-1254	4	Worm	F	0.017	0.000	0.017	----
Aroclor-1254	BK1	Fish	F	0.017	0.000	0.017	----
Aroclor-1254	BK1	Mammals	N	0.091	0.086	0.165	----
Aroclor-1254	BK1	Soil	F	0.025	----	0.025	----
Aroclor-1254	BK1	Vegetation	F	0.017	----	0.017	----
Aroclor-1254	BK1	Water	M	----	----	----	----
Aroclor-1254	BK1	Worm	M	----	----	----	----
Aroclor-1254	BK2	Fish	F	0.165	----	0.165	----
Aroclor-1254	BK2	Mammals	M	----	----	----	----
Aroclor-1254	BK2	Soil	F	0.021	----	0.021	----
Aroclor-1254	BK2	Vegetation	F	0.165	----	0.165	----
Aroclor-1254	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Aroclor-1254	BK2	Insect	N	0.021	----	0.021	----
Aroclor-1260	1	Fish	F	0.017	0.000	0.017	----
Aroclor-1260	1	Mammals	L	0.434	0.560	1.300	0.155
Aroclor-1260	1	Soil	L	2.106	5.290	3.085	0.285
Aroclor-1260	1	Vegetation	N	0.091	0.086	0.165	----
Aroclor-1260	1	Water	F	0.001	0.000	0.001	----
Aroclor-1260	1	Worm	F	0.017	0.000	0.017	----
Aroclor-1260	2	Fish	F	0.017	0.000	0.017	----
Aroclor-1260	2	Mammals	L	1.151	2.988	11.000	0.188
Aroclor-1260	2	Soil	L	5.585	10.197	7.533	1.030
Aroclor-1260	2	Vegetation	N	0.091	0.081	0.165	----
Aroclor-1260	2	Water	F	0.001	0.000	0.001	----
Aroclor-1260	2	Worm	F	0.017	0.000	0.017	----
Aroclor-1260	3	Fish	F	0.017	0.000	0.017	----
Aroclor-1260	3	Mammals	L	0.773	1.333	3.700	0.226
Aroclor-1260	3	Soil	L	5.185	15.095	8.802	6.138
Aroclor-1260	3	Vegetation	N	0.091	0.086	0.165	----
Aroclor-1260	3	Water	F	0.001	0.000	0.001	----
Aroclor-1260	3	Worm	F	0.017	0.000	0.017	----
Aroclor-1260	4	Fish	F	0.017	0.000	0.017	----
Aroclor-1260	4	Mammals	N	0.165	3.246	0.165	----
Aroclor-1260	4	Soil	L	0.038	0.296	0.050	0.031
Aroclor-1260	4	Vegetation	N	0.091	0.105	0.165	----
Aroclor-1260	4	Water	F	0.001	0.000	0.001	----
Aroclor-1260	4	Worm	F	0.017	0.000	0.017	----
Aroclor-1260	BK1	Fish	F	0.017	0.000	0.017	----
Aroclor-1260	BK1	Mammals	N	0.091	0.086	0.165	----
Aroclor-1260	BK1	Soil	F	0.003	----	0.003	----
Aroclor-1260	BK1	Vegetation	F	0.017	----	0.017	----
Aroclor-1260	BK1	Water	M	----	----	----	----
Aroclor-1260	BK1	Worm	M	----	----	----	----
Aroclor-1260	BK2	Fish	F	0.165	----	0.165	----
Aroclor-1260	BK2	Mammals	M	----	----	----	----
Aroclor-1260	BK2	Soil	F	0.021	----	0.021	----
Aroclor-1260	BK2	Vegetation	F	0.165	----	0.165	----
Aroclor-1260	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Aroclor-1260	BK2	Insect	F	0.021	----	0.021	----
Arsenic	1	Fish	F	0.075	----	0.075	----
Arsenic	1	Mammals	N	0.093	0.108	0.150	----
Arsenic	1	Soil	L	13.920	8.630	15.500	11.340
Arsenic	1	Vegetation	N	0.125	0.029	0.150	----
Arsenic	1	Water	N	0.011	0.014	0.027	----
Arsenic	1	Worm	F	0.140	0.000	0.140	----
Arsenic	2	Fish	F	0.075	----	0.075	----
Arsenic	2	Mammals	N	0.165	0.280	0.720	----
Arsenic	2	Soil	L	12.690	8.530	14.300	10.340
Arsenic	2	Vegetation	N	0.152	0.015	0.158	----
Arsenic	2	Water	N	0.011	0.014	0.027	----
Arsenic	2	Worm	F	1.500	0.000	1.500	----
Arsenic	3	Fish	F	0.075	----	0.075	----
Arsenic	3	Mammals	N	0.227	0.230	0.485	----
Arsenic	3	Soil	L	15.560	10.840	18.200	12.340
Arsenic	3	Vegetation	N	0.220	0.133	0.420	----
Arsenic	3	Water	N	0.011	0.014	0.027	----
Arsenic	3	Worm	F	1.800	0.000	1.800	----
Arsenic	4	Fish	F	0.075	----	0.075	----
Arsenic	4	Mammals	N	0.188	0.103	0.240	----
Arsenic	4	Soil	L	9.890	3.780	11.500	9.220
Arsenic	4	Vegetation	N	0.157	0.012	0.170	----
Arsenic	4	Water	N	0.011	0.014	0.027	----
Arsenic	4	Worm	F	1.500	0.000	1.500	----
Arsenic	BK1	Fish	F	0.075	----	0.075	----
Arsenic	BK1	Mammals	N	0.122	0.049	0.180	----
Arsenic	BK1	Soil	F	10.900	----	10.900	----
Arsenic	BK1	Vegetation	F	0.320	----	0.320	----
Arsenic	BK1	Water	M	----	----	----	----
Arsenic	BK1	Worm	M	----	----	----	----
Arsenic	BK2	Fish	F	0.075	----	0.075	----
Arsenic	BK2	Mammals	F	0.110	----	0.110	----
Arsenic	BK2	Soil	F	8.000	----	8.000	----
Arsenic	BK2	Vegetation	F	0.075	----	0.075	----
Arsenic	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Arsenic	BK2	Worm	M	----	----	----	----
Barium	1	Fish	M	----	----	----	----
Barium	1	Mammals	M	----	----	----	----
Barium	1	Soil	L	2493.730	4521.430	3329.800	575.130
Barium	1	Vegetation	M	----	----	----	----
Barium	1	Water	M	----	----	----	----
Barium	1	Worm	F	27.400	0.000	27.400	----
Barium	2	Fish	M	----	----	----	----
Barium	2	Mammals	L	9.294	17.057	54.200	3.983
Barium	2	Soil	L	2241.830	2531.130	2725.400	1066.780
Barium	2	Vegetation	M	----	----	----	----
Barium	2	Water	M	----	----	----	----
Barium	2	Worm	F	16.400	0.000	16.400	----
Barium	3	Fish	M	----	----	----	----
Barium	3	Mammals	L	3.511	1.882	6.300	2.918
Barium	3	Soil	L	281.860	266.690	345.800	207.260
Barium	3	Vegetation	M	----	----	----	----
Barium	3	Water	M	----	----	----	----
Barium	3	Worm	F	8.600	0.000	8.600	----
Barium	4	Fish	M	----	----	----	----
Barium	4	Mammals	M	----	----	----	----
Barium	4	Soil	L	272.310	390.010	437.500	180.400
Barium	4	Vegetation	M	----	----	----	----
Barium	4	Water	M	----	----	----	----
Barium	4	Worm	F	7.900	0.000	7.900	----
Barium	BK1	Fish	M	----	----	----	----
Barium	BK1	Mammals	M	----	----	----	----
Barium	BK1	Soil	F	37.400	----	37.400	----
Barium	BK1	Vegetation	M	----	----	----	----
Barium	BK1	Water	M	----	----	----	----
Barium	BK1	Worm	M	----	----	----	----
Barium	BK2	Fish	M	----	----	----	----
Barium	BK2	Mammals	M	----	----	----	----
Barium	BK2	Soil	F	22.600	----	22.600	----
Barium	BK2	Vegetation	M	----	----	----	----
Barium	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Barium	BK2	Worm	M	----	----	----	----
Cadmium	1	Fish	F	0.075	----	0.075	----
Cadmium	1	Mammals	N	0.348	0.736	0.850	----
Cadmium	1	Soil	L	2.710	3.060	3.300	1.250
Cadmium	1	Vegetation	L	0.215	0.070	0.280	0.206
Cadmium	1	Water	F	0.003	0.000	0.003	----
Cadmium	1	Worm	F	2.800	0.000	2.800	----
Cadmium	2	Fish	F	0.075	----	0.075	----
Cadmium	2	Mammals	N	0.230	0.426	1.000	----
Cadmium	2	Soil	L	3.890	3.820	4.600	2.100
Cadmium	2	Vegetation	N	0.202	0.057	0.249	----
Cadmium	2	Water	F	0.003	0.000	0.003	----
Cadmium	2	Worm	F	4.500	0.000	4.500	----
Cadmium	3	Fish	F	0.075	----	0.075	----
Cadmium	3	Mammals	N	0.056	0.035	0.150	----
Cadmium	3	Soil	L	1.600	1.930	2.100	0.960
Cadmium	3	Vegetation	N	0.218	0.078	0.290	----
Cadmium	3	Water	F	0.003	0.000	0.003	----
Cadmium	3	Worm	F	2.000	0.000	2.000	----
Cadmium	4	Fish	F	0.075	----	0.075	----
Cadmium	4	Mammals	N	0.341	0.178	0.390	----
Cadmium	4	Soil	L	0.440	0.140	0.500	0.420
Cadmium	4	Vegetation	F	0.233	0.091	0.330	----
Cadmium	4	Water	F	0.003	0.000	0.003	----
Cadmium	4	Worm	F	2.300	0.000	2.300	----
Cadmium	BK1	Fish	F	0.075	0.000	0.075	----
Cadmium	BK1	Mammals	N	0.259	0.168	0.480	----
Cadmium	BK1	Soil	F	3.300	----	3.300	----
Cadmium	BK1	Vegetation	F	0.150	----	0.150	----
Cadmium	BK1	Water	M	----	----	----	----
Cadmium	BK1	Worm	M	----	----	----	----
Cadmium	BK2	Fish	F	0.075	----	0.075	----
Cadmium	BK2	Mammals	F	0.140	----	0.140	----
Cadmium	BK2	Soil	F	1.800	----	1.800	----
Cadmium	BK2	Vegetation	F	0.290	----	0.290	----
Cadmium	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Cadmium	BK2	Worm	M	----	----	----	----
Chromium	1	Fish	F	0.530	----	0.530	----
Chromium	1	Mammals	L	0.747	0.107	0.900	0.741
Chromium	1	Soil	L	81.310	102.350	100.200	48.200
Chromium	1	Vegetation	N	0.933	0.646	1.900	----
Chromium	1	Water	F	0.007	0.000	0.007	----
Chromium	1	Worm	F	3.200	0.000	3.200	----
Chromium	2	Fish	F	0.530	----	0.530	----
Chromium	2	Mammals	L	0.719	0.353	1.300	0.619
Chromium	2	Soil	L	135.420	182.560	170.300	73.050
Chromium	2	Vegetation	F	0.555	0.158	0.685	----
Chromium	2	Water	F	0.007	0.000	0.007	----
Chromium	2	Worm	F	3.400	0.000	3.400	----
Chromium	3	Fish	F	0.530	----	0.530	----
Chromium	3	Mammals	N	0.630	0.374	0.900	----
Chromium	3	Soil	L	233.050	329.470	312.000	105.740
Chromium	3	Vegetation	L	0.693	0.350	1.100	0.624
Chromium	3	Water	F	0.007	0.000	0.007	----
Chromium	3	Worm	F	3.700	0.000	3.700	----
Chromium	4	Fish	F	0.530	----	0.530	----
Chromium	4	Mammals	N	0.541	0.106	0.630	----
Chromium	4	Soil	L	28.800	17.980	36.400	25.110
Chromium	4	Vegetation	N	0.523	0.215	0.760	----
Chromium	4	Water	F	0.007	0.000	0.007	----
Chromium	4	Worm	F	2.900	0.000	2.900	----
Chromium	BK1	Fish	N	0.280	0.156	0.390	----
Chromium	BK1	Mammals	N	0.824	0.097	0.930	----
Chromium	BK1	Soil	F	10.400	----	10.400	----
Chromium	BK1	Vegetation	F	1.100	----	1.100	----
Chromium	BK1	Water	M	----	----	----	----
Chromium	BK1	Worm	M	----	----	----	----
Chromium	BK2	Fish	F	0.170	----	0.170	----
Chromium	BK2	Mammals	F	0.330	----	0.330	----
Chromium	BK2	Soil	F	5.300	----	5.300	----
Chromium	BK2	Vegetation	F	0.175	----	0.175	----
Chromium	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Chromium	BK2	Worm	M	----	----	----	----
Hexachlorobenzene	1	Fish	M	----	----	----	----
Hexachlorobenzene	1	Mammals	L	0.085	0.062	0.160	0.067
Hexachlorobenzene	1	Soil	L	10.178	20.143	13.903	1.282
Hexachlorobenzene	1	Vegetation	N	0.047	0.004	0.050	----
Hexachlorobenzene	1	Water	F	0.0001	0.0000	0.0001	----
Hexachlorobenzene	1	Worm	F	0.038	0.000	0.038	----
Hexachlorobenzene	2	Fish	M	----	----	----	----
Hexachlorobenzene	2	Mammals	L	0.344	0.346	1.200	0.167
Hexachlorobenzene	2	Soil	L	31.319	60.774	42.930	5.179
Hexachlorobenzene	2	Vegetation	N	0.052	0.035	0.086	----
Hexachlorobenzene	2	Water	F	0.0001	0.0000	0.0001	----
Hexachlorobenzene	2	Worm	F	0.180	0.000	0.180	----
Hexachlorobenzene	3	Fish	M	----	----	----	----
Hexachlorobenzene	3	Mammals	L	0.222	0.286	0.820	0.077
Hexachlorobenzene	3	Soil	L	25.757	88.576	46.982	1.437
Hexachlorobenzene	3	Vegetation	F	0.017	0.000	0.017	----
Hexachlorobenzene	3	Water	N	0.0001	0.0000	0.0001	----
Hexachlorobenzene	3	Worm	M	0.015	0.000	0.015	----
Hexachlorobenzene	4	Fish	F	----	----	----	----
Hexachlorobenzene	4	Mammals	F	0.017	2.977	0.017	----
Hexachlorobenzene	4	Soil	L	0.274	0.094	0.315	0.262
Hexachlorobenzene	4	Vegetation	M	----	----	----	----
Hexachlorobenzene	4	Water	F	0.0001	0.0000	0.0001	----
Hexachlorobenzene	4	Worm	F	0.009	0.000	0.009	----
Hexachlorobenzene	BK1	Fish	N	0.017	0.005	0.020	----
Hexachlorobenzene	BK1	Mammals	N	0.014	0.013	0.033	----
Hexachlorobenzene	BK1	Soil	N	0.245	----	0.245	----
Hexachlorobenzene	BK1	Vegetation	N	0.002	----	0.002	----
Hexachlorobenzene	BK1	Water	M	----	----	----	----
Hexachlorobenzene	BK1	Worm	M	----	----	----	----
Hexachlorobenzene	BK2	Fish	N	0.017	----	0.017	----
Hexachlorobenzene	BK2	Mammals	N	0.017	----	0.017	----
Hexachlorobenzene	BK2	Soil	N	0.205	----	0.205	----
Hexachlorobenzene	BK2	Vegetation	N	0.017	----	0.017	----
Hexachlorobenzene	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Hexachlorobenzene	BK2	Insect	N	0.002	----	0.002	----
Hexachlorobutadiene	1	Fish	F	0.165	----	0.165	----
Hexachlorobutadiene	1	Mammals	F	0.165	0.000	0.165	----
Hexachlorobutadiene	1	Soil	L	1.826	6.862	3.095	0.368
Hexachlorobutadiene	1	Vegetation	N	0.536	0.743	1.650	----
Hexachlorobutadiene	1	Water	F	0.005	0.000	0.005	----
Hexachlorobutadiene	1	Worm	F	0.165	0.000	0.165	----
Hexachlorobutadiene	2	Fish	F	0.165	----	0.165	----
Hexachlorobutadiene	2	Mammals	N	0.194	0.106	0.330	----
Hexachlorobutadiene	2	Soil	L	10.059	31.097	16.000	0.975
Hexachlorobutadiene	2	Vegetation	N	0.624	0.591	1.110	----
Hexachlorobutadiene	2	Water	F	0.005	0.000	0.005	----
Hexachlorobutadiene	2	Worm	F	0.044	0.000	0.044	----
Hexachlorobutadiene	3	Fish	F	0.165	----	0.165	----
Hexachlorobutadiene	3	Mammals	N	0.211	0.114	0.330	----
Hexachlorobutadiene	3	Soil	L	1.076	2.641	1.709	0.391
Hexachlorobutadiene	3	Vegetation	N	0.908	0.857	1.650	----
Hexachlorobutadiene	3	Water	F	0.005	0.000	0.005	----
Hexachlorobutadiene	3	Worm	F	0.165	0.000	0.165	----
Hexachlorobutadiene	4	Fish	F	0.165	----	0.165	----
Hexachlorobutadiene	4	Mammals	N	0.537	1.418	1.650	----
Hexachlorobutadiene	4	Soil	L	0.274	0.094	0.315	0.262
Hexachlorobutadiene	4	Vegetation	N	0.588	0.367	0.800	----
Hexachlorobutadiene	4	Water	F	0.005	0.000	0.005	----
Hexachlorobutadiene	4	Worm	F	0.165	0.000	0.165	----
Hexachlorobutadiene	BK1	Fish	F	0.165	0.000	0.165	----
Hexachlorobutadiene	BK1	Mammals	N	0.198	0.074	0.330	----
Hexachlorobutadiene	BK1	Soil	F	0.245	----	0.245	----
Hexachlorobutadiene	BK1	Vegetation	F	0.800	----	0.800	----
Hexachlorobutadiene	BK1	Water	M	----	----	----	----
Hexachlorobutadiene	BK1	Worm	M	----	----	----	----
Hexachlorobutadiene	BK2	Fish	F	0.165	----	0.165	----
Hexachlorobutadiene	BK2	Mammals	F	0.600	----	0.600	----
Hexachlorobutadiene	BK2	Soil	F	0.205	----	0.205	----
Hexachlorobutadiene	BK2	Vegetation	F	0.800	----	0.800	----
Hexachlorobutadiene	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics Mean	Std	UCL95	Logarithmic Mean
Hexachlorobutadiene	BK2	Worm	M	----	----	----	----
Lead	1	Fish	F	0.025	----	0.025	----
Lead	1	Mammals	L	0.485		0.570	0.459
Lead	1	Soil	L	54.560	25.050	59.200	49.280
Lead	1	Vegetation	L	0.275	0.126	0.460	0.257
Lead	1	Water	M	----	----	----	----
Lead	1	Worm	F	3.400	0.000	3.400	----
Lead	2	Fish	F	0.025	----	0.025	----
Lead	2	Mammals	L	0.203	0.113	0.450	0.172
Lead	2	Soil	L	57.650	33.550	64.100	50.270
Lead	2	Vegetation	L	0.253	0.065	0.303	0.246
Lead	2	Water	M	----	----	----	----
Lead	2	Worm	F	10.100	0.000	10.100	----
Lead	3	Fish	F	0.025	----	0.025	----
Lead	3	Mammals	L	0.205	0.080	0.310	0.184
Lead	3	Soil	L	57.360	38.090	0.067	49.500
Lead	3	Vegetation	L	0.470	0.171	0.640	0.446
Lead	3	Water	M	----	----	----	----
Lead	3	Worm	F	6.600	0.000	6.600	----
Lead	4	Fish	F	0.025	----	0.025	----
Lead	4	Mammals	L	0.234	0.107	0.429	0.216
Lead	4	Soil	L	31.900	10.490	36.300	30.150
Lead	4	Water	M	----	----	----	----
Lead	4	Vegetation	N	0.380	0.315	0.730	----
Lead	4	Worm	F	5.500	0.000	5.500	----
Lead	BK1	Fish	F	0.025	0.000	0.025	----
Lead	BK1	Mammals	N	0.406	0.137	0.630	----
Lead	BK1	Soil	F	12.900	----	12.900	----
Lead	BK1	Vegetation	F	1.200	----	1.200	----
Lead	BK1	Water	M	----	----	----	----
Lead	BK1	Worm	M	----	----	----	----
Lead	BK2	Fish	F	0.090	----	0.090	----
Lead	BK2	Mammals	F	0.240	----	0.240	----
Lead	BK2	Soil	F	9.800	----	9.800	----
Lead	BK2	Vegetation	F	0.130	----	0.130	----
Lead	BK2	Water	N	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics Mean	Std	UCL95	Logarithmic Mean
Lead	BK2	Worm	N	----	----	----	----
Mercury	1	Fish	F	0.045	----	0.045	----
Mercury	1	Mammals	L	0.096	0.052	0.170	0.084
Mercury	1	Soil	L	2.090	2.810	2.600	0.630
Mercury	1	Vegetation	N	0.095	0.006	0.100	----
Mercury	1	Water	F	0.000	0.000	0.000	----
Mercury	1	Worm	F	0.430	0.000	0.430	----
Mercury	2	Fish	F	0.045	----	0.045	----
Mercury	2	Mammals	L	0.254	0.604	2.200	0.085
Mercury	2	Soil	L	4.050	4.400	4.900	1.730
Mercury	2	Vegetation	L	0.087	0.008	0.090	0.084
Mercury	2	Water	F	0.0002	0.0000	0.0002	----
Mercury	2	Worm	F	0.270	0.000	0.270	----
Mercury	3	Fish	F	0.045	----	0.045	----
Mercury	3	Mammals	L	0.242	0.371	1.000	0.092
Mercury	3	Soil	L	11.230	14.200	14.600	2.630
Mercury	3	Vegetation	N	0.083	0.005	0.086	----
Mercury	3	Water	F	0.0002	0.0000	0.0002	----
Mercury	3	Worm	F	0.660	0.000	0.660	----
Mercury	4	Fish	F	0.045	----	0.045	----
Mercury	4	Mammals	L	0.137	0.109	0.270	0.097
Mercury	4	Soil	L	4.290	13.690	10.100	0.640
Mercury	4	Vegetation	N	0.093	0.012	0.100	----
Mercury	4	Water	F	0.0002	0.0000	0.0002	----
Mercury	4	Worm	F	0.410	0.000	0.410	----
Mercury	BK1	Fish	N	0.118	0.103	0.190	----
Mercury	BK1	Mammals	N	0.092	0.068	0.200	----
Mercury	BK1	Soil	F	0.140	----	0.140	----
Mercury	BK1	Vegetation	F	0.050	----	0.050	----
Mercury	BK1	Water	M	----	----	----	----
Mercury	BK1	Worm	M	----	----	----	----
Mercury	BK2	Fish	F	0.170	----	0.170	----
Mercury	BK2	Mammals	F	0.050	----	0.050	----
Mercury	BK2	Soil	F	0.100	----	0.100	----
Mercury	BK2	Vegetation	F	0.045	----	0.045	----
Mercury	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics Mean	Arithmetic Statistics Std	Arithmetic Statistics UCL95	Logarithmic Mean
Mercury	BK2	Worm	M	----	----	----	----
Vanadium	1	Fish	M	----	----	----	----
Vanadium	1	Mammals	M	----	----	----	----
Vanadium	1	Soil	L	118.480	172.310	150.300	63.090
Vanadium	1	Vegetation	M	----	----	----	----
Vanadium	1	Water	M	----	----	----	----
Vanadium	1	Worm	F	2.200	0.000	2.200	----
Vanadium	2	Fish	M	----	----	----	----
Vanadium	2	Mammals	N	0.233	0.154	0.490	----
Vanadium	2	Soil	L	216.000	301.050	273.500	107.740
Vanadium	2	Vegetation	M	----	----	----	----
Vanadium	2	Water	M	----	----	----	----
Vanadium	2	Worm	F	3.500	0.000	3.500	----
Vanadium	3	Fish	M	----	----	----	----
Vanadium	3	Mammals	N	0.155	0.077	0.360	----
Vanadium	3	Soil	L	375.560	556.710	509.000	160.090
Vanadium	3	Vegetation	M	----	----	----	----
Vanadium	3	Water	M	----	----	----	----
Vanadium	3	Worm	F	2.200	0.000	2.200	----
Vanadium	4	Fish	M	----	----	----	----
Vanadium	4	Mammals	M	----	----	----	----
Vanadium	4	Soil	L	77.020	113.070	124.900	44.840
Vanadium	4	Vegetation	M	----	----	----	----
Vanadium	4	Water	M	----	----	----	----
Vanadium	4	Worm	F	1.600	0.000	1.600	----
Vanadium	BK1	Fish	M	----	----	----	----
Vanadium	BK1	Mammals	M	----	----	----	----
Vanadium	BK1	Soil	F	9.400	----	9.400	----
Vanadium	BK1	Vegetation	M	----	----	----	----
Vanadium	BK1	Water	M	----	----	----	----
Vanadium	BK1	Worm	M	----	----	----	----
Vanadium	BK2	Fish	M	----	----	----	----
Vanadium	BK2	Mammals	M	----	----	----	----
Vanadium	BK2	Soil	F	4.900	----	4.900	----
Vanadium	BK2	Vegetation	M	----	----	----	----
Vanadium	BK2	Water	M	----	----	----	----

Table 3-3 (Continued)
Fields Brook FWA
Data Used in the Ecological Risk Assessment Model for Fields Brook
(mg/kg)

Analyte	Zone	Matrix	Shape	Arithmetic Statistics			Logarithmic
				Mean	Std	UCL95	Mean
Vanadium	BK2	Worm	M	----	----	----	----

Note: Distribution shapes are:

N	=	*normal*
L	=	*lognormal*
U	=	*uniform*
T	=	*triangular*
M	=	*missing*
F	=	*fixed*
----	=	*Not Calculated.*

BK1 and BK2 are off-site reference locations.

Table 4-1
Fields Brook FWA
Toxicity Reference Values (mg/kg-bw/day)

Contaminant of Concern (COC)	Receptor of Concern (ROC)				
	Small Mammals (mouse, shrew)	Medium Mammals (mink, rabbit)	Raptors (hawk)	Great Blue Heron	American Robin
Aroclor 1248	1.30	0.26	0.45	5.58	0.46
Aroclor 1254	0.32	0.15	0.68	3.40	2.54
Aroclor 1260	7.40	0.15	0.94	3.96	0.94
Arsenic	0.75	1.20	1.26	1.36	1.26
Barium	11.60	2.32	*	*	*
Cadmium	0.99	0.75	0.10	0.10	0.10
Chromium	0.99	0.48	1.28	1.28	1.28
Hexachlorobenzene	2.80	0.12	0.11	0.11	0.11
Hexachlorobutadiene	0.20	0.04	1.20	1.20	1.20
Lead	0.90	1.25	0.82	0.19	0.28
Mercury	0.03	0.076	0.01	0.014	0.023
Vanadium	0.70	0.14	*	*	*

* No applicable data were located.

Table 5-1
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on Mean Exposure Concrentrations and
Area use Factors as Presented

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Aroclor-1248	1	0.03	0.01	0.06	0.03	<0.01	0.07	0.07
Aroclor-1254	1	0.03	<0.01	0.06	0.05	<0.01	<0.01	0.07
Aroclor-1260	1	0.04	<0.01	<0.01	<0.01	<0.01	0.01	0.07
Total PCBs	1	0.10	0.01	0.12	0.09	<0.01	0.09	0.21
Aroclor-1248	2	0.05	0.02	0.22	0.13	<0.01	0.29	0.24
Aroclor-1254	2	0.03	<0.01	0.09	0.09	<0.01	0.01	0.10
Aroclor-1260	2	0.04	<0.01	<0.01	<0.01	<0.01	0.02	0.10
Total PCBs	2	0.12	0.02	0.31	0.22	<0.01	0.32	0.44
Aroclor-1248	3	0.03	0.01	0.05	0.04	<0.01	0.09	0.10
Aroclor-1254	3	0.03	<0.01	0.08	0.07	<0.01	0.01	0.08
Aroclor-1260	3	0.11	0.01	0.01	0.01	<0.01	0.09	0.31
Total PCBs	3	0.17	0.02	0.13	0.13	<0.01	0.18	0.49
Aroclor-1248	4	0.01	<0.01	0.01	0.01	<0.01	0.02	0.03
Aroclor-1254	4	0.02	<0.01	0.05	0.04	<0.01	<0.01	0.06
Aroclor-1260	4	0.02	<0.01	<0.01	<0.01	<0.01	0.01	0.06
Total PCBs	4	0.06	0.00	0.06	0.05	<0.01	0.03	0.14
Aroclor-1248	BK1	0.05	0.02	----	----	<0.01	----	0.01
Aroclor-1254	BK1	0.07	0.01	----	----	<0.01	----	0.01
Aroclor-1260	BK1	0.07	0.01	----	----	<0.01	----	0.01
Total PCBs	BK1	0.19	0.04	----	----	<0.01	----	0.03
Aroclor-1248	BK2	----	----	0.02	0.02	----	0.03	0.06
Aroclor-1254	BK2	----	----	0.08	0.07	----	0.01	0.10
Aroclor-1260	BK2	----	----	<0.01	<0.01	----	0.02	0.10
Total PCBs	BK2	----	----	0.10	0.09	----	0.05	0.25
Arsenic	1	0.02	0.01	0.27	0.26	0.01	0.12	0.07
Arsenic	2	0.02	0.01	0.94	0.33	0.01	0.17	0.07
Arsenic	3	0.02	0.02	1.13	0.40	0.01	0.20	0.08
Arsenic	4	0.01	0.01	0.92	0.31	0.01	0.16	0.06
Arsenic	BK1	0.07	0.09	----	----	0.08	----	0.08
Arsenic	BK2	0.06	0.07	----	----	0.06	----	0.05
Barium	1	----	----	----	----	----	----	----
Barium	2	0.67	----	----	----	----	----	----
Barium	3	0.22	----	----	----	----	----	----
Barium	4	----	----	----	----	----	----	----
Barium	BK1	----	----	----	----	----	----	----
Barium	BK2	----	----	----	----	----	----	----
Cadmium	1	0.02	0.07	1.10	0.17	0.03	1.70	0.04
Cadmium	2	0.01	0.05	1.75	0.26	0.03	2.66	0.04
Cadmium	3	0.01	0.02	0.79	0.13	0.02	1.29	0.03
Cadmium	4	0.01	0.04	0.91	0.14	0.01	1.37	0.03
Cadmium	BK1	0.07	0.58	----	----	0.35	----	0.05
Cadmium	BK2	0.04	0.31	----	----	0.22	----	0.05
Chromium	1	0.28	0.07	1.91	1.00	0.06	0.63	0.81
Chromium	2	0.25	0.06	2.26	1.36	0.06	0.84	1.06
Chromium	3	0.44	0.12	2.76	1.87	0.10	1.17	1.51
Chromium	4	0.12	0.03	1.47	0.59	0.02	0.38	0.42
Chromium	BK1	0.37	0.14	----	----	0.09	----	0.34

Table 5-1 (Continued)
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on Mean Exposure Concrentrations and Area use Factors as Presented

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Chromium	BK2	0.18	0.07	----	----	0.05	----	0.10
Hexachlorobenzene	1	0.06	0.03	0.01	0.01	0.02	0.19	0.10
Hexachlorobenzene	2	0.12	0.07	0.05	0.03	0.06	0.68	0.31
Hexachlorobenzene	3	0.06	0.03	0.01	0.01	0.02	0.18	0.09
Hexachlorobenzene	4	0.01	<0.01	----	----	<0.01	----	----
Hexachlorobenzene	BK1	0.04	0.03	----	----	0.03	----	0.01
Hexachlorobenzene	BK2	0.04	0.03	<0.01	<0.01	0.03	0.04	0.02
Hexachlorobutadiene	1	0.29	<0.01	0.60	0.42	<0.01	0.05	1.25
Hexachlorobutadiene	2	0.23	<0.01	0.46	0.49	<0.01	0.05	1.54
Hexachlorobutadiene	3	0.29	<0.01	0.80	0.66	<0.01	0.07	2.08
Hexachlorobutadiene	4	0.38	0.01	0.63	0.44	<0.01	0.05	1.35
Hexachlorobutadiene	BK1	0.99	0.02	----	----	0.01	----	1.80
Hexachlorobutadiene	BK2	1.92	0.05	----	----	0.01	----	1.77
Lead	1	0.09	0.10	2.15	1.04	0.36	2.78	0.27
Lead	2	0.05	0.07	4.92	1.39	0.27	3.98	0.27
Lead	3	0.07	0.08	3.47	1.22	0.31	3.36	0.28
Lead	4	0.04	0.04	2.74	0.83	0.16	2.38	0.18
Lead	BK1	0.10	0.20	----	----	0.62	----	0.15
Lead	BK2	0.07	0.14	----	----	0.50	----	0.06
Mercury	1	0.07	0.23	5.96	1.36	0.04	1.59	0.16
Mercury	2	0.07	0.28	4.38	1.66	0.03	1.78	0.24
Mercury	3	0.11	0.48	9.60	2.63	0.03	3.08	0.31
Mercury	4	0.05	0.18	5.67	1.33	0.03	1.54	0.16
Mercury	BK1	0.31	1.06	----	----	0.59	----	0.07
Mercury	BK2	0.34	0.60	----	----	0.84	----	0.06
Vanadium	1	----	----	----	----	----	----	----
Vanadium	2	1.08	----	----	----	----	----	----
Vanadium	3	2.00	----	----	----	----	----	----
Vanadium	4	----	----	----	----	----	----	----
Vanadium	BK1	----	----	----	----	----	----	----
Vanadium	BK2	----	----	----	----	----	----	----

Note:

BK1 and BK2 are off-site reference locations.

Table 5-2
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on 95% Upper Confidence Limits on the Means of Concentrations and Area Use Factors as Presented

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Aroclor-1248	1	0.33	0.14	0.44	0.50	0.01	1.11	1.04
Aroclor-1254	1	0.08	0.01	0.19	0.22	<0.01	0.02	0.23
Aroclor-1260	1	0.30	0.03	0.01	0.01	<0.01	0.05	0.23
Total PCBs	1	0.70	0.18	0.64	0.72	0.01	1.18	1.50
Aroclor-1248	2	0.49	0.22	1.03	1.13	0.02	2.50	2.33
Aroclor-1254	2	0.09	0.01	0.36	0.43	<0.01	0.04	0.41
Aroclor-1260	2	1.49	0.14	0.02	0.02	<0.01	0.11	0.41
Total PCBs	2	2.07	0.37	1.41	1.58	0.02	2.65	3.16
Aroclor-1248	3	0.26	0.12	0.38	0.46	0.01	1.00	0.98
Aroclor-1254	3	0.13	0.02	0.40	0.48	<0.01	0.05	0.46
Aroclor-1260	3	0.72	0.07	0.02	0.02	<0.01	0.13	0.46
Total PCBs	3	1.11	0.21	0.80	0.96	0.01	1.17	1.90
Aroclor-1248	4	0.01	<0.01	0.02	0.02	<0.01	0.03	0.06
Aroclor-1254	4	0.02	<0.01	0.07	0.07	<0.01	0.01	0.10
Aroclor-1260	4	0.03	<0.01	<0.01	<0.01	<0.01	0.02	0.10
Total PCBs	4	0.06	0.00	0.09	0.09	<0.01	0.06	0.26
Aroclor-1248	BK1	0.09	0.04	----	----	<0.01	----	0.01
Aroclor-1254	BK1	0.12	0.02	----	----	<0.01	----	0.01
Aroclor-1260	BK1	0.12	0.02	----	----	<0.01	----	0.01
Total PCBs	BK1	0.32	0.08	----	----	<0.01	----	0.03
Aroclor-1248	BK2	----	----	0.02	0.02	----	0.03	0.06
Aroclor-1254	BK2	----	----	0.08	0.07	----	0.01	0.10
Aroclor-1260	BK2	----	----	<0.01	<0.01	----	0.02	0.10
Total PCBs	BK2	----	----	0.10	0.09	----	0.05	0.25
Arsenic	1	0.03	0.02	0.35	0.36	0.02	0.17	0.10
Arsenic	2	0.03	0.02	1.01	0.41	0.01	0.21	0.09
Arsenic	3	0.04	0.02	1.26	0.56	0.02	0.27	0.13
Arsenic	4	0.02	0.01	0.97	0.36	0.01	0.18	0.08
Arsenic	BK1	0.08	0.10	----	----	0.08	----	0.08
Arsenic	BK2	0.06	0.07	----	----	0.06	----	0.05
Barium	1	----	----	----	----	----	----	----
Barium	2	2.56	----	----	----	----	----	----
Barium	3	0.40	----	----	----	----	----	----
Barium	4	----	----	----	----	----	----	----
Barium	BK1	----	----	----	----	----	----	----
Barium	BK2	----	----	----	----	----	----	----
Cadmium	1	0.04	0.19	1.12	0.21	0.06	2.01	0.06
Cadmium	2	0.04	0.16	1.78	0.30	0.06	2.99	0.07
Cadmium	3	0.01	0.05	0.82	0.16	0.03	1.49	0.05
Cadmium	4	0.01	0.05	0.90	0.15	0.01	1.48	0.04
Cadmium	BK1	0.10	0.79	----	----	0.37	----	0.05
Cadmium	BK2	0.04	0.31	----	----	0.22	----	0.05
Chromium	1	0.50	0.13	2.63	1.93	0.11	1.18	1.65

Table 5-2 (Continued)
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on 95% Upper Confidence Limits on the Means of Concentrations and Area Use Factors as Presented

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Chromium	2	0.55	0.15	3.48	2.88	0.13	1.73	2.33
Chromium	3	1.17	0.34	5.42	5.11	0.29	3.11	4.26
Chromium	4	0.15	0.04	1.62	0.79	0.03	0.50	0.63
Chromium	BK1	0.41	0.15	----	----	0.10	----	0.34
Chromium	BK2	0.17	0.07	----	----	0.05	----	0.10
Hexachlorobenzene	1	0.31	0.22	0.07	0.08	0.19	1.54	0.77
Hexachlorobenzene	2	0.91	0.53	0.22	0.24	0.47	4.81	2.35
Hexachlorobenzene	3	1.05	0.67	0.21	0.26	0.57	5.06	2.51
Hexachlorobenzene	4	0.01	<0.01	----	----	<0.01	----	----
Hexachlorobenzene	BK1	0.06	0.05	----	----	0.03	----	0.01
Hexachlorobenzene	BK2	0.04	0.03	<0.01	<0.01	0.03	0.04	0.02
Hexachlorobutadiene	1	0.42	0.01	1.35	1.36	0.01	0.15	4.10
Hexachlorobutadiene	2	0.79	0.02	1.63	1.98	0.01	0.24	5.06
Hexachlorobutadiene	3	0.42	0.01	1.28	1.25	<0.01	0.14	3.90
Hexachlorobutadiene	4	0.91	0.02	0.74	0.58	<0.01	0.07	1.85
Hexachlorobutadiene	BK1	1.30	0.03	----	----	0.01	----	1.79
Hexachlorobutadiene	BK2	1.92	0.05	----	----	0.01	----	1.78
Lead	1	0.11	0.12	2.29	1.25	0.42	3.27	0.33
Lead	2	0.07	0.09	5.10	1.61	0.33	4.57	0.35
Lead	3	0.01	0.01	2.84	0.41	<0.01	1.36	0.05
Lead	4	0.05	0.05	2.88	0.99	0.19	2.71	0.23
Lead	BK1	0.11	0.22	----	----	0.63	----	0.15
Lead	BK2	0.08	0.14	----	----	0.50	----	0.06
Mercury	1	0.15	0.67	6.80	2.39	0.04	2.63	0.33
Mercury	2	0.66	2.96	5.71	3.34	0.08	3.47	0.51
Mercury	3	0.66	3.38	14.65	8.76	0.07	9.32	1.31
Mercury	4	0.26	1.37	9.62	6.18	0.04	6.45	0.95
Mercury	BK1	0.56	2.14	----	----	0.96	----	0.07
Mercury	BK2	0.34	0.60	----	----	0.84	----	0.06
Vanadium	1	----	----	----	----	----	----	----
Vanadium	2	2.66	----	----	----	----	----	----
Vanadium	3	6.24	----	----	----	----	----	----
Vanadium	4	----	----	----	----	----	----	----
Vanadium	BK1	----	----	----	----	----	----	----
Vanadium	BK2	----	----	----	----	----	----	----

Note:

BK1 and BK2 are off-site reference locations.

Table 5-3
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on 95% Upper Confidence Limits on the Means of Concentrations and Area Use Factos Equal to 1.0

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Aroclor-1248	1	1.03	0.89	0.44	0.49	0.07	1.08	1.05
Aroclor-1254	1	0.24	0.07	0.19	0.22	0.01	0.02	0.23
Aroclor-1260	1	0.94	0.17	0.01	0.01	0.01	0.05	0.23
Total PCBs	1	2.22	1.13	0.64	0.72	0.08	1.16	1.50
Aroclor-1248	2	2.30	2.01	1.03	1.13	0.15	2.48	2.32
Aroclor-1254	2	0.43	0.13	0.36	0.43	0.02	0.04	0.42
Aroclor-1260	2	7.23	1.24	0.02	0.02	0.03	0.11	0.41
Total PCBs	2	9.96	3.38	1.41	1.58	0.20	2.63	3.15
Aroclor-1248	3	0.97	0.83	0.38	0.46	0.06	1.01	0.96
Aroclor-1254	3	0.48	0.14	0.40	0.49	0.02	0.05	0.46
Aroclor-1260	3	2.68	0.48	0.02	0.02	0.02	0.13	0.47
Total PCBs	3	4.14	1.45	0.80	0.97	0.11	1.18	1.88
Aroclor-1248	4	0.07	0.04	0.02	0.02	<0.01	0.03	0.06
Aroclor-1254	4	0.12	0.03	0.08	0.07	<0.01	0.01	0.10
Aroclor-1260	4	0.12	0.02	<0.01	<0.01	<0.01	0.02	0.10
Total PCBs	4	0.31	0.08	0.09	0.09	<0.01	0.06	0.25
Aroclor-1248	BK1	0.09	0.04	----	----	<0.01	----	0.01
Aroclor-1254	BK1	0.12	0.02	----	----	<0.01	----	0.01
Aroclor-1260	BK1	0.12	0.02	----	----	<0.01	----	0.01
Total PCBs	BK1	0.32	0.08	----	----	<0.01	----	0.03
Aroclor-1248	BK2	----	----	0.02	0.02	----	0.03	0.06
Aroclor-1254	BK2	----	----	0.08	0.07	----	0.01	0.10
Aroclor-1260	BK2	----	----	<0.01	<0.01	----	0.02	0.10
Total PCBs	BK2	----	----	0.10	0.09	----	0.05	0.25
Arsenic	1	0.10	0.13	0.35	0.35	0.11	0.17	0.10
Arsenic	2	0.14	0.17	1.01	0.41	0.11	0.21	0.09
Arsenic	3	0.14	0.18	1.26	0.55	0.13	0.27	0.13
Arsenic	4	0.09	0.11	0.97	0.36	0.09	0.18	0.07
Arsenic	BK1	0.08	0.10	----	----	0.08	----	0.08
Arsenic	BK2	0.06	0.07	----	----	0.06	----	0.05
Barium	1	----	----	----	----	----	----	----
Barium	2	12.23	----	----	----	----	----	----
Barium	3	1.50	----	----	----	----	----	----
Barium	4	----	----	----	----	----	----	----
Barium	BK1	----	----	----	----	----	----	----
Barium	BK2	----	----	----	----	----	----	----
Cadmium	1	0.14	1.17	1.13	0.21	0.39	2.01	0.06
Cadmium	2	0.17	1.44	1.79	0.30	0.51	2.98	0.07
Cadmium	3	0.05	0.35	0.82	0.16	0.26	1.50	0.05
Cadmium	4	0.06	0.44	0.91	0.15	0.12	1.47	0.04
Cadmium	BK1	0.10	0.79	----	----	0.36	----	0.05
Cadmium	BK2	0.04	0.31	----	----	0.22	----	0.05
Chromium	1	1.60	0.81	2.66	1.96	0.74	1.18	1.67

Table 5-3 (Continued)
Fields Brook FWA
Receptor Hazard Quotients (HQs) Based on 95% Upper Confidence Limits on the Means of Concentrations and Area Use Factos Equal to 1.0

Analyte	Zone	Mink	Hawk	Shrew	Mouse	Heron	Robin	Rabbit
Chromium	2	2.60	1.37	3.47	2.92	1.24	1.75	2.38
Chromium	3	4.34	2.37	5.38	5.10	2.23	3.14	4.32
Chromium	4	0.73	0.32	1.63	0.78	0.29	0.50	0.62
Chromium	BK1	0.41	0.15	----	----	0.10	----	0.34
Chromium	BK2	0.17	0.07	----	----	0.05	----	0.10
Hexachlorobenzene	1	1.01	1.36	0.07	0.08	1.25	1.55	0.76
Hexachlorobenzene	2	4.37	4.80	0.22	0.24	4.32	4.80	2.33
Hexachlorobenzene	3	3.88	4.90	0.21	0.26	4.43	5.05	2.49
Hexachlorobenzene	4	0.05	0.04	----	----	0.04	----	----
Hexachlorobenzene	BK1	0.06	0.05	----	----	0.03	----	0.01
Hexachlorobenzene	BK2	0.04	0.03	<0.01	<0.01	0.03	0.04	0.02
Hexachlorobutadiene	1	1.37	0.04	1.35	1.35	0.03	0.15	4.11
Hexachlorobutadiene	2	3.74	0.16	1.64	1.97	0.13	0.24	5.00
Hexachlorobutadiene	3	1.52	0.04	1.27	1.26	0.02	0.14	3.89
Hexachlorobutadiene	4	4.42	0.14	0.74	0.59	0.02	0.07	1.81
Hexachlorobutadiene	BK1	1.31	0.03	----	----	0.01	----	1.79
Hexachlorobutadiene	BK2	1.92	0.05	----	----	0.01	----	1.79
Lead	1	0.34	0.77	2.28	1.23	2.83	3.23	0.33
Lead	2	0.36	0.80	5.13	1.64	3.08	4.56	0.35
Lead	3	0.03	0.04	2.82	0.41	0.02	1.35	0.05
Lead	4	0.21	0.48	2.87	0.98	1.72	2.73	0.23
Lead	BK1	0.11	0.23	----	----	0.64	----	0.15
Lead	BK2	0.08	0.14	----	----	0.49	----	0.06
Mercury	1	0.49	4.14	6.80	2.39	0.27	2.63	0.33
Mercury	2	3.14	26.81	5.68	3.27	0.77	3.46	0.50
Mercury	3	2.49	23.67	14.56	8.80	0.55	9.45	1.32
Mercury	4	1.23	12.26	9.57	6.19	0.35	6.36	0.95
Mercury	BK1	0.56	2.14	----	----	0.96	----	0.07
Mercury	BK2	0.34	0.60	----	----	0.84	----	0.06
Vanadium	1	----	----	----	----	----	----	----
Vanadium	2	12.83	----	----	----	----	----	----
Vanadium	3	23.08	----	----	----	----	----	----
Vanadium	4	----	----	----	----	----	----	----
Vanadium	BK1	----	----	----	----	----	----	----
Vanadium	BK2	----	----	----	----	----	----	----

Note:

BK1 and BK2 are off-site reference locations.

Table 5-4
Survival Results of 14 Day Earthworm Bioaccumulation/Toxicity Tests

Reach	Survival (Percent)
Control (a)	100.0
Control (b)	95.3
2-1 (a)	0.0
2-1 (b)	95.0
2-1 (b)	54.7
4-1 (b)	10.7
4-1 (b)	100.0
4-1 (b)	0.0
5-2 (a)	87.7
8-1 (a)	95.2

(a) June 1993
(b) September 1993

Table 5-5
Concentrations of Analytes Detected in Exposure Media Used for Earthworm Toxicity/Bioaccumulation Tests (All Units are Parts per Million)

Analyte	2-1 June 100% Mort.	4-1 Oct 100% Mort.	5-2 June 12.3% Mort.	8-1 June 4.8% Mort.
1,2,4-Trichlorobenzene	ND	ND	0.078	ND
1,2-Dichlorobenzene	ND	ND	ND	0.092
1,3-Dichlorobenzene	ND	0.035	0.11	ND
1,4-Dichlorobenzene	ND	ND	0.051	0.17
4-Methylphenol	ND	ND	0.14	ND
Acetone	ND	ND	0.14	0.039
Aluminum	8730	5420	9430	9410
Antimony	ND	ND	2.6	ND
Aroclor-1248	ND	0.92	5.6	ND
Arsenic	11.8	11.3	8.3	25.3
Barium	73.8	351	389	271
Benz[a]anthracene	0.028	0.071	0.4	ND
Benzo[a]pyrene	0.037	0.054	0.25	ND
Benzo[b]fluoranthene	0.033	0.071	0.27	ND
Benzo[g,h,i]perylene	0.032	0.033	0.14	ND
Benzo[k]fluoranthene	0.017	0.026	0.1	ND
Beryllium	0.39	0.17	0.46	1.7
Cadmium	3.6	3.4	4.2	5.3
Calcium	1940	4340	13800	3090
Chlorobenzene	ND	ND	0.07	45
Chloroform	0.002	0.003	0.004	0.004
Chromium	15.5	40.5	106	26
Chrysene	0.021	0.066	0.25	ND
Cobalt	5.5	10.7	15.3	14.5
Copper	50.7	12.9	38.4	35.9
Di-n-butyl phthalate	ND	0.033	ND	ND
Dibenz[a,h]anthracene	0.0083	0.0033	0.013	ND

Table 5-5 (Continued)
Concentrations of Analytes Detected in Exposure Media Used for Earthworm Toxicity/Bioaccumulation Tests (All Units are Parts per Million)

Analyte	2-1 June 100% Mort.	4-1 Oct 100% Mort.	5-2 June 12.3% Mort.	8-1 June 4.8% Mort.
Dimethyl phthalate	ND	ND	0.039	ND
Fluoranthene	0.028	0.1	0.47	ND
Fluorene	0.032	0.43	0.9	ND
Hexachlorobenzene	0.001	0.38	1.9	ND
Hexachlorobutadiene	ND	0.038	0.12	ND
Indeno[1,2,3-cd]pyrene	0.0055	0.026	0.13	ND
Iron	24500	18300	23000	34900
Lead	32	25.2	35.6	33.2
Magnesium	2490	1970	2890	2150
Manganese	121	500	1400	785
Mercury	0.5	0.94	4.5	4.6
Nickel	17.4	23.9	34.5	28.6
Phenanthrene	0.03	0.054	0.38	ND
Potassium	1110	439	436	567
Pyrene	0.026	0.089	0.38	ND
Selenium	0.74	ND	0.54	1.6
Silver	ND	ND	0.31	ND
Sodium	276	312	937	1350
Thallium	0.2	ND	ND	0.55
Toluene	ND	ND	ND	0.009
Vanadium	13.7	74.1	237	204
Zinc	55.2	79.5	143	167
bis(2-Ethylhexyl) phthalate	ND	ND	4.4	0.56

APPENDIX A

FIELDS BROOK FLOODPLAIN/WETLAND AREA BIOLOGICAL ANALYTICAL DATA

DRAFT-For Discussion Purposes Only

Aroclor-1248	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	0.0490 mg/kg	UJ
Aroclor-1248	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.0560 mg/kg	
Aroclor-1248	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.0330 mg/kg	U
Aroclor-1248	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.3300 mg/kg	U
Aroclor-1248	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.3300 mg/kg	U
Aroclor-1248	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.0330 mg/kg	U
Aroclor-1248	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.0330 mg/kg	U
Aroclor-1248	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.0330 mg/kg	U
Aroclor-1248	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	0.0410 mg/kg	UJ
Aroclor-1248	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.3300 mg/kg	U
Aroclor-1248	BK2	BK2	BIBK2001S3	930634	Phase 3	Insect	1	0.0410 mg/kg	U
Aroclor-1248	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.3300 mg/kg	U
Aroclor-1248	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 1	031	BI031001S3	9306311	Phase 2	Mice	1	0.0330 mg/kg	UJ
Aroclor-1248	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.0330 mg/kg	U
Aroclor-1248	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.3300 mg/kg	UJ
Aroclor-1248	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1248	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1248	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.1200 mg/kg	P
Aroclor-1248	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.0330 mg/kg	U
Aroclor-1248	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.0330 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.0330 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	041	BI041004S3	9311398	Phase 2	Shrews	3	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1248	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1248	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1248	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 2	Z2-01	BI002002S4	9412815	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-01	BI002003S4	9412816	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-07	BI002008S4	9412821	Phase 3	Mouse	1	0.0330 mg/kg	U

Aroclor-1248	Zone 2	Z2-06	BI002009S4	9412822	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-06	BI002010S4	9412823	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-02	BI002015S4	9412828	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-02	BI002016S4	9412829	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.6600 mg/kg	U
Aroclor-1248	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.1600 mg/kg	U
Aroclor-1248	Zone 2	Z2-02	BI002020S4	9412833	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	0.4400 mg/kg	P
Aroclor-1248	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.3300 mg/kg	UJ
Aroclor-1248	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.0450 mg/kg	J
Aroclor-1248	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.3300 mg/kg	U
Aroclor-1248	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.0330 mg/kg	U
Aroclor-1248	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.3300 mg/kg	U
Aroclor-1248	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.1600 mg/kg	U
Aroclor-1248	Zone 3	Z3-08	BI003012S4	9412851	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-10	BI003033S4	9412869	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-04	BI003002S4	9412844	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-04	BI003003S4	9412845	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-06	BI003005S4	9412846	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-06	BI003006S4	9412847	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-06	BI003007S4	9412848	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-10	BI003015S4	9412853	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-04	BI003026S4	9412863	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1248	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.0470 mg/kg	P
Aroclor-1248	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.0330 mg/kg	U
Aroclor-1248	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1248	Zone 4	082	FW082001S3	9306279	Phase 2	Water	.	0.0010 mg/L	U
Aroclor-1248	Zone 4	082	FW082002S3	9306280	Phase 2	Water	.	0.0010 mg/L	U
Aroclor-1248	Zone 4	082	FW082003S3	9306281	Phase 2	Water	.	0.0010 mg/L	U

Aroclor-1248	Zone 4	082	BI082002S3	930631	Phase	3	Fish	2	0.0330	mg/kg	U
Aroclor-1248	Zone 4	082	FW082001S3	930627	Phase	3	Water	.	0.0010	mg/L	U
Aroclor-1248	Zone 4	082	FW082002S3	930628	Phase	3	Water	.	0.0010	mg/L	U
Aroclor-1248	Zone 4	082	FW082003S3	930628	Phase	3	Water	.	0.0010	mg/L	U
Aroclor-1248	Zone 4	Z4-01	BI004001ST	9412885	Phase	3	Worms	318	0.0330	mg/kg	U
Aroclor-1254	BK1	BK1	BSBK1001S3	9306301	Phase	2	Soil	.	0.0490	mg/kg	UJ
Aroclor-1254	BK1	BK1	BIBK1003S3	930630	Phase	3	Fish	8	0.0330	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1004S3	930632	Phase	3	Fish	2	0.0330	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1007S3	931138	Phase	3	Mice	1	0.3300	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1012S3	931139	Phase	3	Mice	1	0.3300	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1008S3	931138	Phase	3	Shrews	1	0.0330	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1013S3	931139	Phase	3	Shrews	1	0.0330	mg/kg	U
Aroclor-1254	BK1	BK1	BIBK1005S3	930631	Phase	3	Vegetation	.	0.0330	mg/kg	U
Aroclor-1254	BK2	BK2	BSBK2001S3	9306296	Phase	2	Soil	.	0.0410	mg/kg	UJ
Aroclor-1254	BK2	BK2	BIBK2002S3	930630	Phase	3	Fish	31	0.3300	mg/kg	U
Aroclor-1254	BK2	BK2	BIBK2001S3	930634	Phase	3	Insect	1	0.0410	mg/kg	U
Aroclor-1254	BK2	BK2	BIBK2003S3	930631	Phase	3	Vegetation	.	0.3300	mg/kg	U
Aroclor-1254	Zone 1	021	BI021002S3	9311395	Phase	2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1254	Zone 1	031	BI031001S3	9306311	Phase	2	Mice	1	0.0330	mg/kg	UJ
Aroclor-1254	Zone 1	031	BI031002S3	9307630	Phase	2	Mice	2	0.0330	mg/kg	U
Aroclor-1254	Zone 1	021	BI021006S3	9311396	Phase	2	Shrews	3	0.3300	mg/kg	UJ
Aroclor-1254	Zone 1	021	BI021001S3	9306314	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1254	Zone 1	021	BI021007S3	9311862	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1254	Zone 1	031	BI031004S3	9306315	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1254	Zone 1	031	BI031010S3	9311861	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1254	Zone 1	Z1-01	BI001001ST	9412882	Phase	3	Worms	303	0.0330	mg/kg	U
Aroclor-1254	Zone 2	041	BI041001S3	9307628	Phase	2	Mice	2	0.0330	mg/kg	U
Aroclor-1254	Zone 2	041	BI041005S3	9311399	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051002S3	9311400	Phase	2	Mice	2	0.0330	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051003S3	9311401	Phase	2	Mice	6	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051007S3	9311403	Phase	2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052001S3	9307629	Phase	2	Mice	2	0.0330	mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052005S3	9311405	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052006S3	9311406	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052009S3	9311408	Phase	2	Mice	6	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052010S3	9311409	Phase	2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	041	BI041004S3	9311398	Phase	2	Shrews	3	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051006S3	9311402	Phase	2	Shrews	4	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	041	BI041003S3	9306316	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1254	Zone 2	041	BI041008S3	9311860	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051001S3	9306317	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1254	Zone 2	051	BI051008S3	9311859	Phase	2	Vegetation	.	0.3300	mg/kg	UJ

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Aroclor-1254	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1254	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.3300 mg/kg	UJ
Aroclor-1254	Zone 2	Z2-01	BI002002S4	9412815	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-01	BI002003S4	9412816	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-07	BI002008S4	9412821	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-06	BI002009S4	9412822	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-06	BI002010S4	9412823	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-02	BI002015S4	9412828	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-02	BI002016S4	9412829	Phase 3	Mouse	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.6600 mg/kg	U
Aroclor-1254	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.1600 mg/kg	U
Aroclor-1254	Zone 2	Z2-02	BI002020S4	9412833	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	0.0330 mg/kg	U
Aroclor-1254	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.3300 mg/kg	UJ
Aroclor-1254	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.0330 mg/kg	UJ
Aroclor-1254	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.3300 mg/kg	U
Aroclor-1254	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.0330 mg/kg	U
Aroclor-1254	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.3300 mg/kg	U
Aroclor-1254	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.1600 mg/kg	U
Aroclor-1254	Zone 3	Z3-08	BI003012S4	9412851	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-10	BI003033S4	9412869	Phase 3	Shrew	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-04	BI003002S4	9412844	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-04	BI003003S4	9412845	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-06	BI003005S4	9412846	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-06	BI003006S4	9412847	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-06	BI003007S4	9412848	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-10	BI003015S4	9412853	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-04	BI003026S4	9412863	Phase 3	Vole	1	0.0330 mg/kg	U
Aroclor-1254	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.0330 mg/kg	U
Aroclor-1254	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.3300 mg/kg	UJ
Aroclor-1254	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1254	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.3300 mg/kg	UJ
Aroclor-1254	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.3300 mg/kg	UJ
Aroclor-1254	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.3300 mg/kg	UJ

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Aroclor-1254	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.0330	mg/kg	U
Aroclor-1254	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1254	Zone 4	082	FW082001S3	9306279	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	082	FW082002S3	9306280	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	082	FW082003S3	9306281	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.0330	mg/kg	U
Aroclor-1254	Zone 4	082	FW082001S3	930627	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	082	FW082002S3	930628	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	082	FW082003S3	930628	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1254	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	0.0330	mg/kg	U
Aroclor-1260	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	0.0049	mg/kg	UJ
Aroclor-1260	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.0330	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.0330	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.3300	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.3300	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.0330	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.0330	mg/kg	U
Aroclor-1260	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.0330	mg/kg	U
Aroclor-1260	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	0.0410	mg/kg	UJ
Aroclor-1260	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.3300	mg/kg	U
Aroclor-1260	BK2	BK2	BIBK2001S3	930634	Phase 3	Insect	1	0.0410	mg/kg	U
Aroclor-1260	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.3300	mg/kg	U
Aroclor-1260	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 1	031	BI031001S3	9306311	Phase 2	Mice	1	0.0330	mg/kg	UJ
Aroclor-1260	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.0330	mg/kg	U
Aroclor-1260	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	1.3000	mg/kg	PJ
Aroclor-1260	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.0330	mg/kg	U
Aroclor-1260	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.0330	mg/kg	U
Aroclor-1260	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.0330	mg/kg	UJ
Aroclor-1260	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.0330	mg/kg	UJ
Aroclor-1260	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 2	041	BI041004S3	9311398	Phase 2	Shrews	3	0.3300	mg/kg	UJ

Aroclor-1260	Zone	2	051	BI051006S3	9311402	Phase	2	Shrews	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone	2	052	BI052008S3	9311407	Phase	2	Shrews	5	11.0000	mg/kg	J
Aroclor-1260	Zone	2	041	BI041003S3	9306316	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone	2	041	BI041008S3	9311860	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone	2	051	BI051001S3	9306317	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone	2	051	BI051008S3	9311859	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone	2	052	BI052003S3	9306318	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone	2	052	BI052011S3	9311858	Phase	2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone	2	Z2-01	BI002002S4	9412815	Phase	3	Mouse	1	0.0450	mg/kg	
Aroclor-1260	Zone	2	Z2-01	BI002003S4	9412816	Phase	3	Mouse	1	0.0290	mg/kg	JP
Aroclor-1260	Zone	2	Z2-07	BI002008S4	9412821	Phase	3	Mouse	1	0.2400	mg/kg	P
Aroclor-1260	Zone	2	Z2-06	BI002009S4	9412822	Phase	3	Mouse	1	0.0960	mg/kg	P
Aroclor-1260	Zone	2	Z2-06	BI002010S4	9412823	Phase	3	Mouse	1	0.0530	mg/kg	P
Aroclor-1260	Zone	2	Z2-02	BI002015S4	9412828	Phase	3	Mouse	1	0.0330	mg/kg	U
Aroclor-1260	Zone	2	Z2-02	BI002016S4	9412829	Phase	3	Mouse	1	0.0290	mg/kg	JP
Aroclor-1260	Zone	2	Z2-08	BI002012S4	9412825	Phase	3	Shrew	1	3.8000	mg/kg	E
Aroclor-1260	Zone	2	Z2-08	BI002012S4	9412825	Phase	3	Shrew	1	4.8000	mg/kg	
Aroclor-1260	Zone	2	Z2-10	BI002026S4	9412838	Phase	3	Shrew	1	1.1000	mg/kg	E
Aroclor-1260	Zone	2	Z2-10	BI002026S4	9412838	Phase	3	Shrew	1	1.5000	mg/kg	
Aroclor-1260	Zone	2	Z2-02	BI002020S4	9412833	Phase	3	Vole	1	0.0610	mg/kg	P
Aroclor-1260	Zone	2	Z2-01	BI002001ST	9412883	Phase	3	Worms	289	0.0330	mg/kg	U
Aroclor-1260	Zone	3	061	BI061002S3	9311410	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone	3	061	BI061003S3	9311411	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone	3	061	BI061004S3	9311412	Phase	2	Mice	3	0.3300	mg/kg	UJ
Aroclor-1260	Zone	3	081	BI081002S3	9311414	Phase	2	Mice	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone	3	081	BI081006S3	9311415	Phase	2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone	3	061	BI061006S3	9311413	Phase	2	Shrews	6	3.7000	mg/kg	J
Aroclor-1260	Zone	3	061	BI061001S3	9306319	Phase	2	Vegetation	.	0.0330	mg/kg	UJ
Aroclor-1260	Zone	3	061	BI061007S3	9311857	Phase	2	Vegetation	.	0.3300	mg/kg	U
Aroclor-1260	Zone	3	081	BI081001S3	9306320	Phase	2	Vegetation	.	0.0330	mg/kg	U
Aroclor-1260	Zone	3	081	BI081008S3	9311856	Phase	2	Vegetation	.	0.3300	mg/kg	U
Aroclor-1260	Zone	3	Z3-03	BI003008S4	9412849	Phase	3	Shrew	1	1.2000	mg/kg	E
Aroclor-1260	Zone	3	Z3-03	BI003008S4	9412849	Phase	3	Shrew	1	1.4000	mg/kg	
Aroclor-1260	Zone	3	Z3-08	BI003012S4	9412851	Phase	3	Shrew	1	0.0590	mg/kg	P
Aroclor-1260	Zone	3	Z3-10	BI003033S4	9412869	Phase	3	Shrew	1	0.1000	mg/kg	P
Aroclor-1260	Zone	3	Z3-04	BI003002S4	9412844	Phase	3	Vole	1	0.0830	mg/kg	P
Aroclor-1260	Zone	3	Z3-04	BI003003S4	9412845	Phase	3	Vole	1	0.0600	mg/kg	P
Aroclor-1260	Zone	3	Z3-06	BI003005S4	9412846	Phase	3	Vole	1	0.0330	mg/kg	U
Aroclor-1260	Zone	3	Z3-06	BI003006S4	9412847	Phase	3	Vole	1	0.0330	mg/kg	U
Aroclor-1260	Zone	3	Z3-06	BI003007S4	9412848	Phase	3	Vole	1	0.0650	mg/kg	P
Aroclor-1260	Zone	3	Z3-10	BI003015S4	9412853	Phase	3	Vole	1	0.0360	mg/kg	P
Aroclor-1260	Zone	3	Z3-04	BI003026S4	9412863	Phase	3	Vole	1	0.0650	mg/kg	P

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Aroclor-1260	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.0330	mg/kg	U
Aroclor-1260	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.0330	mg/kg	U
Aroclor-1260	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.3300	mg/kg	UJ
Aroclor-1260	Zone 4	082	FW082001S3	9306279	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	082	FW082002S3	9306280	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	082	FW082003S3	9306281	Phase 2	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.0330	mg/kg	U
Aroclor-1260	Zone 4	082	FW082001S3	930627	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	082	FW082002S3	930628	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	082	FW082003S3	930628	Phase 3	Water	.	0.0010	mg/L	U
Aroclor-1260	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	0.0330	mg/kg	U
Arsenic	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	10.9000	mg/kg	J
Arsenic	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.1500	mg/kg	UN
Arsenic	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.1000	mg/kg	UJ
Arsenic	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.1000	mg/kg	BWN
Arsenic	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.1400	mg/kg	BWN
Arsenic	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.1800	mg/kg	BWN
Arsenic	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.1400	mg/kg	BWN
Arsenic	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.3200	mg/kg	BN
Arsenic	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	8.0000	mg/kg	J
Arsenic	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.1500	mg/kg	UN
Arsenic	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.1100	mg/kg	J
Arsenic	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.1500	mg/kg	UN
Arsenic	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.0900	mg/kg	UJ
Arsenic	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.1500	mg/kg	J
Arsenic	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.2700	mg/kg	UJ
Arsenic	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.1000	mg/kg	J
Arsenic	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.1000	mg/kg	J
Arsenic	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.2800	mg/kg	UNW
Arsenic	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.7000	mg/kg	J
Arsenic	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.1200	mg/kg	J
Arsenic	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.0900	mg/kg	J
Arsenic	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.0900	mg/kg	UJ
Arsenic	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.1000	mg/kg	J
Arsenic	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.7200	mg/kg	J

Arsenic	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.1000	mg/kg	J
Arsenic	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.1800	mg/kg	J
Arsenic	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.0800	mg/kg	J
Arsenic	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.0900	mg/kg	J
Arsenic	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.2000	mg/kg	J
Arsenic	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	0.2400	mg/kg	J
Arsenic	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	0.1400	mg/kg	J
Arsenic	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.1800	mg/kg	J
Arsenic	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.1400	mg/kg	J
Arsenic	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	0.1900	mg/kg	UNW
Arsenic	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	0.1900	mg/kg	UNW
Arsenic	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	0.1900	mg/kg	UNW
Arsenic	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	0.1800	mg/kg	UNW
Arsenic	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	0.9400	mg/kg	UNW
Arsenic	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	0.2000	mg/kg	UNW
Arsenic	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	0.2000	mg/kg	UNW
Arsenic	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	0.1800	mg/kg	UNW
Arsenic	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	0.1800	mg/kg	UNW
Arsenic	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	1.5000	mg/kg	NS
Arsenic	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.0900	mg/kg	J
Arsenic	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.0900	mg/kg	J
Arsenic	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.3800	mg/kg	J
Arsenic	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.1600	mg/kg	J
Arsenic	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.4200	mg/kg	J
Arsenic	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	0.8900	mg/kg	UNW
Arsenic	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	0.8200	mg/kg	UNW
Arsenic	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	0.1900	mg/kg	UNW
Arsenic	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	0.1900	mg/kg	UNW
Arsenic	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	0.1700	mg/kg	UNW
Arsenic	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	0.9700	mg/kg	UNW
Arsenic	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	0.8800	mg/kg	UNW
Arsenic	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.1600	mg/kg	UNW
Arsenic	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.1700	mg/kg	UNW
Arsenic	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	1.8000	mg/kg	N
Arsenic	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.1300	mg/kg	J
Arsenic	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.1800	mg/kg	J
Arsenic	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.2400	mg/kg	J

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Arsenic	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.1700	mg/kg	J
Arsenic	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.1500	mg/kg	J
Arsenic	Zone 4	082	FW082001S3	9306293	Phase 2	Water	.	0.0030	mg/L	J
Arsenic	Zone 4	082	FW082002S3	9306294	Phase 2	Water	.	0.0030	mg/L	J
Arsenic	Zone 4	082	FW082003S3	9306295	Phase 2	Water	.	0.0270	mg/L	J
Arsenic	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.1500	mg/kg	UN
Arsenic	Zone 4	082	FW082001S3	930629	Phase 3	Water	.	0.0030	mg/L	U
Arsenic	Zone 4	082	FW082002S3	930629	Phase 3	Water	.	0.0030	mg/L	UW
Arsenic	Zone 4	082	FW082003S3	930629	Phase 3	Water	.	0.0270	mg/L	+
Arsenic	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	1.5000	mg/kg	N
Barium	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	37.4000	mg/kg	J
Barium	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	22.6000	mg/kg	J
Barium	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	27.4000	mg/kg	
Barium	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	54.2000	mg/kg	
Barium	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	3.9000	mg/kg	B
Barium	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	10.3000	mg/kg	B
Barium	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	1.3000	mg/kg	U
Barium	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	2.1000	mg/kg	B
Barium	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	3.8000	mg/kg	B
Barium	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	3.8000	mg/kg	B
Barium	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	2.1000	mg/kg	B
Barium	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	2.8000	mg/kg	B
Barium	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	16.4000	mg/kg	B
Barium	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	5.5000	mg/kg	B
Barium	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	2.4000	mg/kg	B
Barium	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	2.7000	mg/kg	B
Barium	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	1.3000	mg/kg	B
Barium	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	1.4000	mg/kg	U
Barium	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	6.3000	mg/kg	B
Barium	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	4.7000	mg/kg	B
Barium	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	3.9000	mg/kg	B
Barium	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	4.1000	mg/kg	B
Barium	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	8.6000	mg/kg	B
Barium	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	7.9000	mg/kg	B
Cadmium	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	3.3000	mg/kg	J
Cadmium	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.1500	mg/kg	U
Cadmium	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.1500	mg/kg	U
Cadmium	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.2900	mg/kg	U
Cadmium	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.3000	mg/kg	U
Cadmium	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.2400	mg/kg	U
Cadmium	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.4000	mg/kg	B

Cadmium	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.4800 mg/kg	
Cadmium	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.1500 mg/kg	B
Cadmium	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	1.8000 mg/kg	J
Cadmium	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.1500 mg/kg	U
Cadmium	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.2800 mg/kg	U
Cadmium	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.2900 mg/kg	
Cadmium	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.2500 mg/kg	U
Cadmium	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.1500 mg/kg	J
Cadmium	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.8500 mg/kg	
Cadmium	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.1600 mg/kg	J
Cadmium	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.2700 mg/kg	J
Cadmium	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.1500 mg/kg	J
Cadmium	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.2800 mg/kg	J
Cadmium	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	2.8000 mg/kg	
Cadmium	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.1400 mg/kg	J
Cadmium	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.2800 mg/kg	U
Cadmium	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.2800 mg/kg	U
Cadmium	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.2500 mg/kg	U
Cadmium	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.2600 mg/kg	U
Cadmium	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.1400 mg/kg	J
Cadmium	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	1.0000 mg/kg	
Cadmium	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	0.3300 mg/kg	J
Cadmium	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	0.1400 mg/kg	J
Cadmium	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.2500 mg/kg	J
Cadmium	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	0.1600 mg/kg	J
Cadmium	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.2600 mg/kg	J
Cadmium	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.1500 mg/kg	J
Cadmium	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.2500 mg/kg	J
Cadmium	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	0.0900 mg/kg	U
Cadmium	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	0.1000 mg/kg	U
Cadmium	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	0.1000 mg/kg	U
Cadmium	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	0.0800 mg/kg	U
Cadmium	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	0.0900 mg/kg	U
Cadmium	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	0.1000 mg/kg	U
Cadmium	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	0.1400 mg/kg	B
Cadmium	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	0.0900 mg/kg	U
Cadmium	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	0.0800 mg/kg	U
Cadmium	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	4.5000 mg/kg	
Cadmium	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.1500 mg/kg	J
Cadmium	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.2800 mg/kg	J
Cadmium	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.1500 mg/kg	J
Cadmium	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.2900 mg/kg	J

Cadmium	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	0.0900	mg/kg	U
Cadmium	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	0.0800	mg/kg	U
Cadmium	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	0.0800	mg/kg	U
Cadmium	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	0.1500	mg/kg	B
Cadmium	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	0.1000	mg/kg	U
Cadmium	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	0.0800	mg/kg	U
Cadmium	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	0.1000	mg/kg	U
Cadmium	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.0900	mg/kg	U
Cadmium	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.0900	mg/kg	U
Cadmium	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	2.0000	mg/kg	
Cadmium	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.2600	mg/kg	J
Cadmium	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.3900	mg/kg	J
Cadmium	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.1500	mg/kg	J
Cadmium	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.3300	mg/kg	J
Cadmium	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.2200	mg/kg	J
Cadmium	Zone 4	082	FW082001S3	9306293	Phase 2	Water	.	0.0030	mg/L	J
Cadmium	Zone 4	082	FW082002S3	9306294	Phase 2	Water	.	0.0030	mg/L	J
Cadmium	Zone 4	082	FW082003S3	9306295	Phase 2	Water	.	0.0030	mg/L	J
Cadmium	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.1500	mg/kg	U
Cadmium	Zone 4	082	FW082001S3	930629	Phase 3	Water	.	0.0030	mg/L	U
Cadmium	Zone 4	082	FW082002S3	930629	Phase 3	Water	.	0.0030	mg/L	U
Cadmium	Zone 4	082	FW082003S3	930629	Phase 3	Water	.	0.0030	mg/L	U
Cadmium	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	2.3000	mg/kg	
Chromium	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	10.4000	mg/kg	J
Chromium	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.3400	mg/kg	U
Chromium	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.3900	mg/kg	B
Chromium	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.9000	mg/kg	B
Chromium	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.7400	mg/kg	B
Chromium	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.8400	mg/kg	
Chromium	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.7100	mg/kg	B
Chromium	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.9300	mg/kg	
Chromium	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	1.1000	mg/kg	
Chromium	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	5.3000	mg/kg	J
Chromium	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.3400	mg/kg	U
Chromium	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.6600	mg/kg	U
Chromium	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.3500	mg/kg	U
Chromium	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.6700	mg/kg	J
Chromium	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.7100	mg/kg	J
Chromium	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.9000	mg/kg	J
Chromium	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	1.9000	mg/kg	J
Chromium	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.5600	mg/kg	J
Chromium	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.6400	mg/kg	J

Chromium	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.6300	mg/kg	J
Chromium	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	3.2000	mg/kg	
Chromium	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.8000	mg/kg	J
Chromium	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.7800	mg/kg	J
Chromium	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.8100	mg/kg	J
Chromium	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.8900	mg/kg	J
Chromium	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.6200	mg/kg	U
Chromium	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.6100	mg/kg	J
Chromium	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	1.3000	mg/kg	J
Chromium	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	1.3000	mg/kg	J
Chromium	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.6900	mg/kg	J
Chromium	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.4900	mg/kg	J
Chromium	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.5700	mg/kg	U
Chromium	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	1.1000	mg/kg	J
Chromium	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	0.6700	mg/kg	J
Chromium	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.6500	mg/kg	J
Chromium	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	0.3600	mg/kg	J
Chromium	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.6000	mg/kg	J
Chromium	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.3500	mg/kg	J
Chromium	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.7000	mg/kg	J
Chromium	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	0.5500	mg/kg	B
Chromium	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	0.3800	mg/kg	U
Chromium	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	0.7000	mg/kg	B
Chromium	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	0.3400	mg/kg	U
Chromium	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	0.3700	mg/kg	U
Chromium	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	0.4000	mg/kg	U
Chromium	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	0.9600	mg/kg	
Chromium	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	0.5000	mg/kg	B
Chromium	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	0.3400	mg/kg	U
Chromium	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	3.4000	mg/kg	
Chromium	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.9000	mg/kg	J
Chromium	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.6700	mg/kg	J
Chromium	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.5500	mg/kg	J
Chromium	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.8500	mg/kg	J
Chromium	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.7100	mg/kg	J
Chromium	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.7700	mg/kg	J
Chromium	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.4700	mg/kg	J
Chromium	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.8600	mg/kg	J
Chromium	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.3400	mg/kg	J
Chromium	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	1.1000	mg/kg	J
Chromium	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	0.3500	mg/kg	U
Chromium	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	0.5400	mg/kg	B

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Chromium	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	0.3200	mg/kg	U
Chromium	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	0.5400	mg/kg	B
Chromium	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	0.3800	mg/kg	U
Chromium	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	0.3800	mg/kg	B
Chromium	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	0.3900	mg/kg	U
Chromium	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.3700	mg/kg	U
Chromium	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.3400	mg/kg	U
Chromium	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	3.7000	mg/kg	
Chromium	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.6300	mg/kg	J
Chromium	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.5100	mg/kg	J
Chromium	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.5100	mg/kg	J
Chromium	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.5500	mg/kg	J
Chromium	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.4700	mg/kg	J
Chromium	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.7600	mg/kg	J
Chromium	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.3400	mg/kg	J
Chromium	Zone 4	082	FW082001S3	9306293	Phase 2	Water	.	0.0070	mg/L	J
Chromium	Zone 4	082	FW082002S3	9306294	Phase 2	Water	.	0.0070	mg/L	J
Chromium	Zone 4	082	FW082003S3	9306295	Phase 2	Water	.	0.0070	mg/L	J
Chromium	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.5300	mg/kg	Hexa
Chromium	Zone 4	082	FW082001S3	930629	Phase 3	Water	.	0.0070	mg/L	U
Chromium	Zone 4	082	FW082002S3	930629	Phase 3	Water	.	0.0070	mg/L	U
Chromium	Zone 4	082	FW082003S3	930629	Phase 3	Water	.	0.0070	mg/L	U
Chromium	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	2.9000	mg/kg	
Hexachlorobenzene	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	0.4900	mg/kg	U
Hexachlorobenzene	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.0200	mg/kg	
Hexachlorobenzene	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.0130	mg/kg	
Hexachlorobenzene	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.0330	mg/kg	J
Hexachlorobenzene	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.0330	mg/kg	U
Hexachlorobenzene	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.0330	mg/kg	U
Hexachlorobenzene	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.0033	mg/kg	U
Hexachlorobenzene	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.0033	mg/kg	U
Hexachlorobenzene	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.0033	mg/kg	U
Hexachlorobenzene	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	0.4100	mg/kg	U
Hexachlorobenzene	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.0330	mg/kg	U
Hexachlorobenzene	BK2	BK2	BIBK2001S3	930634	Phase 3	Insect	1	0.0041	mg/kg	U
Hexachlorobenzene	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.0330	mg/kg	U
Hexachlorobenzene	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.0330	mg/kg	U
Hexachlorobenzene	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.0400	mg/kg	J
Hexachlorobenzene	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.1600	mg/kg	J
Hexachlorobenzene	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.0440	mg/kg	J
Hexachlorobenzene	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.0500	mg/kg	J
Hexachlorobenzene	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.0380	mg/kg	

Hexachlorobenzene	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.1100	mg/kg	J
Hexachlorobenzene	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.1200	mg/kg	J
Hexachlorobenzene	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.3600	mg/kg	J
Hexachlorobenzene	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	1.2000	mg/kg	J
Hexachlorobenzene	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.3700	mg/kg	J
Hexachlorobenzene	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.2200	mg/kg	J
Hexachlorobenzene	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.8200	mg/kg	J
Hexachlorobenzene	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.3700	mg/kg	J
Hexachlorobenzene	Zone 2	041	BI041004S3	9311398	Phase 2	Shrews	3	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.1600	mg/kg	J
Hexachlorobenzene	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	0.3200	mg/kg	J
Hexachlorobenzene	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.0530	mg/kg	J
Hexachlorobenzene	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.0860	mg/kg	J
Hexachlorobenzene	Zone 2	Z2-01	BI002002S4	9412815	Phase 3	Mouse	1	0.0100	mg/kg	
Hexachlorobenzene	Zone 2	Z2-01	BI002003S4	9412816	Phase 3	Mouse	1	0.0140	mg/kg	
Hexachlorobenzene	Zone 2	Z2-07	BI002008S4	9412821	Phase 3	Mouse	1	0.0280	mg/kg	
Hexachlorobenzene	Zone 2	Z2-06	BI002009S4	9412822	Phase 3	Mouse	1	0.0350	mg/kg	
Hexachlorobenzene	Zone 2	Z2-06	BI002010S4	9412823	Phase 3	Mouse	1	0.0380	mg/kg	
Hexachlorobenzene	Zone 2	Z2-02	BI002015S4	9412828	Phase 3	Mouse	1	0.0017	mg/kg	U
Hexachlorobenzene	Zone 2	Z2-02	BI002016S4	9412829	Phase 3	Mouse	1	0.0031	mg/kg	P
Hexachlorobenzene	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.0580	mg/kg	
Hexachlorobenzene	Zone 2	Z2-08	BI002012S4	9412825	Phase 3	Shrew	1	0.0950	mg/kg	
Hexachlorobenzene	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.0190	mg/kg	
Hexachlorobenzene	Zone 2	Z2-10	BI002026S4	9412838	Phase 3	Shrew	1	0.0240	mg/kg	
Hexachlorobenzene	Zone 2	Z2-02	BI002020S4	9412833	Phase 3	Vole	1	0.0550	mg/kg	
Hexachlorobenzene	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	0.1800	mg/kg	
Hexachlorobenzene	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.3100	mg/kg	J
Hexachlorobenzene	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.2400	mg/kg	J
Hexachlorobenzene	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.1600	mg/kg	J
Hexachlorobenzene	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.8200	mg/kg	J
Hexachlorobenzene	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.0330	mg/kg	U
Hexachlorobenzene	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.0330	mg/kg	U
Hexachlorobenzene	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.0330	mg/kg	
Hexachlorobenzene	Zone 3	Z3-03	BI003008S4	9412849	Phase 3	Shrew	1	0.0410	mg/kg	
Hexachlorobenzene	Zone 3	Z3-08	BI003012S4	9412851	Phase 3	Shrew	1	0.0017	mg/kg	U
Hexachlorobenzene	Zone 3	Z3-10	BI003033S4	9412869	Phase 3	Shrew	1	0.0099	mg/kg	
Hexachlorobenzene	Zone 3	Z3-04	BI003002S4	9412844	Phase 3	Vole	1	0.0240	mg/kg	
Hexachlorobenzene	Zone 3	Z3-04	BI003003S4	9412845	Phase 3	Vole	1	0.0290	mg/kg	

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Hexachlorobenzene	Zone 3	Z3-06	BI003005S4	9412846	Phase 3	Vole	1	0.0740	mg/kg	
Hexachlorobenzene	Zone 3	Z3-06	BI003006S4	9412847	Phase 3	Vole	1	0.0640	mg/kg	
Hexachlorobenzene	Zone 3	Z3-06	BI003007S4	9412848	Phase 3	Vole	1	0.0550	mg/kg	
Hexachlorobenzene	Zone 3	Z3-10	BI003015S4	9412853	Phase 3	Vole	1	0.0073	mg/kg	
Hexachlorobenzene	Zone 3	Z3-04	BI003026S4	9412863	Phase 3	Vole	1	0.1300	mg/kg	P
Hexachlorobenzene	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.0150	mg/kg	
Hexachlorobenzene	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.0330	mg/kg	UJ
Hexachlorobenzene	Zone 4	082	FW082001S3	9306279	Phase 2	Water	.	0.0001	mg/L	U
Hexachlorobenzene	Zone 4	082	FW082003S3	9306281	Phase 2	Water	.	0.0001	mg/L	U
Hexachlorobenzene	Zone 4	082	FW082001S3	930627	Phase 3	Water	.	0.0001	mg/L	U
Hexachlorobenzene	Zone 4	082	FW082002S3	930628	Phase 3	Water	.	0.0001	mg/L	U
Hexachlorobenzene	Zone 4	082	FW082003S3	930628	Phase 3	Water	.	0.0001	mg/L	U
Hexachlorobenzene	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	0.0017	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	0.4900	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.3300	mg/kg	J
Hexachlorobutadiene	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.3300	mg/kg	U
Hexachlorobutadiene	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	1.6000	mg/kg	U
Hexachlorobutadiene	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	0.4100	mg/kg	U
Hexachlorobutadiene	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.3300	mg/kg	U
Hexachlorobutadiene	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	1.2000	mg/kg	U
Hexachlorobutadiene	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	1.6000	mg/kg	U
Hexachlorobutadiene	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	3.3000	mg/kg	U
Hexachlorobutadiene	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.3300	mg/kg	UJ
Hexachlorobutadiene	Zone 1	031	BI031009S3	9311397	Phase 2	Vegetation	.	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052004S3	9311404	Phase 2	Mice	2	0.3300	mg/kg	U

Hexachlorobutadiene	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	1.6000 mg/kg	UJ
Hexachlorobutadiene	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	1.6000 mg/kg	UJ
Hexachlorobutadiene	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	3.3000 mg/kg	U
Hexachlorobutadiene	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-01	BI002013S4	9412826	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-01	BI002014S4	9412827	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-02	BI002021S4	9412834	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-09	BI002022S4	9412817	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-09	BI002025S4	9412837	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-10	BI002029S4	9412841	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-06	BI002031S4	9412842	Phase 3	Mouse	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-06	BI002011S4	9412824	Phase 3	Shrew	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-10	BI002028S4	9412840	Phase 3	Shrew	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-09	BI002023S4	9412835	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	0.0440 mg/kg	J
Hexachlorobutadiene	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	3.3000 mg/kg	UJ
Hexachlorobutadiene	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	3.3000 mg/kg	U
Hexachlorobutadiene	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.3300 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-10	BI003018S4	9412856	Phase 3	Shrew	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-07	BI003029S4	9412865	Phase 3	Shrew	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-07	BI003031S4	9412867	Phase 3	Shrew	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-04	BI003011S4	9412850	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-09	BI003013S4	9412852	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-10	BI003016S4	9412854	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-10	BI003020S4	9412858	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-04	BI003023S4	9412860	Phase 3	Vole	1	0.6600 mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-04	BI003025S4	9412862	Phase 3	Vole	1	0.6600 mg/kg	U

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Hexachlorobutadiene	Zone 3	Z3-10	BI003034S4	9412870	Phase 3	Vole	1	0.6600	mg/kg	U
Hexachlorobutadiene	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	3.3000	mg/kg	U
Hexachlorobutadiene	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.5000	mg/kg	U
Hexachlorobutadiene	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.5000	mg/kg	U
Hexachlorobutadiene	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	1.6000	mg/kg	U
Hexachlorobutadiene	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	1.6000	mg/kg	U
Hexachlorobutadiene	Zone 4	082	FW082001S3	9306279	Phase 2	Water	.	0.0100	mg/L	UJ
Hexachlorobutadiene	Zone 4	082	FW082002S3	9306280	Phase 2	Water	.	0.0100	mg/L	UJ
Hexachlorobutadiene	Zone 4	082	FW082003S3	9306281	Phase 2	Water	.	0.0100	mg/L	UJ
Hexachlorobutadiene	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.3300	mg/kg	U
Hexachlorobutadiene	Zone 4	082	FW082001S3	930627	Phase 3	Water	.	0.0100	mg/L	U
Hexachlorobutadiene	Zone 4	082	FW082002S3	930628	Phase 3	Water	.	0.0100	mg/L	U
Hexachlorobutadiene	Zone 4	082	FW082003S3	930628	Phase 3	Water	.	0.0100	mg/L	U
Hexachlorobutadiene	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	0.3300	mg/kg	U
Lead	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	12.9000	mg/kg	J
Lead	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.0500	mg/kg	U
Lead	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.0500	mg/kg	U
Lead	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.3900	mg/kg	*
Lead	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.3300	mg/kg	W*
Lead	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.4100	mg/kg	W*
Lead	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.2700	mg/kg	BW*
Lead	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.6300	mg/kg	*
Lead	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	1.2000	mg/kg	
Lead	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	9.8000	mg/kg	J
Lead	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.0900	mg/kg	B
Lead	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.2400	mg/kg	B*
Lead	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.1300	mg/kg	B
Lead	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.5400	mg/kg	J
Lead	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.2200	mg/kg	J
Lead	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.5700	mg/kg	J
Lead	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.1800	mg/kg	J
Lead	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.2400	mg/kg	J
Lead	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.2200	mg/kg	J
Lead	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.4600	mg/kg	J
Lead	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	3.4000	mg/kg	
Lead	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.0600	mg/kg	J
Lead	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.4400	mg/kg	J
Lead	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.1900	mg/kg	J

Lead	Zone 2	051	BI051003S3	9311401	Phase 2 Mice	6	0.1500	mg/kg	J
Lead	Zone 2	051	BI051007S3	9311403	Phase 2 Mice	5	0.1800	mg/kg	J
Lead	Zone 2	052	BI052001S3	9307629	Phase 2 Mice	2	0.0500	mg/kg	J
Lead	Zone 2	052	BI052005S3	9311405	Phase 2 Mice	4	0.1800	mg/kg	J
Lead	Zone 2	052	BI052006S3	9311406	Phase 2 Mice	4	0.2000	mg/kg	J
Lead	Zone 2	052	BI052009S3	9311408	Phase 2 Mice	6	0.1800	mg/kg	J
Lead	Zone 2	052	BI052010S3	9311409	Phase 2 Mice	5	0.1600	mg/kg	J
Lead	Zone 2	051	BI051006S3	9311402	Phase 2 Shrews	4	0.4500	mg/kg	J
Lead	Zone 2	052	BI052008S3	9311407	Phase 2 Shrews	5	0.2800	mg/kg	J
Lead	Zone 2	041	BI041003S3	9306316	Phase 2 Vegetation	.	0.1600	mg/kg	J
Lead	Zone 2	041	BI041008S3	9311860	Phase 2 Vegetation	.	0.2900	mg/kg	J
Lead	Zone 2	051	BI051001S3	9306317	Phase 2 Vegetation	.	0.2900	mg/kg	J
Lead	Zone 2	051	BI051008S3	9311859	Phase 2 Vegetation	.	0.3400	mg/kg	J
Lead	Zone 2	052	BI052003S3	9306318	Phase 2 Vegetation	.	0.2300	mg/kg	J
Lead	Zone 2	052	BI052011S3	9311858	Phase 2 Vegetation	.	0.2100	mg/kg	J
Lead	Zone 2	Z2-07	BI002005S4	9412818	Phase 3 Mouse	1	0.1600	mg/kg	BW
Lead	Zone 2	Z2-07	BI002006S4	9412819	Phase 3 Mouse	1	0.1300	mg/kg	BW
Lead	Zone 2	Z2-07	BI002007S4	9412820	Phase 3 Mouse	1	0.0900	mg/kg	U
Lead	Zone 2	Z2-09	BI002024S4	9412836	Phase 3 Mouse	1	0.0900	mg/kg	UW
Lead	Zone 2	Z2-10	BI002027S4	9412839	Phase 3 Mouse	1	0.0900	mg/kg	UW
Lead	Zone 2	Z2-07	BI002033S4	9412843	Phase 3 Mouse	1	0.1000	mg/kg	U
Lead	Zone 2	Z2-01	BI002018S4	9412831	Phase 3 Shrew	1	0.1800	mg/kg	BW
Lead	Zone 2	Z2-01	BI002017S4	9412830	Phase 3 Vole	1	0.2000	mg/kg	BW
Lead	Zone 2	Z2-01	BI002019S4	9412832	Phase 3 Vole	1	0.1300	mg/kg	BW
Lead	Zone 2	Z2-01	BI002001ST	9412883	Phase 3 Worms	289	10.1000	mg/kg	
Lead	Zone 3	061	BI061002S3	9311410	Phase 2 Mice	4	0.2200	mg/kg	J
Lead	Zone 3	061	BI061003S3	9311411	Phase 2 Mice	4	0.2800	mg/kg	J
Lead	Zone 3	061	BI061004S3	9311412	Phase 2 Mice	3	0.2000	mg/kg	J
Lead	Zone 3	081	BI081002S3	9311414	Phase 2 Mice	4	0.1700	mg/kg	J
Lead	Zone 3	081	BI081006S3	9311415	Phase 2 Mice	5	0.2300	mg/kg	J
Lead	Zone 3	061	BI061006S3	9311413	Phase 2 Shrews	6	0.3100	mg/kg	J
Lead	Zone 3	061	BI061001S3	9306319	Phase 2 Vegetation	.	0.2900	mg/kg	J
Lead	Zone 3	061	BI061007S3	9311857	Phase 2 Vegetation	.	0.6400	mg/kg	J
Lead	Zone 3	081	BI081001S3	9306320	Phase 2 Vegetation	.	0.3600	mg/kg	J
Lead	Zone 3	081	BI081008S3	9311856	Phase 2 Vegetation	.	0.5900	mg/kg	J
Lead	Zone 3	Z3-03	BI003021S4	9412859	Phase 3 Mouse	1	0.1700	mg/kg	BW
Lead	Zone 3	Z3-07	BI003028S4	9412864	Phase 3 Mouse	1	0.1100	mg/kg	BW
Lead	Zone 3	Z3-07	BI003030S4	9412866	Phase 3 Mouse	1	0.1100	mg/kg	BW
Lead	Zone 3	Z3-10	BI003017S4	9412855	Phase 3 Shrew	1	0.1400	mg/kg	BW
Lead	Zone 3	Z3-04	BI003024S4	9412861	Phase 3 Shrew	1	0.1400	mg/kg	BW
Lead	Zone 3	Z3-10	BI003019S4	9412857	Phase 3 Vole	1	0.1000	mg/kg	U
Lead	Zone 3	Z3-10	BI003032S4	9412868	Phase 3 Vole	1	0.0900	mg/kg	UW

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Lead	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.0800	mg/kg	UW
Lead	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.0900	mg/kg	BW
Lead	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	6.6000	mg/kg	S
Lead	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.4700	mg/kg	J
Lead	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.1700	mg/kg	J
Lead	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.1700	mg/kg	J
Lead	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.2800	mg/kg	J
Lead	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.1600	mg/kg	J
Lead	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.1200	mg/kg	J
Lead	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.7300	mg/kg	J
Lead	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.2900	mg/kg	J
Lead	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.0500	mg/kg	U
Lead	Zone 4	082	FW082001S3	930629	Phase 3	Water	.	0.0050	mg/L	UN
Lead	Zone 4	082	FW082002S3	930629	Phase 3	Water	.	0.0010	mg/L	UNW
Lead	Zone 4	082	FW082003S3	930629	Phase 3	Water	.	0.0010	mg/L	UNW
Lead	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	5.5000	mg/kg	S
Mercury	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	0.1400	mg/kg	J
Mercury	BK1	BK1	BIBK1003S3	930630	Phase 3	Fish	8	0.1900	mg/kg	N
Mercury	BK1	BK1	BIBK1004S3	930632	Phase 3	Fish	2	0.0900	mg/kg	UN
Mercury	BK1	BK1	BIBK1006S3	931138	Phase 3	Mice	1	0.0900	mg/kg	U
Mercury	BK1	BK1	BIBK1007S3	931138	Phase 3	Mice	1	0.0900	mg/kg	U
Mercury	BK1	BK1	BIBK1012S3	931139	Phase 3	Mice	1	0.1000	mg/kg	U
Mercury	BK1	BK1	BIBK1008S3	931138	Phase 3	Shrews	1	0.1200	mg/kg	
Mercury	BK1	BK1	BIBK1013S3	931139	Phase 3	Shrews	1	0.2000	mg/kg	
Mercury	BK1	BK1	BIBK1005S3	930631	Phase 3	Vegetation	.	0.1000	mg/kg	UN
Mercury	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	0.1000	mg/kg	J
Mercury	BK2	BK2	BIBK2002S3	930630	Phase 3	Fish	31	0.1700	mg/kg	N
Mercury	BK2	BK2	BIBK2005S3	931139	Phase 3	Mice	1	0.1000	mg/kg	U
Mercury	BK2	BK2	BIBK2003S3	930631	Phase 3	Vegetation	.	0.0900	mg/kg	UN
Mercury	Zone 1	021	BI021002S3	9311395	Phase 2	Mice	5	0.1000	mg/kg	U
Mercury	Zone 1	031	BI031001S3	9306311	Phase 2	Mice	1	0.0900	mg/kg	J
Mercury	Zone 1	031	BI031002S3	9307630	Phase 2	Mice	2	0.1000	mg/kg	J
Mercury	Zone 1	021	BI021006S3	9311396	Phase 2	Shrews	3	0.1700	mg/kg	J
Mercury	Zone 1	021	BI021001S3	9306314	Phase 2	Vegetation	.	0.0900	mg/kg	J
Mercury	Zone 1	021	BI021007S3	9311862	Phase 2	Vegetation	.	0.1000	mg/kg	J
Mercury	Zone 1	031	BI031004S3	9306315	Phase 2	Vegetation	.	0.0900	mg/kg	J
Mercury	Zone 1	031	BI031010S3	9311861	Phase 2	Vegetation	.	0.1000	mg/kg	J
Mercury	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	0.4300	mg/kg	
Mercury	Zone 2	041	BI041001S3	9307628	Phase 2	Mice	2	0.0800	mg/kg	J
Mercury	Zone 2	041	BI041005S3	9311399	Phase 2	Mice	4	0.0800	mg/kg	U
Mercury	Zone 2	051	BI051002S3	9311400	Phase 2	Mice	2	0.0900	mg/kg	U
Mercury	Zone 2	051	BI051003S3	9311401	Phase 2	Mice	6	0.0900	mg/kg	J

Mercury	Zone 2	051	BI051007S3	9311403	Phase 2	Mice	5	0.0900 mg/kg	U
Mercury	Zone 2	052	BI052001S3	9307629	Phase 2	Mice	2	0.0900 mg/kg	J
Mercury	Zone 2	052	BI052005S3	9311405	Phase 2	Mice	4	0.0900 mg/kg	UJ
Mercury	Zone 2	052	BI052006S3	9311406	Phase 2	Mice	4	0.1000 mg/kg	J
Mercury	Zone 2	052	BI052009S3	9311408	Phase 2	Mice	6	0.0900 mg/kg	UJ
Mercury	Zone 2	052	BI052010S3	9311409	Phase 2	Mice	5	0.0900 mg/kg	UJ
Mercury	Zone 2	051	BI051006S3	9311402	Phase 2	Shrews	4	0.1600 mg/kg	
Mercury	Zone 2	052	BI052008S3	9311407	Phase 2	Shrews	5	2.2000 mg/kg	J
Mercury	Zone 2	041	BI041003S3	9306316	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 2	041	BI041008S3	9311860	Phase 2	Vegetation	.	0.0900 mg/kg	J
Mercury	Zone 2	051	BI051001S3	9306317	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 2	051	BI051008S3	9311859	Phase 2	Vegetation	.	0.0900 mg/kg	J
Mercury	Zone 2	052	BI052003S3	9306318	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 2	052	BI052011S3	9311858	Phase 2	Vegetation	.	0.1000 mg/kg	J
Mercury	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	0.0900 mg/kg	
Mercury	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	0.0800 mg/kg	
Mercury	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	0.1100 mg/kg	
Mercury	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	0.0800 mg/kg	U
Mercury	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	0.0800 mg/kg	U
Mercury	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	0.0900 mg/kg	U
Mercury	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	0.1800 mg/kg	
Mercury	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	0.0800 mg/kg	U
Mercury	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	0.0900 mg/kg	U
Mercury	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	0.2700 mg/kg	
Mercury	Zone 3	061	BI061002S3	9311410	Phase 2	Mice	4	0.0800 mg/kg	UJ
Mercury	Zone 3	061	BI061003S3	9311411	Phase 2	Mice	4	0.0900 mg/kg	UJ
Mercury	Zone 3	061	BI061004S3	9311412	Phase 2	Mice	3	0.1000 mg/kg	UJ
Mercury	Zone 3	081	BI081002S3	9311414	Phase 2	Mice	4	0.0900 mg/kg	UJ
Mercury	Zone 3	081	BI081006S3	9311415	Phase 2	Mice	5	0.0800 mg/kg	UJ
Mercury	Zone 3	061	BI061006S3	9311413	Phase 2	Shrews	6	1.0000 mg/kg	J
Mercury	Zone 3	061	BI061001S3	9306319	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 3	061	BI061007S3	9311857	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 3	081	BI081001S3	9306320	Phase 2	Vegetation	.	0.0900 mg/kg	J
Mercury	Zone 3	081	BI081008S3	9311856	Phase 2	Vegetation	.	0.0800 mg/kg	J
Mercury	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	0.0900 mg/kg	U
Mercury	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	0.0900 mg/kg	U
Mercury	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	0.1100 mg/kg	
Mercury	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	0.4600 mg/kg	
Mercury	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	0.6700 mg/kg	
Mercury	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	0.1000 mg/kg	U
Mercury	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	0.0800 mg/kg	
Mercury	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.0900 mg/kg	

Mercury	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.0900	mg/kg	U
Mercury	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	0.6600	mg/kg	
Mercury	Zone 4	082	BI082004S3	9311417	Phase 2	Mice	3	0.1000	mg/kg	UJ
Mercury	Zone 4	134	BI134003S3	9311419	Phase 2	Mice	5	0.0900	mg/kg	UJ
Mercury	Zone 4	134	BI134006S3	9311420	Phase 2	Mice	5	0.1000	mg/kg	UJ
Mercury	Zone 4	134	BI134002S3	9311418	Phase 2	Shrews	5	0.2600	mg/kg	J
Mercury	Zone 4	134	BI134009S3	9311423	Phase 2	Shrews	4	0.2700	mg/kg	J
Mercury	Zone 4	082	BI082003S3	9306321	Phase 2	Vegetation	.	0.1000	mg/kg	J
Mercury	Zone 4	082	BI082010S3	9311855	Phase 2	Vegetation	.	0.1000	mg/kg	J
Mercury	Zone 4	134	BI134001S3	9306322	Phase 2	Vegetation	.	0.0800	mg/kg	J
Mercury	Zone 4	082	FW082001S3	9306293	Phase 2	Water	.	0.0002	mg/L	J
Mercury	Zone 4	082	FW082002S3	9306294	Phase 2	Water	.	0.0002	mg/L	J
Mercury	Zone 4	082	FW082003S3	9306295	Phase 2	Water	.	0.0002	mg/L	J
Mercury	Zone 4	082	BI082002S3	930631	Phase 3	Fish	2	0.0900	mg/kg	UN
Mercury	Zone 4	082	FW082001S3	930629	Phase 3	Water	.	0.0002	mg/L	U
Mercury	Zone 4	082	FW082002S3	930629	Phase 3	Water	.	0.0002	mg/L	
Mercury	Zone 4	082	FW082003S3	930629	Phase 3	Water	.	0.0002	mg/L	U
Mercury	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	0.4100	mg/kg	
Vanadium	BK1	BK1	BSBK1001S3	9306301	Phase 2	Soil	.	9.4000	mg/kg	J
Vanadium	BK2	BK2	BSBK2001S3	9306296	Phase 2	Soil	.	4.9000	mg/kg	J
Vanadium	Zone 1	Z1-01	BI001001ST	9412882	Phase 3	Worms	303	2.2000	mg/kg	B
Vanadium	Zone 2	Z2-07	BI002005S4	9412818	Phase 3	Mouse	1	0.4900	mg/kg	B
Vanadium	Zone 2	Z2-07	BI002006S4	9412819	Phase 3	Mouse	1	0.2900	mg/kg	U
Vanadium	Zone 2	Z2-07	BI002007S4	9412820	Phase 3	Mouse	1	0.4900	mg/kg	B
Vanadium	Zone 2	Z2-09	BI002024S4	9412836	Phase 3	Mouse	1	0.2500	mg/kg	U
Vanadium	Zone 2	Z2-10	BI002027S4	9412839	Phase 3	Mouse	1	0.2800	mg/kg	U
Vanadium	Zone 2	Z2-07	BI002033S4	9412843	Phase 3	Mouse	1	0.3000	mg/kg	U
Vanadium	Zone 2	Z2-01	BI002018S4	9412831	Phase 3	Shrew	1	0.2500	mg/kg	U
Vanadium	Zone 2	Z2-01	BI002017S4	9412830	Phase 3	Vole	1	0.2800	mg/kg	U
Vanadium	Zone 2	Z2-01	BI002019S4	9412832	Phase 3	Vole	1	0.2900	mg/kg	B
Vanadium	Zone 2	Z2-01	BI002001ST	9412883	Phase 3	Worms	289	3.5000	mg/kg	B
Vanadium	Zone 3	Z3-03	BI003021S4	9412859	Phase 3	Mouse	1	0.2600	mg/kg	U
Vanadium	Zone 3	Z3-07	BI003028S4	9412864	Phase 3	Mouse	1	0.2500	mg/kg	U
Vanadium	Zone 3	Z3-07	BI003030S4	9412866	Phase 3	Mouse	1	0.2400	mg/kg	U
Vanadium	Zone 3	Z3-10	BI003017S4	9412855	Phase 3	Shrew	1	0.2400	mg/kg	U
Vanadium	Zone 3	Z3-04	BI003024S4	9412861	Phase 3	Shrew	1	0.2900	mg/kg	U
Vanadium	Zone 3	Z3-10	BI003019S4	9412857	Phase 3	Vole	1	0.2500	mg/kg	U
Vanadium	Zone 3	Z3-10	BI003032S4	9412868	Phase 3	Vole	1	0.3600	mg/kg	B
Vanadium	Zone 3	Z3-10	BI003035S4	9412871	Phase 3	Vole	1	0.2800	mg/kg	U
Vanadium	Zone 3	Z3-10	BI003036S4	9412872	Phase 3	Vole	1	0.2600	mg/kg	U
Vanadium	Zone 3	Z3-01	BI003001ST	9412884	Phase 3	Worms	253	2.2000	mg/kg	B
Vanadium	Zone 4	Z4-01	BI004001ST	9412885	Phase 3	Worms	318	1.6000	mg/kg	B

APPENDIX B

RARE, THREATENED, ENDANGERED SPECIES INFORMATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
6950-H Americana Parkway
Reynoldsburg, Ohio 43068

IN REPLY REFER TO

COPY FOR YOUR INFORMATION

September 28, 1994

Mr. Jack Dingledine
CH2M Hill
1 Dayton Centre, Suite 1400
1 South Main Street
Dayton, OH 45402-1828

Dear Mr. Dingledine:

We would like to provide you with the official comments of the U.S. Fish and Wildlife Service regarding federally listed endangered species that may occur in the vicinity of the Fields Brook Superfund site in Ashtabula, Ohio.

ENDANGERED SPECIES COMMENTS: Our records show that the Fields Brook Superfund project falls within the range of the Indiana bat, bald eagle, and clubshell mussel, federally listed endangered species. The site is also within the range of the butternut (a tree), marsh spear grass, eastern sand darter (a fish), and eastern massasauga (a rattlesnake), all category 2 candidates for federal listing as endangered species. Candidate "category 2" species are under review by the U.S. Fish and Wildlife Service for possible addition to the endangered species list at some time in the future. These candidate species currently have no legal protection under the Endangered Species Act.

Of the federally listed endangered species mentioned above, only the Indiana bat appears to have much likelihood of occurring in the Fields Brook area. Summer habitat requirements for the species are not well defined, but the following are thought to be of importance:

1. Dead trees and snags along riparian corridors, especially those with exfoliating bark or cavities in the trunk or branches which may be used as maternity roosts;

2. Live trees, such as shagbark hickory, which have exfoliating bark;

3. Stream corridors, riparian areas, and nearby woodlots which provide forage sites.

In consideration of the above habitat requirements, we recommend that if trees with exfoliating bark (potential roost trees) are encountered in the project area, they and surrounding trees should be saved wherever possible. If they must be cut, this should not be done between April 15 and September 15.

If desirable trees are present, and if the above time restriction is unacceptable, mist net or other surveys should be conducted to determine if Indiana bats are present. The survey should be designed and conducted in coordination with Mr. Buddy Fazio (Endangered Species Coordinator) of this office.

If you have questions or we may be of further assistance in this matter please contact Mr. Buddy Fazio or Mr. Bill Kursy of this office.

Sincerely,

Kent E. Kroonemeyer
Supervisor

cc: Mr. Ed Hanlon, U.S. EPA Region 5

APPENDIX C

SELECTION OF CONTAMINANTS OF ECOLOGICAL CONCERN FOR THE FIELDS BROOK FLOODPLAIN WETLAND AREA

Table of Contents

1 Introduction

At the request of U.S. EPA, EA Engineering has prepared the following screening level assessment to determine which of the contaminants of potential concern (COPCs) should be propagated through the complete ecological risk assessment process as COCs for the Fields Brook floodplain/wetland. Included in the list are those compounds identified by U.S. EPA (1995) and CH2M-Hill (1994) except for two volatile compounds (tetrachloroethylene and 1,2-dichloroethylene) that were not detected in any biotic tissues at the site. For this screening assessment only Phase II validated data were used with the exception of the partially validated (some COPCs) Phase III earthworm data. The site-specific earthworm data were used in preferance to generic biota-to-soil accumulation factors (BSAFs). In addition, due to the need to proceed expeditiously, the receptors of concern presented by EA in previous documents (*e.g.*, 1 December 1994 letter from P. Clifford to E. Hanlon) are evaluated herein so that data and models for new receptors were not required for this screening effort.

2 Methods

Calculation of screening level risks was performed using 95th percentiles of distributions of concentrations of contaminants in soils, water, vegetation, and small mammal composites. It must be recognized that this is only a screening excercise, values presented are not the products of a complete risk assessment, and only COPC screening should be conducted with these values. One-half of the detection limit was used for values reported as non-detects. For all but small mammal composites, distribution shapes were determined using the "W" statistic for normality. If distributions were determined to be either normal or log-normal, 95 percent UCLs were calculated as:

$$95\%\ UCL = Mean + \left(1.64 \times \begin{matrix} standard \\ deviation \end{matrix}\right)$$

where the mean and standard deviation were transformed to the log scale for log-normal distributions. When data did not fit either normal or log-normal distributions, the empirical distribution was used and 95th percentiles were determined non-parametrically.

Because actual contaminant concentration distributions in small mammal composites are not known for the Phase II data, it was necessary to use the information available (number of individuals in the composite and measured contaminant concentrations) to place an upper bound on the 95th percentile. The mathematical formulation requires the following definitions:

a) x{i,j} = true value for j-th individual of i-th composite.

b) x{i,.} = total of x{i,j} summed over j.

c) concentration{i} = measurements, known: x{i,.} = concentration{i}.

d) 95th% = 95-th percentile of empirical distribution using all x{i,j}.

Where the object is to maximize the 95th percentile. This procedure is subject to the following restrictions:

x{i,j} > 0, for all i & j
x{i,.} = concentration{i}, all i

The methodology employed was iterative and monotonically increased the 95th percentile. The initial values for x{i,j} were defined by assigning all concentration{i} into a single individual in composite i. These initial values tend to produce a large 95th percentile, and continued iteration produces even larger 95th percentiles for alternate values of x{i,j}. The process was repeated by assigning all concentration{i} uniformly across 2 individuals in composite i, 3 individuals, etc. until all possible distributions had been accounted for. The largest 95th percentile generated by this process was selected as the 95th percentile for subsequent calculations. This process generates an estimate of the 95th percentile which is known to be larger than the true 95th percentile and as such, contributes uncertainty and conservatism of the final hazard quotient (HQ) estimate. Samples collected under the Phase III sampling program will be used for the actual risk assessment and will allow incorporation of actual measures of the variances present in small mammal populations into the process.

The 95th percentiles for media used in modeling are presented in Table 1. It should be noted that the values presented for soils were based on Phase II data only and as such, due to sample size constraints, are highly uncertain and HQs derived using these data can be used only for COPC screening. Samples collected under the Phase III sampling program will generate more accurate estimates of the 95th percentiles and will be used for the actual risk assessment. Water and fish tissue concentrations from the upstream area (Zone 4) were used to reflect probable concentrations in the lower reaches of the Brook *following remedial activities associated with the sediment operable unit. Maximum concentrations were* used for earthworm tissue data in each exposure zone.

Concentrations of barium and vanadium are available only for earthworms (Phase III data) and Phase II soils data because these are TAL metals and only priority pollutant metals were evaluated in other media in Phase II (per U.S. EPA 1994). Concentrations of these metals will be available in Phase III data for mammals and as such, these metals will be retained as provisional COCs for complete risk assessment because insufficient information exists to eliminate them at this stage.

2.1 Exposure Assumptions

In response to comments received from U.S. EPA and other agencies, several of the model parameters used in the draft ecological risk assessment prepared by EA Engineering (June 1994) were modified for this evaluation. Specifically, ingestion rates were modified for mink and red-tailed hawks, and the foraging range for robins was reduced.

The resulting model parameter list is presented in Table 2. Table 3 presents the portion of each receptor's activities (area use factor; AUF) which will be conducted in each Zone (Figure 1; assuming 195 acres are represented by the four zones). The values presented are used as multipliers to decrement the dose calculated by the food-web model presented in EA (1994):

$$Dose_{ik} = R_k \times \sum_{j=1}^{n} Fr_{kj} \times Cf_{ij} \times AUF_{kz}$$

Where:

$Dose_{ik}$	=	Dose of compound i to the kth consumer; mg compound per kg organism wet weight (fresh or live weight) per day
Cf_{ij}	=	Concentration of compound i in food source j (includes soil)
Fr_{kj}	=	Fraction of k's diet which is food source j
R_k	=	Feeding rate; kg food (wet) per kg organism (wet) per day
n	=	Number of food sources
$C_{i,j}$	=	Concentration of compound i in j's diet (wet weight)
AUF_{kz}	=	Area use factor for receptor k in zone z

2.2 Toxicity Reference Values (TRVs)

A TRV is an exposure level for a receptor taxon (including sensitive subgroups such as taxa under regulatory protection) that is likely to be without appreciable risk of deleterious effects. TRVs may be developed for different routes of exposure such as oral, inhalation, and dermal. They may be obtained from appropriate regulatory criteria, or be developed using either exposure dose (expressed as mg/kg body weight/day for oral intake); concentration in food, water, or air (expressed as mg/kg, mg/L, mg/m^3, respectively); or body burden [*i.e.,* internal dosage, mg/kg (fresh or live weight)]. For this screening assessment, dose-based TRVs were obtained or developed from available toxicological literature to provide a basis to evaluate exposure of site biota exposed to concentrations of COPCs measured on-site. These derivations were made in a manner consistent with that presented in USEPA (1994) although uncertainty factors are obtained from another source (discussed below). When toxicity data are lacking for some taxa, a sensitive toxicological endpoint was identified from the most appropriate and available taxa and extrapolated for application.

2.2.1 Application of Uncertainty Factors in Developing TRVs

In developing TRVs for ROCs, uncertainty factors (UFs) were set at their most plausible values reflecting the relationship between experimental response and the risk under consideration for each COPC. UFs are established based on values suggested by the literature and the toxicological database for the COPCs of interest at the site. There are numerous studies that demonstrate that a consistent use of only factors of ten as UF values result in overly conservative estimates of risk (see discussion below). These studies show that many UFs can safely provide protection of 80 to 99.9 percent when set at values less than ten.

For this investigation, a factor of five was used to account for inter-taxon variability, a value that is realistic based on previous studies examining UFs. The studies of Evans et al. (1944), Lehman and Fitzhugh (1954), and Hayes (1967) indicate that extrapolations of animal studies to humans for prolonged and repeated exposures only require adjustments of about two to four times. Suter and Rosen (1988) in contrast, using an aquatic database, suggested that UFs of 10 and 20 or more may be required for extrapolating between families and orders, respectively.

For TRV estimation, a factor of ten was used to extrapolate from lowest observed adverse effect level (LOAEL) to no observed adverse effect level (NOAEL) endpoints and from subchronic to chronic endpoints. A factor of 100 was used to extrapolate from single oral doses and acute LD50s to chronic

NOAELs. These UFs are conservative (*i.e.*, indicate lower concentrations of toxicological concern than are actually of concern) based on suggested values found in the literature. Weil and McCollister (1963) observed that factors of 2, 3, 5, and less than 10 could provide an equivalent full chronic NOAEL downward adjustment from a subchronic NOAEL 59, 73, 90, and 97 percent of the time, respectively, for small mammals. McNamara (1976) similarly noted a value of approximately three for the subchronic to chronic NOAEL ratios for 41 different compounds. Weil and McCollister (1963) showed that 96 percent (50 of 52) of small mammal studies had LOAEL-to-NOAEL ratios of 5 or less. The average ratio for the subchronic studies was less than 3, while full chronic studies showed a mean ratio of approximately 3.5. In comparison, Suter and Rosen (1988) developed regressions between LC50 data and maximum acceptable toxicant concentrations (by definition lower than a LOAEL because it is the geometric mean of the LOAEL and NOAEL) and found extrapolation factors of 8, 18, 22, and 34 for marine invertebrates and fish, and freshwater invertebrates and fish, respectively.

The most scientifically sound data point found for each COPC was selected for calculation of TRVs for each ROC at the site. Whenever possible, the toxicity endpoint used as a TRV is a NOAEL for chronic or subchronic exposures. Since the true effects level is higher by an unknown amount than the NOAEL, the NOAEL may result in overestimation of risk, and as such, is a conservative endpoint. When more than one NOAEL is available for a particular animal, the lowest NOAEL with a serious effect (*e.g.*, liver necrosis versus decreased body weight gain) was chosen. The maximum adjustment adopted for the TRV derivation approach discussed above was set at 500 for those data considered to be the most uncertain when extrapolated, *i.e.*, lethal endpoints observed under acute or single exposure conditions for organisms other than the ROCs.

Toxicity data for terrestrial animals are relatively scant, and few exist for the specific receptors selected at this site. Development of TRVs for this screening investigation was based largely on toxicity of chemicals to laboratory animals, primarily rats and mice, that were developed for human health assessments. Primary literature sources were used whenever possible in generating TRVs for each COPC and ROC at this site.

The following text presents the supporting information for TRV development. TRVs are summarized in Table 4.

Aroclor 1248 - Small Mammals, Mouse, Shrew (1.3 mg/kg-bw/day) - This value was based on a 5 wk LOAEL of 13 mg/kg-bw/day for mice exposed to Aroclor 1248 (Thomas and Hindsill 1978 in ATSDR 1991). After 5 weeks of exposure, mice at the LOAEL had decreased resistance to infection, resulting in increased mortality. Also reported in ATSDR (1991) was a 4 wk NOAEL of 50 mg/kg-bw/day for rats based on hematological and hepatic (focal necrosis) effects. An cute oral LD50 value of 11,000 mg/kg for rats was also found (Fishbein, 1974). The 5 wk mouse value was divided by a factor of 10 to estimate a chronic NOAEL, resulting in a TRV of 1.3 mg/kg-bw/day.

Aroclor 1248 - Medium Mammals, Mink, Rabbit (0.26 mg/kg-bw/day) - No data were found regarding medium mammal exposure to Aroclor 1248. This value was based on the Aroclor 1248 TRV for small mammals of 1.3 mg/kg-bw/day and divided by 5 to account for species extrapolation, resulting in a TRV of 0.26 mg/kg-bw/day for medium mammals.

Aroclor 1248 - Herons (5.58 mg/kg-bw/day) - This value was based on a 5 d LC50 value of 2,795 mg/kg reported for mallards exposed to Aroclor 1248 (Heath et al. 1972). This value was divided by 100 to estimate a chronic NOAEL and further divided by 5 to account for inter-taxon variability, resulting in a TRV of 5.58 mg/kg-bw/day.

Aroclor 1248 - Raptors (0.45 mg/kg-bw/day) - This value was based on a 1.5 yr NOAEL of 0.45 mg/kg-bw/day for screech owls (McLane and Hughes, 1980). The NOAEL reported as 3 mg/kg dietary feed was multiplied by the estimated daily consumption of screech owls (15% of body wt.; Nagy, 1987) and then divided by the estimated body weight of adult screech owls (150 g; Terres, 1982) to achieve a NOAEL of 0.45 mg/kg-bw/day. The exposure encompassed two full breeding seasons and the endpoints measured included survival, egg production, egg hatchability, and eggshell thickness. It should be noted that 3.0 mg/kg was the only dose administered (plus controls) to the owls, thus the estimated NOAEL value obtained is likely conservative.

Aroclor 1248 - Chickens/Pheasants and Turkeys (2.3 mg/kg-bw/day) - This value was based on a 10 wk NOAEL of 2.3 mg/kg-bw/day for Japanese quail (Scott, 1977). The NOAEL reported as 20 mg/kg dietary feed was multiplied by the estimated daily consumption of Japanese quail (12% of body wt.; Nagy, 1987) and then divided by the estimated body weight of adult Japanese quail (180 g; Terres, 1982) to yield a NOAEL of 2.3 mg/kg-bw/day. Endpoints measured included survival, egg production, egg shell breaking strength and egg hatchability. LD50 values were also reported for ring-necked pheasant, bobwhite quail, and Japanese quail exposed to Aroclor 1248 for 5 d (Heath et al. 1972). Five day LD50 values of 1,310 mg/kg, 1,175 mg/kg, and 4,845 mg/kg were reported for ring-necked pheasant, bobwhite quail, and Japanese quail, respectively (Heath et al. 1972).

Aroclor 1248 - Passerine Birds, American Robin (0.46 mg/kg-bw/day) - No data were found regarding song bird exposure to Aroclor 1248. This value was based on the TRV for ground-feeding birds of 2.3 mg/kg-bw/day, the most rigorous study examining the effects of Aroclor 1248 on birds (*e.g.*, multiple dose levels). The ground-feeding bird TRV was divided by 5 to account for inter-taxon variability, resulting in a TRV of 0.46 mg/kg-bw/day.

Aroclor 1254 - Small Mammals, Mouse, Shrew (0.32 mg/kg-bw/day) - This value was based on a two generation study reporting a NOAEL of 0.32 mg/kg-bw/day for rats (Linder et al. 1974). The NOAEL was based on several reproductve endpoints, including number of litters, litter size, total pups per treatment group, pup survival, and mean body weight at weaning. A 2 yr National Cancer Institute (NCI) study examining the effects of Aroclor 1254 on rats was presented by Ward (1985) and Morgan et al. (1981). The NCI data indicated a 2 yr LOAEL of 25 mg/kg feed, or 1.125 mg/kg-bw/day, based on survival, growth, and incidence of neoplastic nodules and hepatocellular carcinomas (Ward, 1985; Morgan et al. 1981). A 9 wk reproductive study reporting a LOAEL of 6.4 mg/kg-bw/day for rats was also found (Baker et al. 1977) with maternal toxicity and fetal mortality as the endpoints. Collins and Capen (1980) reported a 60 d LOAEL (fetotoxic effects) of 50 mg/kg (2.5 mg/kg-bw/day) for rats. Pup weights were significantly reduced and ultrastuctural lesions were found on thyroids of pups at 50 ppm.

Aroclor 1254 - Medium Mammals, Mink, Rabbit (0.15 mg/kg-bw/day) - This value was based on a 4 mo NOAEL of 0.15 mg/kg-bw/day for mink exposed to Aroclor 1254 (Aulerich and Ringer, 1977). The NOAEL was based on adult mortality, number of females whelped, number of kits born, and kits per female. The dietary concentration of 1.0 mg/kg Aroclor 1254 was multiplied by the estimated mass of food consumed daily (0.15 kg/d) and then divided by the average mass of minks used (1.0 kg-bw) to yield 0.15 mg/kg-bw/day. Aulerich and Ringer (1977) also reported a 10 mo LOAEL of 0.30 mg/kg-bw/day (2 mg/kg feed) for mink exposed to Aroclor 1254. Endpoints included adult mortality, number of adult females mated and whelped, and kit survival and body weight. An 8 wk LOAEL of 0.19 mg/kg-bw/day for mink exposed to Aroclor 1254 was reported by Aulerich et al. (1985). The LOAEL was based on body weight loss and reproductive success. The dietary concentration of 2.5 mg/kg Aroclor 1254 was multiplied by the estimated mass of food consumed daily (0.069 kg/d) and then divided by the average mass of minks used (0.9 kg-bw) to achieve 0.19 mg/kg-bw/day. Hornshaw et al. (1986) reported 28 d LC50 values for mink ranging from 49-58 mg/kg.

Aroclor 1254 - Songbirds, American Robin (2.54 mg/kg-bw/day) - This value was based on a 56 d LC50 of 254 mg/kg-bw/day for Bengalese finches exposed to Aroclor 1254 (Prestt et al. 1970). The endpoints were mortality and body weight loss. The 56 d NOAEL values from the same study ranged from 12-36 mg/kg-bw/day. The LD50 value of 254 mg/kg-bw/day was reduced by a factor of 100 to estimate a chronic NOAEL of 2.54 mg/kg-bw/day.

Aroclor 1254 - Herons and Ducks (3.4 mg/kg-bw/day) - This value was based on a 1.5 yr NOAEL of 3.41 mg/kg-bw/day for mallards exposed to Aroclor 1254 (Heath et al. 1972). The exposure encompassed two full breeding seasons, with the NOAEL based on mortality and several reproductive endpoints. The value reported by Heath et al. (1972) of 25 mg/kg feed was multiplied by the average amount of dry feed consumed daily by an adult mallard (0.15 kg; Welty, 1982) and divided by the weight of an adult mallard (1.1 kg; Terres, 1982) to achieve a NOAEL of 3.41 mg/kg-bw/day. This value was identical to the 3 mo NOAEL of 25 ppm Aroclor 1254 (diet) for mallards reported by Custer and Heinz (1980). Various reproductive endpoints were measured with no adverse effects observed at the NOAEL. A 5 d LC50 of 2,700 mg/kg was also reported for mallards exposed to Aroclor 1254 (Heath et al. 1972).

Aroclor 1254 - Raptors (0.68 mg/kg-bw/day) - No data were found regarding raptor exposure to Aroclor 1254. This value was based on the heron TRV of 3.4 mg/kg-bw/day because it was the most rigorous avian exposure to Aroclor 1254 found. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.68 mg/kg-bw/day for raptors.

Aroclor 1260 - Small Mammals, Mouse, Shrew (7.4 mg/kg-bw/day) - This value was based on a two generation study reporting a NOAEL of 7.4 mg/kg-bw/day for rats (Linder et al. 1974). The NOAEL was based on several reproductve endpoints, including number of litters, litter size, total pups per treatment group, pup survival, and mean body weight at weaning. A 29 mo (full life cycle) LOAEL of 3.45 mg/kg-bw/day (100 mg/kg diet) for rats was reported by Norback and Weltman (1985). Liver lesions occurred mainly in female rats at 100 mg/kg and eventually progressed to hepatocellular carcinomas (carcinogenicity) in livers. The dietary level of 100 mg/kg Aroclor 1260 was converted to an intake of 5 mg/kg-bw/day by assuming that a rat consumes 5% of its body weight per day. This dosage was converted to a Time Weighted Average (TWA) dose of 3.45 mg/kg-bw/day to reflect the fact that rats received 100 mg/kg for 16 mo, 50 mg/kg for 8 mo, and 0 mg/kg for the last 5 mo. This TWA LOAEL was divided by 10 to estimate a chronic NOAEL (TRV) of 0.345 mg/kg-bw/day. Kimbrough (1975) reported a 21 mo LOAEL of 4.64 mg/kg-bw/day for rats. Mean final rat body weights and body weight gain were significantly reduced, and hepatocellular carcinomas formed in livers of 14% of treated rats (vs. 0.58% for controls) at a dietary level of 100 mg/kg. The dietary level of 100 mg/kg Aroclor 1260 was converted to a dose of 5 mg/kg-bw/day by assuming that a rat consumes 5% of its body weight per day. This dosage was converted to a Time Weighted Average (TWA) dose of 4.64 mg/kg-bw/day to reflect the fact that rats received 11.6 mg/kg-bw/day during the first week of exposure, 6.1 mg/kg-bw/day at 3 mo, and 4.3 mg/kg-bw/day at 21 mo due to fluctuating dietary ingestion rates.

Aroclor 1260 - Medium Mammals, Mink, Rabbit (0.15 mg/kg-bw/day) - This value was based on a 4 mo NOAEL of 0.15 mg/kg-bw/day for mink exposed to Aroclor 1254 (Aulerich et al. 1977). The endpoints were survival, reproductive success and fetal mortality. This value was retained, as Aroclor 1254 and Aroclor 1260 have similar log Kow values (6.5 and 6.8, respectively), thus the bioaccumulation potential for Aroclor 1260 is expected to be similar to Aroclor 1254 (ATSDR 1991). The small and medium mammal data also suggest that Aroclors 1254 and 1260 affect these receptors at similar doses (ATSDR 1991). Further, mink are more sensitive to PCBs than most species of animals such as ferrets, mice, rats (Aulerich et al. 1985). Thus, mink are expected to be protective of these and other mammalian species.

Aroclor 1260 - Chickens/Pheasants and Turkeys (4.7 mg/kg-bw/day) - This value was based on an 18 mo NOAEL of 100 mg/kg feed for chickens (Keplinger et al. 1971). No effects on body weight, egg shell thickness, or egg hatchability were observed at the NOAEL dose. The value reported of 100 mg/kg feed was multiplied by the average amount of dry feed consumed daily by an adult chickens (0.085 kg; Welty, 1982) and divided by the weight of an adult domestic chicken (1.8 kg; Welty, 1982) to achieve a TRV of 4.7 mg/kg-bw/day. A 50 d LC50 value of 500 mg/kg for bobwhite quail was also found (Hurst et al. 1973). Other LC50 values of 500 mg/kg for bobwhite quail were also reported for 28 and 39 d exposures (Hurst et al. 1973). Five day LD50 values of 1,260 mg/kg, 745 mg/kg, and 2,185 mg/kg were also reported for ring-necked pheasant, bobwhite quail, and Japanese quail, respectively (Heath et al. 1972).

Aroclor 1260 - Herons and Ducks (3.96 mg/kg-bw/day) - This value was based on a 5 d LC50 value of 1,975 mg/kg reported for mallards exposed to Aroclor 1260 (Heath et al. 1972). This value was divided by 100 to estimate a chronic NOAEL and further divided by 5 to account for inter-taxon variation, resulting in a TRV of 3.96 mg/kg-bw/day.

Aroclor 1260 - Raptors and Songbirds (0.94 mg/kg-bw/day) - No data were found regarding raptor or songbird exposure to Aroclor 1260. This value was based on the TRV for chickens/pheasants and turkeys of 4.7 mg/kg-bw/day because it was the most rigorous avian exposure to zinc found. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.94 mg/kg-bw/day.

Arsenic - Small Mammals (0.75 mg/kg-bw/day) - This value was based on a 3 generation NOAEL of 0.75 mg/kg-bw/day for mice exposed to arsenic via drinking water (Schroeder and Mitchener 1971). The dietary dose of 5 mg/kg (via water) was multiplied by the estimated daily water intake of 0.003 kg/d (Calder and Braun 1983) and then divided by the estimated weight of an adult mouse (0.02 kg) to obtain 0.75 mg/kg-bw/day. The NOAEL was based on survival of offspring, number of litters, failure of adult mice to breed, and total population size at the end of the study. This was the only study found reporting population level effects (*i.e.,* reproduction) of arsenic on small mammals. Also found was a life-cycle (1200 d) NOAEL for rats of 0.34 mg/kg-bw/day based on a single dose level (Schroeder et al. 1968). The NOAEL was based on cardiovascular and hematological abnormalities, life span, and body weight gain. Other chronic NOAEL values found ranged up to 12 mg/kg-bw/day (Byron et al. 1967). Eisler (1988) also reported acute toxicity values for hamsters ranging from 1.5 to 5.0 mg/kg-bw/day; however, these values were based on acute exposures.

Arsenic - Medium Mammals, Mink, Rabbit (1.2 mg/kg-bw/day) - This value was based on a 2 yr NOAEL of 1.2 mg/kg-bw/day for dogs (Byron et al. 1967). The endpoints included various respiratory, cardiovascular, gastrointestinal, hematological, hepatic, and renal effects. This value was similar to the chronic oral toxicity value found for domestic cats of 1.5 mg/kg-bw/day and lower than single oral dose values for rabbits, which ranged from 8-40 mg/kg-bw (Eisler, 1988).

Arsenic - Ducks (6.8 mg/kg-bw/day) - This value was based on a 32 d LD50 for mallard ducks (Eisler, 1988). The value reported in Eisler (1988) as 500 mg/kg diet was multiplied by the amount of dry feed consumed daily by an adult mallard (0.15 kg; Welty, 1982) and divided by the weight of an adult mallard (1.1 kg; Terres, 1982) to yield a TRV of 68.2 mg/kg-bw/day. Other toxicological values found were an acute (test duration not reported) LD50 of 323 mg/kg-bw and a 6 d LD50 of 1000 mg/kg diet

(136 mg/kg-bw/day) for mallards. The 32 d LC50 of 68.2 mg/kg-bw/day was divided by 10 to estimate a chronic NOAEL, resulting in a TRV of 6.8 mg/kg-bw/day.

Arsenic - Herons (1.36 mg/kg-bw/day) - This value was based on the duck TRV of 6.8 mg/kg-bw/day. The duck TRV of 6.8 mg/kg-bw/day was divided by 5 to account for inter-taxon variability.

Arsenic - Raptors (1.26 mg/kg-bw/day) - No data were found regarding raptor exposure to arsenic. The chicken/pheasant TRV was used to extrapolate this TRV because it was the most rigorous avian exposure found. The raptor TRV was extrapolated from the chicken/pheasant TRV of 6.3 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability.

Barium - Small Mammals, Mouse, Shrew (11.6 mg/kg-bw/day) - This value was based on a 92 d NOAEL (115.8 mg/kg-bw/day) in mice (Dietz et al. 1992). The NOAEL was based on survival, weight loss, various behavioral and reproductive endpoints, and lack of histopathologic lesions. This value was divided by 10 to estimate a chronic NOAEL of 11.6 mg/kg-bw/day. Rats were also exposed in the same study with similar results. The mouse value was similar to other values reported for barium chloride in ATSDR (1990). Rats exposed to barium chloride for 13 wk via water resulted in a NOAEL of 35 mg/kg-bw/day (ATSDR, 1990). However, studies reporting NOAEL values for serious effects in rats and mice exposed to barium acetate were considerably lower than those for barium chloride, ranging from 0.7 to 0.95 (ATSDR, 1990). As reported in ATSDR (1990), barium chloride is more commonly used in manufacturing processes than barium acetate. Hence, barium chloride exposure to terrestrial ROCs in NECOU are more likely to occur than exposure to barium acetate. Therefore, the chloride form of barium was used to develop the TRV.

Barium - Medium Mammals, Mink, Rabbit (2.32 mg/kg-bw/day) - No data were found regarding barium exposure to medium or large mammals. The medium mammal and deer TRVs were extrapolated from the small mammal TRV of 11.6 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability.

Barium - All Birds (ND) - No data were found regarding barium exposure to birds.

Benzo[a]pyrene - All Receptors (0.5 mg/kg-bw/day) - This value was obtained from U.S. EPA (1995).

Beryllium - Small Mammals, Mouse, Shrew (0.80 mg/kg-bw/day) - This value was based on a rat 3.2 yr NOAEL of 0.85 mg/kg-bw/day and a 898 d mouse NOAEL of 0.80 mg/kg-bw/day. The endpoints in both the rat and mouse studies included various respiratory, cardiovascular, and hepatic effects (ATSDR, 1991). Other values were found reporting beryllium exposure to rats and mice but were greater than the TRV, ranging from 10 to 121 mg/kg-bw/day (ATSDR, 1991).

Beryllium - Medium Mammals, Mink, Rabbit (0.16 mg/kg-bw/day) - No data were found regarding barium exposure to medium or large mammals. The medium mammal and deer TRVs were extrapolated from the small mammal TRV of 0.80 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability.

Beryllium - All Birds (ND) - No data were found regarding beryllium exposure to birds.

Cadmium - Small Mammals, Mice, Shrews (0.99 mg/kg-bw/day)- This value was based on a full lifespan NOAEL (1100-1200 d) of 5 mg/kg (0.99 mg/kg-bw/day) for rats exposed to lead acetate in drinking water (Schoeder et al. 1965). The endpoints were visible signs of toxicity, lifespan and longevity. The dietary dose of 5 mg/kg (via water) was multiplied by the estimated daily water intake of 0.099 kg/d (Calder and Braun, 1983) and then divided by the estimated weight of an adult rat (1.0 kg) to obtain 0.495 mg/kg-bw/day. A 6 mo NOAEL of 1.9 mg/kg-bw/day for mice was also found (Schroeder and Michener, 1971). The endpoints were lack of congenital abnormalities and reproductive failure. These values are lower than other published intermediate and chronic NOAELs for rats, mice, and rabbits where serious sublethal effects (e.g., reproduction) were reported (ATSDR, 1991).

Cadmium - Medium Mammals, Mink, Rabbit (0.75 mg/kg-bw/day) - This TRV was based on a 12 mo NOAEL value of 0.75 mg/kg-bw/day for dogs reported by Loser and Lorke (1977). The endpoints examined were not provided. This value was used for all medium mammals, as no other data were found.

Cadmium - Ducks (0.49 mg/kg-bw/day) - This value was based on a 12 wk NOAEL for young wood ducks reported by Mayack et al. (1981). The exposure duration was 12 wk and the endpoint was formation of kidney lesions. The TRV of 0.49 mg/kg-bw/day was calculated from the value reported in Mayack et al. (1981) by multiplying 6.61 mg/kg diet by 0.037 kg of food eaten daily (Nagy, 1987) and then dividing by 0.5 kg weight for the average wood duck exposed in the study. Cain et al. (1983) also exposed mallard ducklings to cadmium for 12 wk, with the endpoint of lack of formation of mild and severe kidney lesions. The NOAEL of 2.8 mg/kg-bw/day was calculated from the value reported in Cain et al. (1983) by multiplying 9.2 mg/kg in mallard duckling diet by 0.34 kg of food eaten daily (Welty, 1982) and then dividing by 1.1 kg weight for the average mallard duckling tested. A 90 d LOAEL and a 42 d NOAEL value for mallard ducks of 210 mg/kg (20 mg/kg-bw/day) and 150 mg/kg diet (17.0 mg/kg-bw/day) were also found in White and Finley (1978) and Di Giulio and Scanlon (1984), respectively.

Cadmium - All Other Birds (0.1 mg/kg-bw/day) - This value was based on the duck TRV of 0.49 mg/kg-bw/day. The duck TRV of 0.49 mg/kg-bw/day was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.1 mg/kg-bw/day for other birds.

Chromium - Small Mammals (0.99 mg/kg-bw/day) - This value was based on a 21 mo life span NOAEL value of 0.40 mg/kg-bw/day for mice exposed to chromic acetate (Schroeder et al. 1963). The NOAEL was based on survival and growth. Dose calculation was based on a water ingestion rate of 0.004 kg/d and body weight of 0.05 kg supplied by the author. This was the lowest chronic NOAEL value found for small mammals exposed to chromium. This value is a factor of 10 to 1000 lower than other published NOAELs for both trivalent and hexavalent chromium to small mammals (ATSDR, 1991). As such, this value should be considered conservative.

Chromium - Medium and Large Mammals (0.48 mg/kg-bw/day) - This value was based on a 4 yr NOAEL value of 0.48 mg/kg-bw/day for dogs exposed to hexavalent chromium (Eisler 1986). The NOAEL was based on "no measurable effects," which were not specified by the author. Dose calculation was based on a dog drinking rate of 0.66 L/d (Calder and Braun 1983) and body weight of 8.3 kg (Gralla et al. 1977).

Chromium - Ducks (6.4 mg/kg-bw/day) - This value was based on a 5 mo NOAEL for black ducks reported in Eisler (1986). No effects were observed with respect to survival, reproduction, and blood chemistry at this dose. A TRV of 6.36 mg/kg-bw/day was calculated from the 50 mg Cr/kg value reported in Eisler (1986) by multiplying by 0.15 kg of food eaten daily (Welty, 1982) and then dividing by 2.60 lb (1.18 kg) weight for an average adult black duck (Terres, 1982). This was the only value found for ducks exposed to chromium.

Chromium - All Other Birds (1.28 mg/kg-bw/day) - No data were found regarding other bird exposure to chromium. The duck TRV was used to extrapolate to other birds because it was the most rigorous (and only) avian exposure to chromium found. This TRV was extrapolated from the duck TRV of 6.4 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability, resulting in a TRV of 1.28 mg/kg-bw/day.

Copper - Small Mammals, Mice, Shrews (4.20 mg/kg-bw/day) - This value was based on an 850 d LOAEL found for mice of 4.2 mg/kg-bw/day with decreased body weight gain as the endpoint (ATSDR, 1989). Decreased survival in mice from the same study was 42.5 mg/kg-bw/day after 850 d of exposure. NOAELs found for mink and mice were lower than those found for rabbits exposed to copper. Omole (1977) and King (1975) reported 8 wk and 6 wk NOAELs, respectively, of 7.1 mg/kg-bw/day for rabbits with organ weights, body weight gain, and food consumption as endpoints. The mouse value of 4.20 mg/kg-bw/day was used as the TRV.

Copper - Medium Mammals, Mink, Rabbits (2.85 mg/kg-bw/day) - This value was based on a 357 d NOAEL of 2.85 mg/kg-bw/day for mink (Aulerich et al. 1982). The NOAEL was based on mink survival. The reproductive NOAEL from the same study was 12.9 mg/kg-bw/day. The NOAEL based on survival was used to derive the TRV. No other values were found for medium mammals.

Copper - Turkey (8.2 mg/kg-bw/day) - This value was based on a 24 wk NOAEL for 1-day old turkey chicks (Kashani et al. 1986). The value reported in Kashani et al. (1986) as 240 mg/kg dry feed was multiplied by the amount of dry feed consumed daily by a domestic hen (3.4% of total body weight; Welty, 1982) and divided by the weight of turkey chicks at 12 wk of age (approximately 5.8 kg) to achieve a TRV of 8.2 mg/kg-bw/day.

Copper - All Other Birds (1.64 mg/kg-bw/day) - No data were found regarding duck, heron, and raptor exposure to copper. The turkey TRV was used to extrapolate these TRVs because it was the most scientifically sound avian exposure to copper found. The bird TRV was extrapolated from the turkey TRV of 8.2 mg/kg-bw/day by dividing by 5 to account for inter-taxon variability.

Hexachlorobenzene (HCB) Small Mammals, Mice, Shrews (2.80 mg/kg-bw/day) - This value was based on a 2 yr (4 generations) NOAEL of 2.80 mg/kg-bw/day for rats exposed to HCB (Grant et al. 1977). The endpoints measured included lactation, fertility, and offspring viability indices and offspring birth weights. The NOAEL of 40 mg/kg dietary feed was multiplied by the estimated daily consumption of rats (0.014 kg; Nagy, 1987) and then divided by the average mass of an adult Norway rat (200 g; Burt and Grossenheider, 1976) to yield a NOAEL of 2.80 mg/kg-bw/day. This NOAEL is supported and supplemented by other data found for mice and hamsters. Cabral et al. (1979) reported a NOAEL of 6 mg/kg-bw/day for mice exposed to HCB for 105-120 wks based on induction of liver-cell tumors. Cabral et al. (1977) also reported a LOAEL of 4 mg HCB/kg-bw/day (50 mg/kg) for life cycle exposures (70 wks) of hamsters based on hepatoma formation and tumor incidence in liver.

Hexachlorobenzene (HCB) Medium Mammals (0.12 mg/kg-bw/day) - This value was based on a 331 d NOAEL of 0.12 mg/kg-bw/day for mink to HCB (Bleavins et al. 1984). The endpoints included kit mortality and growth, litter size, and increased percentage of stillbirths. The average mass of HBC consumed for 331 d of 58.5 mg was divided by the number of days (331) and then divided by the average mass of adult minks (1.5 kg-bw; Hornshaw et al. 1986) to yield 0.12 mg/kg-bw/day. Bleavins et al. (1984) also reported a 332 d NOAEL value for ferrets of 0.88 mg/kg-bw/day. Gralla et al. (1977) exposed beagle dogs to HCB for 1 yr, resulting in a NOAEL of 1.2 mg/kg-bw/day. The endpoints measured were mortality, body weight, and various gastrointestinal and hepatic effects (Gralla et al. 1977). Since the key study by Bleavins et al. (1984) for mink provided a chronic NOAEL and is supported by other data, no uncertainty factors were applied

Hexachlorobenzene (HCB) Chicken/Pheasant and Turkey (0.53 mg/kg-bw/day) - This value was based on a 90 d NOAEL of 0.50 mg/kg-bw/day for Japanese quail exposed to HCB (Vos et al. 1971). The NOAEL reported as 5 mg/kg dietary feed was multiplied by the estimated daily consumption of Japanese quail (0.016 kg/d; Nagy, 1987) and then divided by the average body weight of quail used (150 g) to yield a NOAEL of 0.53 mg/kg-bw/day. At the NOAEL dose, egg hatchability, survival, egg production, and eggshell thickness were not affected, whereas significant increases of liver weights, fecal coprophorphyrin excretion and liver lesions were observed. Schwetz et al. (1974) reported a 90 d LOAEL of 4 mg/kg-bw/day (20 mg/kg feed) for Japanese quail exposed to HCB. The LOAEL was based on a significant decrease in the number of hatched chicks suviving for one week. However, no effects on body weight, food consumption, egg production, fertility and hatchibility of eggs, or eggshell thickness were observed.

Hexachlorobenzene (HCB) All Birds (0.11 mg/kg-bw/day) - No data were found regarding other bird exposure to hexachlorobenzene. This value was based on the TRV for chicken/pheasant and turkey of 0.53 mg/kg-bw/day. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 0.11 mg/kg-bw/day.

Hexachlorobutadiene - Small Mammals, Shrews, Mice (0.2 mg/kg-bw/day) - This value was based on a chronic NOAEL of 0.2 mg/kg-bw/day for rats as reported in CH2M HILL (1994). Exposure duration and endpoints were not provided.

Hexachlorobutadiene - Medium Mammals, Mink, Rabbit (0.04 mg/kg-bw/day) - No data were found regarding medium mammal exposure to hexachlorobutadiene. The small mammal TRV of 0.2 mg/kg-bw/day was used to extrapolate to the medium mammal TRV by dividing by 5 to account for inter-taxon variability.

Hexachlorobutadiene (HCBD) - All Birds (1.2 mg/kg-bw/day) - This value was based on a 90 d NOAEL of 6 mg/kg-bw/day for Japanese quail (Schwetz et al. 1974). At the NOAEL dose, no effects on body weight, food consumption, egg production, fertility and hatchibility of eggs, survival of hatched chicks, or eggshell thickness were observed. No other data were found regarding bird exposure to HCBD. The NOAEL for Japanese quail was divided by 5 to extrapolate to other species of birds, yielding a TRV of 1.2 mg/kg-bw/day.

Hexachloroethane - Small Mammals, Shrews, Mice (1.0 mg/kg-bw/day) - This value was based on a chronic NOAEL of 0.7 mg/kg-bw/day for rats as reported in CH2M HILL (1994). Exposure duration and endpoints were not provided.

Hexachloroethane - Medium Mammals, Mink, Rabbits (0.2 mg/kg-bw/day) - No data were found regarding medium mammal exposure to hexachloroethane. The small mammal TRV of 1.0 mg/kg-bw/day was used to extrapolate to the medium mammal TRV by dividing by 5 to account for inter-taxon variability.

Hexachloroethane - All Birds (ND) - No data were found regarding hexachloroethane exposure to birds.

Lead - Small Mammals, Mice, Shrews (0.90 mg/kg-bw/day) - This value was based on a 9 mo NOAEL of 0.90 mg/kg-bw/day for rats (Grant et al. 1980). At the NOAEL, no effects were observed with respect to general growth, health, neurobehavioral development, and structural/functional integrity of target organ systems. These data were supported by the findings of Kimmel et al. (1980), who observed a 90 d NOAEL of 0.90 mg/kg-bw/day for rats exposed to lead acetate. Rats were exposed via drinking water from weaning through mating, gestation, and lactation. At the NOAEL, no effects were observed on the ability of females to conceive, to carry a normal litter to term, to deliver offspring, length of term, or birth weights. No significant effects on embryo- or fetotoxicity, or teratogenicity were observed at the NOAEL. The only effects observed were a slight delay in time of vaginal opening and slight depression of body weight. A full life cycle (4 yr) NOAEL of 25 mg/kg (1.25 mg/kg-bw/day) for rats was reported by Schroeder et al. (1970) based on overall body weight, survival, and longevity. Other values were found for rats, mice, and guinea pigs but all were greater than the 0.90 mg/kg-bw/day TRV or used less serious endpoints such as increases in blood pressure (Eisler, 1988; ATSDR, 1990). A study examining the effects of lead on postnatal development of the bank vole was also found but was considerably higher than the other values found for small mammals (380 mg/kg-bw/day; Zakrzewska, 1988).

Lead - Medium Mammals, Mink, Rabbit (1.25 mg/kg-bw/day) - The most reliable chronic study found for medium mammals was a 2 yr LOAEL of 12.5 mg/kg-bw/day for dogs (ATSDR, 1990). Dogs were exposed to lead acetate in food and the endpoint was lack of neurological effects (not described). This value was divided by 10 to estimate a chronic NOAEL for medium mammals of 1.25 mg/kg-bw/day. *This value was similar to another value found for dogs as reported by* Sax (1984) *for lead* acetate. Sax (1984) reported a LD_{LO} (lowest dose expected to cause death) of 191 mg lead/kg for dog. If this value is divided by 100 to estimate a chronic NOAEL (1.91 mg/kg), it is consistent with the TRV of 1.25 mg/kg-bw/day.

Lead - Raptors (0.82 mg/kg-bw/day) - This value was based on red-tailed hawk NOAEL values ranging from 0.82 to 6.55 mg/kg-bw/day (Lawler et al. 1991; Redig et al. 1991). Lead exposure durations ranged from 21 to 24 d and had no adverse effects on gastrointestinal function, body weight, and other hematological functions (Lawler et al. 1991; Redig et al. 1991). A 5 mo NOAEL for American kestrel (Franson et al. 1983; Pattee, 1984) was also reported as 54 mg/kg feed. This value was multiplied by the amount of feed consumed daily by the kestrels (0.05 kg) and divided by the average weight of the exposed kestrels (0.135 kg) to achieve a TRV of 20.0 mg/kg-bw/day. No adverse effects were observed with respect to survival, egg laying, initiation of incubation, fertility, eggshell thickness (Pattee, 1984), histopathological lesions, body weights, or organ weights (Franson et al. 1983). Ten day and 60 d LOAEL values for American kestrel of 25 and 448 mg/kg feed (9.3 and 166 mg/kg-bw/day), respectively, were also reported by Hoffman et al. (1985) and Custer et al. (1984). Based on these data, the TRV of 0.82 mg/kg-bw/day for raptors appears conservative.

Lead - Herons (0.19 mg/kg-bw/day) - This TRV was based on the data from Edens and Garlich (1983), who reported 10 wk (3.3 mg/kg-bw/day) and 17 wk (0.19 mg/kg-bw/day) LOAEL values for Leghorn hens and Japanese quail hens, respectively, and were based on significant decreases in egg production. A 64 wk LOAEL of 6.25 mg lead acetate/kg-bw/day (equivalent to 3.98 mg/kg-bw/day as lead) was also found for rock doves (Anders et al. 1982). The endpoints were anemia, kidney pathology, and elevation in erythrocyte porphyrin. Damron and Wilson (1975) observed no adverse effects (body weight gain, mortality, feeding rate) in bobwhite quail exposed to lead for 6 wk at 187.5 mg/kg-bw/day. Morgan et al. (1975) reported a 5 wk NOAEL of 100 mg/kg feed (13 mg/kg-bw/day) for Japanese quail based on reduced growth and anemia. The 100 mg/kg feed value was multiplied by the amount of feed consumed daily by the quail (0.013 kg/d; Nagy 1987) and divided by the average weight of the exposed quail (0.1 kg) to achieve a NOAEL of 13.0 mg/kg-bw/day. Kendall and Scanlon (1981) reported a 11 wk NOAEL of 100 mg Pb/kg (7.9 mg/kg-bw/day) for ringed turtle doves. At the NOAEL, no adverse effects were observed on egg production or egg fertility (Kendall and Scanlon, 1981). With respect to the other data found for birds, the 0.19 mg/kg-bw/day value for Japanese quail appears quite conservative. As such, the TRV was set to 0.19 mg/kg-bw/day.

Lead - Passerine Birds (0.28 mg/kg-bw/day) - This value was based on an 11 d NOAEL value of 2.8 mg/kg-bw/day for starlings exposed to trialkyl lead (Osborn et al. 1983). The NOAEL was based on survival, growth, and food consumption. The NOAEL was divided by 10 to estimate a chronic NOAEL, resulting in a TRV of 0.28 mg/kg-bw/day. No other data were found.

Mercury (Organic) - Small Mammals, Shrews, Mice (0.03 mg/kg-bw/day) - This value was based on 11-12 wk LOAELs for rats and mice of 0.302 and 0.636 mg/kg-bw/day, respectively (Ilback, 1991; Ilback et al. 1991). Immunological and developmental effects observed at the LOAEL dose (3.9 mg/kg feed) included reduced natural killer T-cell activity, decreased thymus weight and cell number, decreased cell-mediated cytotoxicity, increased thymus lymphocyte activity in fetuses. These effects are not considered life-threatening but are the most scientifically sound data found for small mammal exposure to organic mercury compounds. No neurotoxic effects (i.e., arched backs and ataxia) were observed at 1.0 mg/kg-bw/day (NOAEL) in mice exposed to methylmercuric chloride in drinking water for 110 d or mice exposed to mercuric chloride at 3 mg/kg-bw/day (NOAEL) for 400 d (Ganser and

Kirschner, 1985). Khera (1973) reported a 95-125 d NOAEL of 0.1 mg/kg-bw/day for rats exposed to methyl mercuric chloride based on body weights and reproductive success. The LOAEL of 0.302 mg/kg-bw/day was divided by 10 to estimate a chronic NOAEL (TRV).

Mercury (Organic) - Medium Mammals, Mink, Rabbits (0.076 mg/kg-bw/day) - This value was based on a 93 d NOAEL of 0.076 mg/kg-bw/day for adult female mink exposed to methyl mercury chloride (Wobeser et al. 1975). No obvious clinical signs of toxicity were observed (e.g., anorexia, weight loss, ataxia, head tremors) at the NOAEL dose after 93 days. The NOAEL dose of 1.1 mg/kg feed was multiplied by the average daily feeding rate for mink (0.069 kg/d; Aulerich et al. 1985) and then divided by the average weight of adult female mink (1.0 kg-bw; U.S. EPA, 1993) to obtain a TRV of 0.076 mg/kg-bw/day. Auerlich et al. (1974) examined the dietary effects of mercury and methylmercury (MeHg) on mink. Methylmercury was considerably more toxic than inorganic mercury to mink, with a LC100 of 5 mg MeHg/kg after 37 days of exposure, compared to a 5 mo NOAEL of 1.01 mg Hg/kg-bw/day as mercuric chloride (Auerlich et al. 1974). Hanko et al. (1970) reported a 58 d LC50 value of 5 mg MeHg/kg for ferrets, similar to the Borg et al. (1974) MeHg value reported for mink. A 159-213 d LOAEL of 0.08-0.10 mg/kg-bw/day was reported for otters exposed to methyl mercury in the diet (2.0 mg MeHg/kg), with anorexia, ataxia, convulsions, and death as the endpoints (O'Connor and Nielson, 1980). A 2 yr NOAEL for domestic cats of 0.02 mg/kg-bw/day based on food consumption, body weight gain, and various neurological endpoints was found in Charbonneau et al. (1976). A LOAEL for dogs of 0.1 mg/kg-bw/day exposed during pregnancy was also found (endpoint was stillbirths) (Eisler, 1987). The mink value was used to generate the TRV because it is more taxonomically similar to ROCs than domestic cats or dogs.

Mercury (Organic) - Ducks (0.068 mg/kg-bw/day) - This value was based on a 12 mo NOAEL for mallard ducks (Heinz, 1974). The value reported in Heinz (1974) as 0.5 mg MeHg/kg feed (methylmercury dicyandiamide, or Morsodren) was multiplied by the amount of feed consumed daily by an adult mallard (0.15 kg; Welty, 1982; page 113) and divided by the weight of an adult mallard (2.4 lb or 1.1 kg; Terres, 1982) to achieve a TRV of 0.068 mg/kg-bw/day. The endpoints measured included mortality and reproductive success. This value was lower than the 21 wk NOAEL reported for mallard ducks (Scheuhammer, 1987) as 3.0 mg/kg feed (0.41 mg/kg-bw/day), the 85 d NOAEL value obtained by Haegele et al. (1974) of 6.2 mg/kg diet (0.75 mg/kg-bw/day), and the 214 d NOAEL of 0.28 mg/kg-bw/day by Pass et al. (1975) for mallards exposed to methyl mercury. Based on these supporting data, the TRV appears sufficiently protective.

Mercury (Organic) - Herons (0.014 mg/kg-bw/day) - No data were found for herons. This value was based on the TRV for ducks of 0.068 mg/kg-bw/day. The duck TRV of 0.068 mg/kg-bw/day was divided by 5 to account for inter-taxon variability, resulting in a TRV of 0.014 mg/kg-bw/day for herons.

Mercury (Organic) - Raptors (0.01 mg/kg-bw/day) - This value was based on a 47 d LC100 of 0.92-1.2 mg/kg-bw/day for goshawks exposed to methylmercury (MeHg) (Borg et al. (1970). The dietary dose of 10-13 mg MeHg/kg was multiplied by the average daily goshawk feeding rate of 0.093 kg/d and then divided by the average mass of the goshawks exposed (1.0 kg) to achieve 0.92-1.2 mg/kg-bw/day. This value was divided by 100 to estimate a chronic NOAEL of 0.01 mg/kg-bw/day. A LOAEL of unknown exposure duration of kestrels to mercury was also found (Scheuhammer, 1987). Considerable mortality was observed in kestrels exposed to 13 mg Hg/kg as feed. This value was multiplied by the amount of feed consumed daily by an adult kestrel (10% of body weight or 0.011 kg; Welty, 1982) and divided by the weight of an adult kestrel (0.113 kg; Terres, 1982) to achieve a LOAEL of 1.26 mg/kg-bw/day.

Mercury (Organic) - All Other Birds (0.023 mg/kg-bw/day) - This value was based on an 8 wk LOAEL of 0.23 mg/kg-bw/day for starlings (Nicholson and Osborn, 1984). The dietary dose of 1.1 mg/kg feed was multiplied by the estimated starling feeding rate of 0.0147 kg/d (Nagy, 1987) and then divided by the estimated mass of the starlings exposed (0.070 kg; Terres, 1982) to achieve 0.23 mg/kg-bw/day. The endpoint was the presence of numerous kidney lesions, although no outward signs of toxicity were observed. The value obtained by Nicholson and Osborn (1984) was divided by 10 to account for uncertainty, as there was only one dose level and only 10 birds were exposed.

Vanadium - Small Mammals, Mice, Shrews (0.7 mg/kg-bw/day) - This value was based on a chronic NOAEL of 0.7 mg/kg-bw/day for mice reported in CH2M HILL (1994). Exposure duration and endpoints were not provided.

Vanadium - Medium Mammals (0.14 mg/kg-bw/day) - No data were found regarding medium mammal exposure to vanadium. The small mammal TRV of 0.7 mg/kg-bw/day was used to extrapolate to the medium mammal TRV by dividing by 5 to account for inter-taxon variability.

Vanadium - All Birds (ND) - No data were found regarding vanadium exposure to birds.

Zinc - Small Mammals, Mice, Shrews (53 mg/kg-bw/day) - This value is based on a 13 wk mouse NOAEL of 53 mg/kg-bw/day in a study by Maita et al. (1981). The endpoints included lack of ulcerations in forestomach, decreased white blood cell count, anemia, and lack of regressive lesions. This was the lowest small mammal NOAEL found for serious effects from the recent published literature. Other chronic NOAEL values found for mice, rats, and rabbits ranged from 104 to 320 mg/kg-bw/day (ATSDR, 1992; Eisler, 1993).

Zinc - Medium Mammals, Mink, Rabbits (20.8 mg/kg-bw/day) - This value is based on a 25 wk mink NOAEL of 20.8 mg/kg-bw/day (ATSDR, 1992) in a study by Bleavins et al. (1983). The endpoints for mink dams included lack of reproductive and developmental effects on their offspring. This value is lower than other NOAEL values reported in ATSDR (1992) for dog (76.5 mg/kg-bw/day; Drinker et al. 1927), cat (83.2 mg/kg-bw/day; Drinker et al. 1927), and ferret (141 mg/kg-bw/day; Straube et al. 1980).

Zinc - Chicken/Pheasant and Turkey (125 mg/kg-bw/day) - This value was based on a 12 wk and 44 wk exposures (NOAELs of 125 mg/kg-bw/day) reported for domestic chickens (Stahl et al. 1990). The endpoints measured were overall egg production, feed conversion, and feed consumption. The value reported in Stahl et al. (1990) as 2000 mg/kg dry feed was multiplied by the amount of dry feed consumed daily by hens in controls (0.125 kg) and divided by the weight of control hens (2.0 kg) to achieve a TRV of 125 mg/kg-bw/day. This value was lower than other values found reporting ground-feeding bird exposure to zinc (Eisler, 1993). Other values reported in Eisler (1993) were greater than 125 mg/kg-bw/day or were of shorter exposure duration.

Zinc - Ducks (10.2 mg/kg-bw/day) - This value was based on a 60 d LOAEL for mallard ducks (Gasaway and Buss, 1972). The value reported in Gasaway and Buss (1972) of 3,000 mg/kg feed was multiplied by the average amount of dry feed consumed daily by exposed mallards (0.034 kg) and divided by the weight of an adult mallard (1.0 kg; Terres, 1982) to achieve a LOAEL of 102.1 mg/kg-bw/day. The endpoints were based on mortality, food consumption, changes in body weight, and various organ weights. This value was similar to other values found exposing mallards to zinc (Eisler, 1993). Thirty day exposures of mallards to doses of 3,000 mg/kg zinc and higher in feed resulted in leg paralysis, reduced feeding rates, and mortality (Eisler, 1993). Exposures (56 d) of 3 day old mallard ducklings to

2,500 mg/kg zinc and higher (LOAEL=1,700 mg/kg-bw/day) in feed resulted in progressive degeneration of the pancreas (Eisler, 1993). The Gasaway and Buss (1972) value of 102.1 mg/kg-bw/day was divided by 10 to estimate a chronic NOAEL. Based on these data, the Gasaway and Buss (1972) value appears conservative.

Zinc - Heron (2.04 mg/kg-bw/day) - No data were found regarding heron exposure to zinc. This value was based on the TRV for ducks of 10.2 mg/kg-bw/day. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 2.04 mg/kg-bw/day.

Zinc - All Other Birds (25 mg/kg-bw/day) - No data were found regarding raptor exposure to zinc. This value was based on the TRV for chicken/pheasant of 125 mg/kg-bw/day because it was the most rigorous avian exposure to zinc found. This value was divided by 5 to account for inter-taxon variation, resulting in a TRV of 25 mg/kg-bw/day.

2.3 Calculation of Screening Hazard Quotients

Using the information described above and the food-web model presented in EA (1994), screening hazard quotients (SHQs) were calculated for each receptor, COC, and zone when sufficient information existed to do so using the following relationship:

$$SHQ = \frac{Exposure\ Dose\ (mg / kg\text{-}bw / day)}{TRV\ (mg / kg\text{-}bw / day)}$$

SHQs are presented in Table 5. SHQs greater than 1.0 are highlighted

3 Contaminants of Concern

U.S. EPA (1995) determined that hazard quotients (HQs) for acenaphthylene, benz[a]anthracene, benzo[b]fluoranthene, chrysene, fluoranthene, fluroene, naphthalene, and phenanthrene were all less than 1.0 therefore, these compounds are not considered in this document and are not retained as COCs. SHQs for barium and vanadium could not be calculated using the Phase II data and are provisionally retained as COCs. All other COPCs are discussed below.

Aroclor-1248: SHQs range up to 3.94 and this COPC is retained as a COC.

Aroclor-1254: A single SHQ of 2.40 was calculated for this aroclor and this COPC is retained as a COC.

Aroclor-1260: SHQs range up to 2.16 and this COPC is retained as a COC.

Arsenic: SHQs for arsenic, although only slightly above reference (zone 4), are sufficiently elevated to retain this COPC as a COC.

Benzo[a]pyrene: SHQs range up to 0.8 and this COPC is not retained as a COC.

Beryllium: SHQs range up to 0.26 and this COPC is not retained as a COC.

Cadmium: SHQs range up to 2.69 and, although these SHQs are only slightly above reference (zone 4), this COPC is retained as a COC.

Chromium: SHQs range up to 20.37 and this COPC is retained as a COC.

Copper: SHQs range up to 1.08 which, given the conservative nature of this screening, is not sufficiently greater than 1.0 to retain this COPC as a COC.

Hexachlorobenzene: SHQs range up to 5.07 and this COPC is retained as a COC.

Hexachlorobutadiene: SHQs range up to 3.58 and this COPC is retained as a COC.

Hexachloroethane: SHQs range up to 0.71 and this COPC is not retained as a COC.

Lead: SHQs range up to 7.23 and this COPC is retained as a COC.

Mercury: SHQs range up to 49.17 and this COPC is retained as a COC.

Zinc: SHQs range up to 0.86 and this COPC is not retained as a COC.

The final list of COCs for the Fields Brook floodplain/wetland area ecological investigation is:

Aroclor-1248	Barium (provisional)	Hexachlorobutadiene
Aroclor-1254	Cadmium	Lead
Aroclor-1260	Chromium	Mercury
Arsenic	Hexachlorobenzene	Vanadium (provisional)

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Appendix D

Determination of Distribution Parameters for Environmental Concentrations

Determination of Parameter Distributions

Distributions for concentrations of contaminants in tissues, Cf_{ij}, were generated from Phase II and III data and were used to establish means and 95% UCLM for modeling purposes. The lognormal distribution was used as the default distribution shape for biological media because it allowed an exact treatment of the data, and because it is a plausible distribution for the analytes investigated herein. The plausibility of the lognormal distribution is evident from the positive skewness exhibited by the observed non-negative variates.

Biological media concentration observations frequently fell below a detection limit and as such were "unobserved". In statistical terms, these observations are said to be left censored, and all that is known about the observations is that they fall below the detection limit and are greater than or equal to zero. This information can be used formally *via* maximum likelihood estimation to establish distribution parameters, but an approach more applicable to this specific data set was used here - the Gibbs sampler.

The Gibbs sampler is an exact method to simulate the parameters (mean and variance on the logarithmic scale) of the lognormal distribution conditional on the measured concentrations, or what is know about the concentrations. This approach characterizes the statistical uncertainty as a probability function of the mean and variance. To do this, prior distributions are needed for the mean and variance. Prior distribution characteristics were selected that were uninformative (no information that was not directly presented by the raw data was generated). In particular, the prior for the mean permitted calculation of all possible means with equal likelihood. A scale invariant prior (Berger, 1980, p. 70) for the variance was selected. When there was no censoring, standard statistical techniques allowed simulation of the mean and variance from the posterior distribution that resulted (Tanner, 1993, p. 12). However, when there was left censoring (in this case, truncation of the distribution because of detection limits in the left tail of the distribution) the parameters were simulated with the Gibbs sampler which includes imputation of the missing (non-detect) data. Basically, the measurements that correspond to non-detects were conditionally simulated to fall below the detection limit.

Composite Samples

Concentrations in many of the small mammal samples obtained during Phase II sampling were analyzed as composites. Because of concerns raised by U.S. EPA, Phase III data on individual mammals were collected and combined with the Phase II composites to establish distributions in the manner specified below. These samples cause no technical difficulty in the applicability of the Gibbs sampler with data imputation. Basically, a composite sample is just another example of incomplete data. The simulation was implemented by simulating the observations in a group conditional on the composite measurement that was observed as a point or a non-detect.

Because the lognormal distribution was used (see test of lognormality below) it was necessary to simulate the samples of a composite conditional on the geometric mean. While a conditional simulation based on the average is formally correct and possible, the numerical analysis required is largely undeveloped. Therefore, the geometric mean was used to approximate the sample average, and this led to useful and tractable results. To remove the approximation would require extensive additional developmental work that is beyond the scope of the present project needs.

Test of Lognormality

One of the by-products of the Gibbs sampler is a list of observations unaffected by detection limits or composite sampling. Each iterate of the simulation represents one complete data set that exhibits the assumed uncertainly when there is a non-detect or composite. These data sets were log transformed and subjected to the Shapiro-Wilk test of normality. The significance level was found by averaging the p-values over all iterates of the simulation. Average p-values greater than 5% were taken as evidence of the log-normal distribution. When data failed the test, the methodology described below was used to select between the normal or uniform distributions.

Estimating the Parameters of the Lognormal Distribution

The lognormal analysis was performed by zone, matrix, and analyte to estimate the parameters of each distribution, the mean and standard deviation. Because past trapping success (Phase II) indicated that a sufficient number of individual specimens for analysis would likely only be available from Zones 2 and 3 (Phase III), the variances estimated in Zone 2 were applied to Zone 1, and the variances estimated in Zone 3 were applied to Zone 4. This approach is conservative because Zones 2 and 3 display greater variance in media concentrations and application of the variance to Zones 1 and 4 as described generates higher 95% UCLM estimates for those two zones while the means are relatively unaffected. When sufficient data were obtained to conduct a Gibbs simulation, and when the lognormal distribution was accepted by the test described above, the mean and standard deviation were estimated by averaging the results of the simulations. This corresponds with the estimators that minimize squared-error loss. The 95% UCLM was found by selecting the 95th percentile of the distribution of the mean functions, *i.e.*, $\exp\{\mu + 0.5\sigma^2\}$, that resulted from the simulation.

When methods for the lognormal distribution were not used, the methods described below were used to define the various distributions.

Selecting Alternative Distributions (Normal or Uniform)

The first step was to estimate the parameters of each distribution. For the normal distribution this is straightforward because these distributions are defined by the mean and variance. The mean (μ) and variance (σ^2) were estimated as:

$$\mu = \sum_i \frac{y_i}{N}$$

$$\sigma^2 = \sum_i \frac{(y_i - \mu)^2}{(N - 1)}$$

Where:

y_i = I-th observation from a sample of size N.

It is less straightforward to estimate the uniform distribution, but numerically the process is well defined. The lower (l_t) and upper (h_t) limits were found by the method of moments using the minimum ($y_{(1)}$) and maximum ($y_{(N)}$) order statistics:

$$I_u = y_{(1)} - \frac{\{y_{(N)} - y_{(1)}\}}{(N - 1)}$$

$$h_u = y_{(1)} + \frac{\{y_{(N)} - y_{(1)}\}}{(N - 1)}$$

If I_u was calculated to be less than 0, it was feasible to reset I_u or I_t to zero.

Cumulative Distribution Functions and the Probit Function

These functions were determined in accordance with the following assumptions and relationships:

- Let M(x) be the cumulative distribution function of N(y). That is,

$$M(x) = \int_{-\infty}^{x} N(y)dy$$

The density function N(y) is to be treated as one of the normal or uniform density functions. Standard statistical theory provides that if y~N(y) (meaning y is distributed by N(y)), then M(y) has a [0,1] uniform distribution (*e.g.*, Press *et al*, 1986, p. 277). Similarly if u has a [0,1] uniform distribution, and $\Psi(x)$ is the probit function, that is the inverse cumulative normal distribution function, then $\Psi(u)$ has a standard normal distribution.

To summarize, if y is distributed as $\phi(y)$, then $\psi(\Phi(y))$ has a standard normal distribution. Therefore, to test the hypothesis that $y \sim \phi(y)$ an alternative test is constructed to determine if $\psi(\Phi(y))$ is normally distributed. Standard tests can be used to evaluate the normality assumption on the transformed variable, leading to acceptance or rejection of the hypothesis that $y \sim \phi(y)$.

The transformations used are listed below:

Distribution	Transformation
	$z = \psi(\Phi(y))$
Normal	$z_n = (y-\mu)/\sigma$
Uniform	$z_u = \psi[(y-l_u)/(h_u-l_u)]$.

3.1.1.6 Shapiro-Wilk Statistic

The distribution was selected as normal or uniform by finding those variables among z_n and z_u that were the most normally distributed. There are several ways to construct normality tests, including the one sample Kolmogorov-Smirnov test and the probability plot method. The Shapiro-Wilk test is one of the most powerful methods when sample size is less than 50 (Shapiro and Wilk, 1965; Shapiro and Francia, 1972), and it was used here. The larger the Shapiro-Wilk statistics the more normal the shape of the distribution. Therefore, the selected distribution corresponded to the largest statistic calculated from z_n and z_u.

Attachment II
The Final Ecological Risk Assessment Report for the Fields Brook Floodplain/Wetland Area prepared by EPA-Edison, February 1995

FINAL REPORT
FIELDS BROOK SITE
ASHTABULA, OHIO

FEBRUARY, 1995

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1.0 INTRODUCTION

Fields Brook is located in the city of Ashtabula in northeastern Ohio. The brook drains a 5.6 square mile watershed that includes Ashtabula Township and the eastern section of the city of Ashtabula. The main channel of the brook is about 3.9 miles long. It begins at Cook Road, south of the Penn Central Railroad, and flows northwesterly to Middle Road and then westerly to its confluence with the Ashtabula River, about 8,000 feet from Lake Erie. From Cook Road to State Highway 11, Fields Brook flows through an area of heavy industry. Downstream of Highway 11, the stream flows through a primarily residential portion of the City of Ashtabula.

There are numerous industrial sites in the Fields Brook watershed which have contributed a variety of organic and metal contaminants to Fields Brook and the surrounding floodplain. Previous sampling results indicate that floodplain soils and sediments contain a variety of volatile organic compounds (VOCs) such as 1,1,2,2-tetrachloroethane and trichloroethylene; semivolatile organic compounds (SVOCs) such as chrysene; pesticides; polychlorinated biphenyls (PCBs); and metals.

2.0 PROBLEM FORMULATION

Problem formulation is the first phase of an ecological risk assessment and establishes the goals, breadth and focus of the assessment. The problem formulation process includes: 1) identification of potential contaminants of concern (COCs); 2) exposure characterization; 3) hazard characterization and toxicity assessment; 4) selection of assessment endpoints; and 5) production of testable hypotheses.

2.1 Identification of Potential COCs

Potential contaminants of ecological concern were reviewed to determine contaminants which should be carried through this risk assessment. Sixteen contaminants were selected as potential COCs based on levels measured on-site (EA 1994), ecotoxicity, and their bioaccumulative potential (Table 1).

2.2 Exposure Characterization

The objective of exposure characterization is to determine the pathways and media through which receptors may be exposed to site contaminants. Potential exposure pathways are dependant on habitats and receptors present on-site, the extent and magnitude of contamination, and environmental fate and transport of COCs.

The area of concern at this site is the floodplain associated with Fields Brook. Plant community types range from managed turf and grassy areas to mature, second growth deciduous woodland. Second growth shrub and wooded wetlands cover the majority of the watershed. Large marsh areas and some open water are present in the upper reaches of the watershed. Aquatic habitat within the watershed is generally lotic (flowing water); however, there are segments of the stream that are more lentic in nature (standing water) due to local topography or presence of beaver dams. Based on habitat characteristics, terrestrial organisms which utilize floodplain habitat can potentially be exposed to contaminants present at this site.

As a result of industrial activities in the Fields Brook watershed, mercury, PCBs, hexachlorobenzene, and other contaminants have accumulated in the floodplain and stream sediments. However, very little data on the extent and magnitude of contamination in the area was available to conduct this risk assessment. Maximum levels of contaminants in soil/sediment and biota samples reported in the Ecological Risk Assessment for Fields Brook Floodplains and Wetlands (data from EA Engineering, Science and Technology 1994, presented in a summary table in EVS 1994) were used in this risk assessment.

This risk assessment will not address contaminant fate and transport. The area of concern has been identified as the Fields Brook floodplain. Fields Brook is being remediated as a separate unit; therefore, this risk assessment is limited to terrestrial receptors. Mink were selected as a higher trophic level mammalian receptor species, and fish comprise a large portion of their diet. Contaminant levels measured in fish tissue were apparently composites of on-site and reference locations (EA 1994). Concentrations measured were assumed to reflect the quality of fish tissue samples following remediation of Fields Brook; therefore, this dietary component was included in the risk calculations for this receptor species.

Exposure to COCs present in forage and prey species via ingestion could cause toxicity in higher trophic level organisms. Sampling conducted at the site indicates that site-related contaminants have accumulated in tissues of floodplain biota. In addition to exposure via consumption of contaminated forage, ecological receptors may also be exposed through ingestion of surface water and incidental ingestion of soil/sediment. No surface water data was available to evaluate exposure to COC via ingestion of contaminated surface water. The exposure pathways that will be evaluated in this risk assessment will be ingestion of contaminated soil and prey.

2.3 Hazard Characterization / Toxicity Assessment

2.3.1 PCBs

PCBs are a group of synthetic halogenated aromatic hydrocarbons. They are extremely stable compounds and degrade slowly once released into the environment.

Several studies have indicated that PCBs are not leachable in soils, and are readily adsorbed by soil constituents. Organic matter and clay content of soil influences the bioavailability of PCBs to plants (Strek and Weber 1982). Uptake of PCBs from soils by plants has been documented, however, only in very low amounts (Iwata *et al.* 1974, Iwata and Gunther 1976, Weber and Mrozek 1979). Effects of PCBs on plants include reduced growth and chlorophyll content, and effects on photosynthesis (Strek and Weber 1982).

Acute toxicity of PCBs to aquatic organisms, birds, and mammals is low compared to most organochlorine compounds (Peakall 1975). Reported chronic effects include reproductive failure, birth defects, skin lesions, tumors, and liver disorders. PCBs have extremely high liposolubility, and can be bioconcentrated by organisms and biomagnified through food chains. Interspecies differences in sensitivity to PCBs are large, even between species that are closely related taxonomically (Eisler 1986).

The primary biochemical effect of PCBs is to induce hepatic mixed function oxidase systems, increasing an organism's capacity to biotransform or detoxify xenobiotic chemicals (Melanon and Lech 1983). PCBs also induce hepatic enzymes that metabolize naturally occurring steroid hormones (Peakall 1975). These hepatic microsomal enzyme systems are most likely correlated with observed adverse reproductive effects (Tanabe 1988).

2.3.2 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs consist of hydrogen and carbon in the form of two or more fused benzene rings. There are numerous PAH compounds, each differing in the number and arrangement of benzene rings. The low molecular weight PAHs (2 -3 rings) tend to be more acutely toxic, while the higher molecular weight compounds (4 - 7 rings) have been shown to be carcinogenic, teratogenic, or mutagenic to a number of receptors (Eisler 1987).

In general, PAHs show little tendency to biomagnify in food chains despite their high lipid solubility. This is thought to be because most organisms rapidly metabolize and excrete PAH compounds. Where assimilation of ingested PAHs has been demonstrated, metabolism and excretion were rapid (Neff 1982).

It is thought that toxicity associated with PAHs is due not to the initial compound, but with metabolized intermediates. The majority of the enzymatic activity associated with the metabolization of PAH compounds takes place in the liver (Fourman 1989). The first step in the metabolic process is the oxidation of PAHs by cytochrome P 450 enzyme systems. The metabolic by-products go through a series of reactions, ultimately forming diol-epoxides and phenol-oxides, which are believed to be the carcinogenic intermediates of PAHs (Stein *et al.* 1990). These compounds have the ability to form DNA adducts by covalently bonding with genetic material (Varnasi *et al.* 1989).

PAHs are also potent immunotoxic compounds, suppressing humoral and cell-mediated immune response. Many PAHs have been shown to adversely affect host tumoricidal activities, resulting in tumor formation. It appears that PAH compounds which are carcinogenic are also immunosuppressive (Peakall 1993).

2.3.3 Hexachlorobenzene

Hexachlorobenzene (HCB) is a very stable, unreactive compound which does not undergo physical or chemical degradation. It is volatile in water vapor even at low temperatures and is a potentially important mechanism for environmental dispersal (U.S. EPA 1976a). Hexachlorobenzene is a very persistent compound which bioaccumulates in terrestrial and aquatic organisms and is not readily metabolized (Courtney 1979).

Several studies have reported low acute toxicity associated with HCB exposure. It is not very soluble in water (5 μg/L); therefore, aquatic animals may not be directly exposed to levels high enough to cause acute toxicity (Nebeker *et al.* 1989). A single large oral dose of HCB may produce no toxic effects. However, repeated exposure to much smaller doses over longer periods may result in serious toxicological effects (U.S. EPA 1976b).

Exposure to HCB results in an increase in synthesis of porphyrins due to the failure of control mechanisms. Toxic effects noted after HCB exposure include porphyria, cutaneous lesions, hyperexcitability, an increase in liver weight, changes in liver enzymes, and morphological changes in the liver (Courtney 1979).

2.3.4 Cadmium

Cadmium is a mutagen, teratogen, and a suspected carcinogen (RTECS 1991). Tissue levels of cadmium increase with the age of an organism and eventually act as a cumulative poison (Hammons *et al.* 1978). Cadmium replaces essential metals (e.g., zinc) at critical sites on proteins and enzymes, and may inhibit a variety of enzymatic reactions. It inhibits Phase I and Phase II biotransformation reactions, probably by alteration of the enzymes responsible for these reactions (Sipes and Gandolfi 1986). Cytochrome P-450 monoxygenases play a major role in Phase I reactions. Cadmium also combines with sulfhydryl groups in enzymes, which affects the transfer of electrons from compounds in the citric acid cycle to compounds in the electron transport chain. Cadmium can inhibit adenosine triphosphate (ATP) activity in the following ways: it binds to and inactivates enzymes which synthesize ATP, and it binds to ATPase, which is required to convert ATP to ADP + PO_4. (Hammons *et al.* 1978)

Vertebrates tend to accumulate cadmium in the kidney and liver tissue (Eisler 1975). Freshwater aquatic species are most sensitive to toxic effects of cadmium, followed by marine organisms, birds, and mammals.

2.3.5 Copper

Copper does not appear to have mutagenic properties (IRIS 1990), but it is a teratogen (RTECS 1991) and a possible carcinogen (Venugopal and Luckey 1978). Copper is caustic, and acute toxicity is primarily related to this property (Hatch 1978).

Copper is an essential element for animals and is a component of many metalloenzymes and respiratory pigments (Demayo *et al.* 1982). It is also essential to iron utilization and functions in enzymes for energy production, connective tissue formation, and pigmentation (Venugopal and Luckey 1978). Excess copper ingestion leads to accumulation in tissues, especially in the liver. High levels of copper modify hepatic metabolism (Brooks 1988), which may lead to inability of the liver to store and excrete additional copper. When liver concentration exceeds a certain level, the metal is released into the blood, causing hemolysis and jaundice. High copper levels also inhibit essential metabolic enzymes (Demayo *et al.* 1982). Toxic symptoms appear when the liver accumulates 3 to 15 times the normal level of copper (Demayo *et al.* 1982).

Although the exact mechanism of toxicity is not known, the following mechanisms have been proposed: Formation of stable inhibitory complexes with cytochrome P-450 (Wiebel *et al.* 1971); impairment of function of NADPH-cytochrome c reductase and alteration of mixed function oxidations (Reiners *et al.* 1986); and inhibition of heme biosynthesis (Martell 1981). Intranuclear inclusions may act as a detoxifying mechanism where copper is complexed by protein ligands, protecting cytoplasmic organelles (Demayo *et al.* 1982).

Ruminants are the most sensitive mammal species to copper toxicosis. Young animals retain more dietary copper than older animals and are more sensitive to copper toxicity (Venugopal and Luckey 1978).

2.3.6 Lead

Lead does not biomagnify to a great extent in food chains, although accumulation by plants and animals has been extensively documented (Wixson and Davis 1993, Eisler 1988). Older organisms typically contain the highest tissue lead concentrations, with the majority of the accumulation in the bony tissue of vertebrates (Eisler 1988).

Predicting the accumulation and toxicity of lead is difficult since its effects are influenced to a very large degree, relative to other metals, by interactions among physical, chemical, and biological variables. In general, organolead compounds are more toxic than inorganic lead compounds, and young, immature organisms are most susceptible to its effects (Eisler 1988). In plants, lead inhibits growth by reducing photosynthetic activity, mitosis, and water absorption (Demayo *et al.* 1982). The mechanism by which photosynthetis activity is reduced is attributed to the blocking of sulfhydryl groups, inhibiting the conversion of coproporphyrinogen to proporphyrinogen (Holl and Hampp 1975).

The toxic effects of lead on aquatic and terrestrial organisms are extremely varied and include mortality, reduced growth and reproductive output, blood chemistry alterations, lesions, and behavioral changes. However, many effects exhibit general trends in their toxic mechanism. Generally, lead inhibits the formation of heme, adversely affects blood chemistry, and accumulates at hematopoietic organs (Eisler 1988). At high concentrations near levels causing mortality, marked changes to the central nervous system occur prior to death (Eisler 1988).

2.3.7 Mercury

Mercury can exist in three oxidation states: elemental mercury (Hg^0), mercurous ion (Hg_2^{2+}), and mercuric ion (Hg^{2+}). The mercuric ion is the most toxic inorganic chemical form (Clarkson and Marsh 1982). Methylmercury (MeHg) is the most hazardous form of mercury due to its high stability, its lipid solubility, and the ability to penetrate membranes in living organisms (Beijer and Jernalov 1979).

Mercury and its compounds have no known biological function. It is a mutagen, teratogen, and carcinogen, and causes embryocidal, cytochemical, and histopathological effects. Forms of mercury with relatively low toxicity can be transformed into forms of very high toxicity, such as methylmercury, through biological processes. In addition, mercury can be bioconcentrated in organisms and biomagnified through food chains.

Mercury in soils is generally not available for uptake by plants, due to the high binding capacity to clays and other charged particles (Beauford *et al.* 1977). Mercury levels in plant tissues increase as soil levels increase, however 95 percent of the accumulation and retention of mercury is in the root system (Beauford *et al.* 1977, Cocking *et al.* 1991).

All mercury compounds interfere with thiol metabolism in organisms, causing inhibition or inactivation of proteins containing thiol ligands and ultimately leading to mitotic disturbances (Das *et al.* 1982, Elhassani 1983). Mercury also binds strongly with sulfhydryl groups. Phenyl- and methylmercury compounds are among the strongest known inhibitors of cell division (Birge *et al.* 1979). In mammals, methylmercury irreversibly destroys the neurons of the central nervous system.

For all organisms tested, early developmental stages were most sensitive to toxic effects of mercury. Organomercury compounds, especially methylmercury, were more toxic than inorganic forms. In aquatic organisms, mercury adversely affects reproduction, growth, behavior, osmoregulation and oxygen exchange. At comparatively low concentrations in birds and mammals, mercury adversely affects growth and development, behavior, motor coordination, vision, hearing, histology, and metabolism. In mammals, the fetus is the most sensitive life stage (Eisler 1987).

2.3.8 Zinc

Zinc is essential for mormal growth and reproduction in plants and animals and is regulated by metallothioneins. Metallothioneins act as temporary zinc storage sites and aid in reducing the toxicity of zinc to both vertebrates and invertebrates (Olsson *et al.* 1989). Zinc is not known to bioaccumulate in food chains, because it is regulated by the body and excess zinc is eliminated.

Zinc has its primary metabolic effect on zinc-dependant enzymes that regulate the biosynthesis and catabolic rate of RNA and DNA. High levels of zinc induce copper deficiency and interfere with metabolism of calcium and iron (Goyer 1986). The pancreas and bone seem to be the primary targets of zinc toxicity in birds and mammals. Pancreatic effects include cytoplasmic vacuolation, cellular atrophy, and cell death (Lu and Combs 1988, Kazacos and Van Vleet 1989).

Zinc preferentially accumulates in bone, and induces osteomalacia (a softening of bone caused by a deficiency of calcium, phosphorus and ofher minerals) (Kaji *et al.* 1988). Gill epithelium is the primary target site in fish. Zinc toxicosis results in destruction of gill epithelium and tissue hypoxia (Spear 1981).

2.4 Selection of Assessment Endpoints

Viability of terrestrial populations (e.g., reproductive effects are given top priority) and organism survivability were selected as assessment endpoints for this risk assessment.

2.5 Production of Testable Hypothesis

The objectives of this study are to evaluate whether COCs are present in floodplain soils at levels where adverse effects on floodplain biota are likely. The exposure pathway of concern is accumulation of toxic levels of PCBs, PAHs, HCB, cadmium, copper, lead, mercury, or zinc in upper trophic level organisms via ingestion of contaminated prey or incidental soil/sediment ingestion. The hypothesis to be tested is that levels of COCs in forage species do not exceed levels that are toxic to higher trophic level organisms that forage in the Fields Brook floodplain.

2.6 Selection of Receptor Species

Figures 1 and 2 present conceptual food webs for the Fields Brook floodplain and wetland study area. Receptor species were selected from each trophic level where appropriate. Organisms which are likely to be exposed to contaminants in the floodplain because of specific behaviors, patterns of habitat use, or feeding habits were selected for evaluation in this risk assessment. The availability of appropriate toxicity information on which risk calculations could be based was also an important consideration. The receptor species selected for this initial ecological risk screening assessment are: deer mouse (*Peromyscus maniculatus*), short-tailed shrew (*Blarina brevicauda*), muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), mink (*Mustela vison*), American robin (*Turdus migratorius*), and American kestrel (*Falco sparverius*).

2.6.1 Small mammals

The deer mouse and short-tailed shrew were selected as receptors because of their presence on-site, their importance as prey for higher level consumers, and the different exposure pathways represented by each species. The deer mouse is primarily omnivorous while the shrew is carnivorous.

2.6.2 Herbivorous mammal

The muskrat was selected as a receptor because it represents a herbivorous mammal and is potentially present in the floodplain. Although organic COCs generally do not accumulate in vegetation, ingestion of vegetation may be an important exposure route for contaminants such as cadmium, copper and zinc.

2.6.3 Carnivorous mammal

The red fox was selected as a receptor based on their presence in the region and the fact that small mammals comprise a significant portion of their diet. Mink was selected as an appropriate receptor species because it is an upper trophic level consumer that feeds on small mammals and fish. It is recognized that the upper part of Fields Brook is in a heavily industrialized area, and mink may not actually occur at this site. However, the site is located within the recorded range for mink, and they utilize floodplain habitat for feeding (Linscombe *et al.* 1982). In addition, mink are extremely sensitive to toxic effects of PCBs (Eisler 1986). Evaluation of exposure of mink to COCs will provide a conservative estimate of risk for upper trophic level mammals potentially feeding in the Fields Brook floodplain.

2.6.4 Insectivorous bird

The American robin was selected as an appropriate insectivorous bird species to evaluate effects of accumulation of COCs within the floodplain food web. American robins have been reported as potential summer residents at this site (EA Engineering, Science and Technology, Inc. 1992).

2.6.5 Carnivorous bird

The American kestrel was selected as a receptor because it is an upper trophic level bird species. Kestrels are carnivorous and feed on small mammals, insects and herptiles.

2.7 Conceptual Model

2.7.1 Exposure Pathway Model

The conceptual model relies on contaminant and habitat characteristics to identify critical exposure pathways to the selected measurement endpoints. Previous sampling data indicates that COCs are present in Fields Brook floodplain soils and biota (EA 1994). Terrestrial receptors may be exposed by feeding on organisms which have accumulated COCs in their tissues. Higher trophic level receptors may also be exposed via incidental ingestion of soils/sediments. The following pathways will be evaluated in this risk assessment:

I. Small mammals
Ingestion of vegetation
Ingestion of invertebrates
Incidental soil ingestion

II. Muskrat
Ingestion of vegetation
Incidental soil ingestion

III. Red Fox
Ingestion of small mammals
Incidental soil ingestion

IV. Mink
Ingestion of small mammals
Ingestion of herptiles
Ingestion of fish
Incidental soil ingestion

VI. American Robin
Ingestion of vegetation
Ingestion of terrestrial invertebrates
Ingestion of soil

VII. American Kestrel
Ingestion of small mammals
Ingestion of invertebrates
Ingestion of herptiles
Incidental soil ingestion

A graphical representation of the conceptual model is presented in Figures 1 and 2.

3.0 ASSUMPTIONS

This risk assessment evaluates exposure to contaminants through food and incidental soil ingestion. No surface water data was available for this risk assessment; therefore, this exposure pathway was not evaluated. Limited data on COC levels in environmental samples and biota was available, and the quality of some data presented in EA (1994) was questionable. Therefore, the following conservative assumptions were made to conduct this risk assessment:

- Maximum contaminant levels measured in soil and biota samples collected on-site (data from EA 1994, presented in a summary table in EVS 1994) were used in risk calculations.

- A biota to soil accumulation factor (BSAF) of one was assumed at the lower trophic levels (vegetation and soil invertebrates).

- Maximum concentrations of COCs reported in soil and biota were assumed to be present site-wide.

- An area use factor of 100 percent was assumed for all receptors.

- Contaminants were assumed to be 100 percent bioavailable.

- Soil/sediment analyses in the original risk assessment (EA 1994) were reported as dry weight. These data were converted to wet weight using the reported mean percent solids (66.7 percent).

- The assessment was limited to a terrestrial risk screening assessment, with the exception of the following assumption. No aquatic receptor species were selected since Fields Brook is being remediated as a separate unit.

- Fish are an important forage species for mink. Fish tissue samples were apparently composites of both on-site and background stations (EA 1994). Concentrations measured in fish tissue were assumed to reflect the quality of fish tissue samples following remediation of the Brook.

- For contaminants not detected in biota samples, a concentration of one-half the detection limit was used in risk calculations.

- Dietary composition information was obtained from the literature for the receptor species. Some of the receptors eat varied diets, while site-specific information on levels of COCs in forage species is limited. It was assumed that levels of COCs measured in forage species collected on-site could be used as a surrogate for all forage species consumed. If site-specific contaminant levels were not available for all forage species consumed, the percentage comprised by organisms for which contaminant levels were measured was increased so that 100 percent of daily consumption could be evaluated (e.g. the reported percent diet for red fox is 2.8 percent soil, 75.2 percent small mammals and 22 percent other. The percent dietary composition levels used in risk calculations were: 2.8 percent soil and 97.2 percent small mammals). Dietary composition reported in the literature is presented in Table 2 and percentages used in risk calculations are presented in Table 3.

- A literature search was conducted to determine the chronic toxicity of the contaminants of concern when ingested by the indicator species. If no toxicity values could be located for the receptor species, values reported for a closely related species were used. All studies were critically reviewed to determine whether study design and methods were appropriate. When values for chronic toxicity were not available, LD_{50} (median lethal dose) values were used. For purposes of this risk assessment, a factor of 10 was used to convert the reported LD_{50} to a Lowest Observed Adverse Effect Level (LOAEL). If several toxicity values were reported for a receptor species, the most conservative value was used in the risk calculations. Toxicity values obtained from long-term feeding studies were used in preference to those obtained from single dose oral studies.

- In some cases, contaminant doses were reported as part per million contaminant in diet. These were converted to daily intake (in milligrams per kilogram body weight per day; mg/kg-day) by using the formula:

  Daily intake (mg/kg-day) = Contaminant dose (mg/kg in diet) x Ingestion rate (kg/day) x 1/Bodyweight (kg)

This conversion allows dietary toxicity levels cited for one species to be converted to a daily dose based on body weight. This daily dose may then be used to evaluate the risk to a similar species if no specific toxicity data is available for a target receptor.

4.0 EXPOSURE PROFILE

Life history information utilized to estimate concentrations of contaminants to which receptor species are exposed was obtained from the *Wildlife Exposure Factors Handbook* (U.S. EPA 1993). Ingestion rates and dietary composition of receptor species used in risk calculations are presented in Table 3.

5.0 CONTAMINANTS OF CONCERN

Contaminants of concern were selected based on levels measured on-site compared to reference levels, ecotoxicity, persistence, and bioaccumulative potential. Sixteen contamiants were evaluated in this risk assessment (Table 1).

6.0 EFFECTS PROFILE

A literature search was conducted to determine levels of exposure to contaminants at which no adverse effect would be expected (no observed adverse effect level; NOAEL). If a NOAEL was not available for a COC or receptor species, then a converted lowest observed adverse effect level (LOAEL) or LD_{50} was used. A factor of 10 was used to convert an LD_{50} to a LOAEL, and to convert a LOAEL to a NOAEL. The results of the literature search are presented in Tables 4 through 11. Effect levels selected for use in risk calculations are presented in Table 12.

7.0 RISK CHARACTERIZATION

To estimate risk to wildlife utilizing the Fields Brook site, implications of the exposure concentrations need to be determined. The hazard quotient method (U.S. EPA 1989, Barnthouse *et al.* 1986) compares exposure concentrations to ecological endpoints such as reproductive failure or reduced growth. The comparisons are expressed as ratios of potential intake values to population effect levels, or:

$$\text{Hazard Quotient} = \frac{\text{Exposure Concentration}}{\text{No Observed Adverse Effect Level (NOAEL)}}$$

A hazard quotient greater than 1 indicates that exposure to the contaminant has the potential to cause adverse effects in the organism. A hazard quotient less than one does not indicate a lack of risk. The hazard quotient should be interpreted based on the severity of the effect reported, and the magnitude of the calculated quotient.

Exposure concentrations were calculated for each target receptor species based on levels of contaminants detected in site media, daily food ingestion rates, incidental soil/sediment ingestion rates, and body weight reported in the literature. These calculations are presented in Appendix A. Daily intake rates calculated for all receptor species are presented in Table 13. Calculated hazard quotients are presented in Table 14.

8.0 SOURCES OF UNCERTAINTY

There are factors inherent in the risk assessment process which contribute to uncertainty and need to be considered when interpreting results. Major sources of uncertainty include natural variability, error, and insufficient knowledge.

Natural variability is an inherent characteristic of ecological systems and stressors. One source of uncertainty is the small database available for calculating parameters used in the exposure model. Very little data was available for use in this risk assessment, and no information was available to determine whether existing data is representative of actual site conditions.

Error can also be introduced by use of invalid assumptions in the conceptual model. The assumptions used in this risk assessment are presented in Section 3.0. Conservative assumptions were made in light of the uncertainty associated with the risk assessment process. This was done in order to minimize the possibility of concluding that no risk is present when a threat actually does exist (i.e., elimination of false negatives). Whenever possible, risk calculations were based on conservative values. For example, a BSAF of 1 was used to estimate movement of COCs from soils to lower trophic level species (plants, invertebrates); an area use factor of 1 was assumed for all receptor species; and NOAELs used to calculate hazard quotients were the lowest values found in the literature.

An important contributor to uncertainty is the incompleteness of the data or information upon which the risk assessment is based. Risk calculations are based on maximum COC levels in soil and biota samples (EA 1994). No information was available regarding sampling locations or the extent of contamination in the floodplain.

Literature values for the toxicity of COCs were not available for all of the receptor species. An attempt was made to identify studies using closely related species in order to make risk estimates for the selected receptors. Species respond differently to exposure to toxins, and although reported NOAELs used in the quotient calculations are for closely related species, responses to COCs by the indicator species may be different from species for which the toxicity data is reported. Methodological problems were also apparent in several of the studies from which NOAELs were obtained. Unfortunately, no better studies were found for some of the selected receptors.

A literature search was conducted to identify appropriate NOAELs and LOAELs for this risk assessment. The values used to calculate hazard quotients were the lowest values found in the literature. In many of the studies reviewed, adverse effects were observed at the lowest exposure concentration. This made it impossible to identify appropriate NOAELs for some receptors. In these cases, a factor of 10 was used to convert the LOAEL to a NOAEL, which adds uncertainty to the NOAEL based calcuations.

Doses in toxicological studies can be reported in units of mg contaminant/kg diet, or in units of mg contaminant/kg body weight/day. All doses reported as mg/kg in diet were converted to units of mg/kgBW/day. If body weights were reported for the test animals in a given study, these values were used for making this conversion. Otherwise, the body weight and ingestion rate for the species reported in other literature sources were used.

Another source of uncertainty arises from the use of toxicity values reported in the literature which are derived from single species, single contaminant laboratory studies. Prediction of ecosystem effects from laboratory studies is difficult. Laboratory studies cannot take into account the effects of environmental factors which may add to the effects of contaminant stress. NOAELs were generally selected from studies using single contaminant exposure scenarios. Species utilizing the Fields Brook floodplain are exposed to a variety of contaminants. Risk was evaluated on a single contaminant basis using the hazard quotient method. This method does not evaluate interactions between contaminants or risk from exposure to several contaminants simultaneously.

No data were available regarding the form of contaminants detected in site media and biota. In order to maintain a consistently conservative approach in this risk assessment, the calculated daily dosage for the receptor species were compared to NOAELs reported for the most toxic form (e.g., methylmercury or organic lead).

There is very little information available in the literature regarding the rates of incidental soil/sediment ingestion for wildlife species. In this risk assessment, most of these values were based on estimates reported for species similar to the indicator species.

9.0 PRELIMINARY SITE SPECIFIC CLEANUP GOALS

Preliminary site-specific cleanup goals were back-calculated according to the following equation:

$$\text{Cleanup goal} = \frac{\text{Maximum COC concentration in soil}}{\text{Maximum calculated Hazard Quotient}}$$

By dividing the highest measured sediment/soil concentration by the highest calculated HQ for a COC, a sediment/soil concentration will be obtained which will produce a hazard quotient value equal to 1 for the most sensitive receptor of concern. Use of this equation assumes that the clean up level is protective of all species in the environment as the calculated cleanup level presumably is protective of the most sensitive receptor of concern. Calculated clean up goals are presented in Table 15.

10.0 SUMMARY AND CONCLUSIONS

Hazard quotient calculations indicate that all receptor species are at risk from calculated exposure levels for PCBs, hexachlorobenzene, and mercury. Hazard quotients ranged from 1.2 to 645.7 for PCBs; 2.8 to 546.7 for HCB; and 2.02 to 854.4 for mercury. Species with the highest hazard quotients are those with a significant portion of their diet comprised of vegetation or invertebrates.

Hazard quotient calculations also indicate that some receptors may be at risk from exposure to cadmium, copper, and lead present in forage species in the Fields Brook floodplain. Risk from exposure to these COCs is mainly confined to the receptor species that consume large amounts of vegetation or terrestrial invertebrates.

Ecological cleanup values obtained using the maximum hazard quotient calculated for a receptor species are very conservative and probably below reference levels in many cases, although no reference data was available for comparison. The highest hazard quotients were always associated with species whose diet is comprised mainly of vegetation or invertebrates. No site-specific data was available for levels of COCs in plants or terrestrial invertebrates; therefore, a BSAF of 1 was used to estimate movement of contaminants from soils into these lower trophic level species. This factor may overestimate uptake of many of the contaminants of concern by these forage species.

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TABLE 1. Maximum Concentrations of Contaminants of Concern in Soil and Biota Samples (EVS 1994)
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994
(Concentrations are expressed in mg/kg)

Contaminant	Floodplain Soil[a]	Mice	Shrews	Herptiles	Fish
PCBs	360 (241.2)	0.165	11	0.165	0.0165
Hexachlorobenzene	480 (321.6)	1.2	0.82	0.0165	0.0165
Acenapthylene	0.13 (0.0871)	0.39	0.38	0.51	0.335
Benzo(a)anthracene	2.4 (1.61)	0.009	0.001	0.0045	0.11
Benzo(a)pyrene	2.7 (1.81)	0.0004	0.0004	0.0042	0.135
Benzo(b)fluoranthene	6 (4.02)	0.012	0.0003	0.0012	0.01
Chrysene	2.1 (1.407)	0.0007	0.0025	0.0025	0.025
Fluoranthene	5.7 (3.819)	0.0035	0.0035	0.0035	0.115
Fluorene	0.076 (0.0509)	0.07	0.0035	0.0003	0.115
Napthalene	0.235 (0.157)	0.03	0.03	0.03	0.06
Phenanthrene	4.6 (3.082)	0.105	0.105	0.105	0.35
Cadmium	7.8 (5.226)	0.145	1	0.155	0.075
Copper	79.9 (53.533)	4.5	4.8	2.1	1.15
Lead	147 (98.49)	0.54	0.14	1.4	0.025
Mercury	57.2 (38.324)	0.1	2.2	0.25	0.095
Zinc	320 (214.4)	37.4	38	24.6	13.65

[a] Numbers in parentheses are dry weight values converted to wet weight using the reported mean percent solids (66.7%)

TABLE 2. Exposure Parameters for Receptor Species Reported in the *Wildlife Exposure Factors Handbook* (U.S.EPA 1993)
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

Receptor Species	Ingestion Rate (kg food/kg body weight per day)	Percent of Diet						
		Soil/sediment	Vegetation	Invertebrates	Small Mammals	Herptiles	Fish	Other
Deer mouse	0.19	2.4	39.1	56.9	NA	NA	NA	1.6
Short-tailed shrew	0.49	2.5	12.8	68.8	NA	NA	NA	15.9
Muskrat	0.34	9.4	90.6	NA	NA	NA	NA	NA
Red fox	0.069	2.8	NA	NA	75.2	NA	NA	22
Mink	0.22	2.8	NA	NA	36.5	24.2	19.3	17.2
American Robin	1.52	10.4	7.2	82.4	NA	NA	NA	NA
American kestrel	0.29	8.2	NA	29.9	29.1	1.7	NA	31.1

NA = Not applicable

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TABLE 3. Exposure Parameters for Receptor Species used in Hazard Quotient Calculations
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

Receptor Species	Ingestion Rate (g food/g body weight/day)	Composition of Diet (%)					
		Soil/ Sediment	Vegetation	Invertebrates	Small Mammals	Herptiles	Fish
Deer mouse	0.19	2.4	39.9	57.7	NA	NA	NA
Short-tailed shrew	0.49	2.5	20.8	76.7	NA	NA	NA
Muskrat	0.34	9.4	90.6	NA	NA	NA	NA
Red fox	0.069	2.8	NA	NA	97.2	NA	NA
Mink	0.22	2.8	NA	NA	42.2	30	25
American robin	1.52	10.4	7.2	82.4	NA	NA	NA
American kestrel	0.29	8.2	NA	40.3	39.5	12.1	NA

NA = Not applicable

TABLE 4. Lethal and Sublethal Effects of PCBS
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
White-footed mice	9 to 15 months	10 μg/g Aroclor 1254 1.27[a]	Longer intervals between births, smaller litter sizes, and smaller litter size at weaning	Linzey (1987)
White-footed mice	60 days	200 mg/kg Aroclor 1254	Decreased number of litters, no effect on litter size	Merson and Kirkpatrick (1976)
Dog (Beagle)	Not stated	5.0 (Aroclor 1254)	Significant decrease in number of term pregnancies, number of live pups/litter at birth, and number of pups alive after 2 weeks	Earl *et al.* (1974)
Dog (Beagle)	Not stated	1.0 (Aroclor 1254)	None	Earl *et al.* (1974)
Mink	2 years	0.23 (total PCBs)	Reproductive failure	Hornshaw (1983)
Mink	Not stated	20 mg/kg Aroclor 1016	Higher kit mortality and a reduction in kit growth	Bleavins *et al.* (1980)
Mink	Not stated	5 mg/kg Aroclor 1242	Complete reproductive failure	Bleavins *et al.* (1980)
Mink	16 weeks	5 mg/kg Aroclor 1254	Loss of offspring	Ringer (1983)
Mink	4 months	2 mg/kg Aroclor 1254	Nearly complete reproductive failure	Aulerich and Ringer (1977)
Mink	Not stated	1.0 μg/g Aroclor 1254	Significant reduction in growth rate of kits nursed by mothers receiving PCB contaminated diet	Wren *et al.* (1987)
Mink	Not stated	0.64 mg/kg Aroclor 1254 0.096 mg/kg-day[a]	Reproductive failure	Platonow and Karstad (1973)

TABLE 4 (Cont'd). Lethal and Sublethal Effects of PCBS
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Mallard	5 days	587	LD_{50}	Heath (1972)
Mallard	Single dose	435	LD_{50}	Stotz and Greichus (1978)
White Pelican	10 weeks	175 mg/kg 16	Increased size of hepatocytes, number of vacuoles per hepatocyte, and number of mitochondria in hepatocytes	Stotz and Greichus (1978)
Kestrel	Not stated	33 mg/kg diet 9-10 mg/kg-day	Decrease in sperm concentration	Bird *et al.* (1983)
Chicken	6 weeks	20 mg/kg in diet 3.5[c]	Significant decrease in hatchability of eggs	Britton and Huston (1973)

[a] Calculated using an ingestion rate of 0.127 g/g bodyweight/day reported by authors
[b] Calculated using an ingestion rate of 0.150 kg/day (Auerlich *et al.* 1973) and bodyweight of 1 kg (Linscombe *et al.* 1982)
[c] Calculated using an ingestion rate of 0.140 kg/day and bodyweight of 0.8 kg (RTECS 1982)

TABLE 5. Lethal and Sublethal Effects of Polycyclic Aromatic Hydrocarbons
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE	PAH
Rodents	Not stated	50 mg/kg body weight	LD_{50}	Sims and Overcash (1978)	Benzo(a)pyrene
Rodents	Not stated	700 mg/kg bodyweight	LD_{50}	Sims and Overcash (1978)	Phenanthrene
Rodents	Not stated	1780 mg/kg body weight	LD_{50}	Sims and Overcash (1978)	Naphthalene
Rodents	Not stated	2000 mg/kg body weight	LD_{50}	Sims and Overcash (1978)	Fluoranthene
Rat	700 days	41	Ocular and internal lesions	IRIS (1990)	Naphthalene
Mice	Subchronic study	250	Nephropathy, increased liver weight, and hematological alterations	IRIS (1990)	Fluoranthene

[a] Calculated using an ingestion rate of 0.003 kg/day and bodyweight of 0.025 kg (RTECS 1987)
[b] Calculated using an ingestion rate of 15 g/day and body weight of 200 g (RTECS 1987)
[c] Calculated using an ingestion rate of 250 g/day and body weight of 10 kg (RTECS 1982)

TABLE 6. Lethal and Sublethal Effects of Hexachlorobenzene
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Rat	130 weeks	2	Significant reduction in pup viability	Arnold *et al.* (1985)
Dog	5 or 12 months	100 mg/day 2.5[a]	Progressive weight loss	Gralla *et al.* (1977)
Dog	5 or 12 months	1000 mg/day 25[a]	Diarrhea, anorexia, and progressive weight loss	Gralla *et al.* (1977)
Mink	331 days	1 mg/kg 0.15[b]	Significant decrease in kit body weight at birth, increase in kit mortality	Bleavins *et al.* (1984)
Mink	331 days	5 mg/kg 0.75[b]	Significant decrease in kit body weight, increase in kit mortality	Bleavins *et al.* (1984)
Mink	331 days	25 mg/kg 3.75[b]	Significant decrease in kit body weight, increase in kit mortality, significant reduction in litter size and number of kits born alive	Bleavins *et al.* (1984)
American kestrel	Not stated	20 mg/kg 6[c]	Increased kidney weight and histological damage in kidneys and liver	Vos *et al.* (1972)
Japanese quail	90 days	20 mg/kg 4.64[d]	No sign of toxicity in adults. Levels measured in eggs 6 ppm; significant decrease in survival of chicks that hatched	Schwetz *et al.* (1974)

[a] Calculated using an adult ingestion rate of 250 g/day and body weight of 10 kg (RTECS 1982)
[b] Calculated using an ingestion rate of 0.150 kg/day (Auerlich *et al.* 1973) and bodyweight of 1 kg (Linscombe *et al.* 1982)
[c] Calculated using an ingestion rate of 0.30 g/g-day (Exposure Factors Handbook)
[d] Calculated using an ingestion rate of 11.6 g/day (Hill and Camardese 1986) and body weight of 50 g (Morgan *et al.* 1975) for 14 day-old quail

TABLE 7. Lethal and Sublethal Effects of Cadmium
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Rat	10 weeks	5 mg/kg 0.75[a]	No effect on growth	Pribble and Weswig (1973)
Sprague-Dawley mice	28 days	1.8 mg/kg in diet, incorporated in oyster tissue 0.23[b]	Significant decrease in hemoglobin production, decrease in total serum iron	Siewicki *et al.* (1983)
Rat	6 weeks over mating and gestation period	10	Significant decrease in total embryo implants, live fetuses and fetal body weight; significant increase in resorptions	Sutou *et al.* (1980)
Dog	Not stated	0.75	NOAEL	Loser and Lorke (1977)
Mallard ducklings	12 weeks	20 mg/kg 3.31[c]	Decrease in packed cell volume and hemoglobin; mild to severe kidney lesions	Cain *et al.* (1983)
Mallard duck	90 days	20 mg/kg 4[d]	Testicular damage	White *et al.* (1984)
White Leghorn chickens	48 weeks	48 mg/kg 8.4[e]	Significant decrease in egg production	Leach *et al.* (1979)
Japanese quail	4 weeks	75 mg/kg 17.4	Decrease in testis size, lack of spermatogenesis, severe anemia	Richardson *et al.* (1974)

[a] Dose calculated using an ingestion rate of 0.015 kg/day and a body weight of 0.1 kg reported by authors
[b] Dose calculated using an ingestion rate of 0.004 kg/day and a body weight of 0.0314 kg reported by authors
[c] Dose calculated using an ingestion rate of 0.01 kg/day (Szaro and Heinz 1981) and body weight reported by authors
[d] Dose calculated using an ingestion rate of 0.25 kg/day and body weight of 1.25 kg (Newell *et al.* 1987)
[d] Calculated using an ingestion rate of 11.6 g/day (Hill and Camardese 1986) and body weight of 50 g (Morgan *et al.* 1975) for 14 day-old quail

TABLE 8. Lethal and Sublethal Effects of Copper
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Dog	Not stated	100	Death	Oil and Hazardous Materials Database (1987)
Chicken	Not stated	350 mg/kg 61.3[a]	Significant decrease in growth and food consumption	Smith (1969)
Chicks	Not stated	325 mg/kg 23.5[b]	Respiratory problems	Hatch (1978)
Shaver Chicken	Not stated	49.4	Decrease in egg production, body weight and food and water intake	Jackson (1977)

[a] Calculated using an ingestion rate of 0.140 kg/day and bodyweight of 0.8 kg (RTECS 1982)
[b] Calculated using an ingestion rate of 0.0125 kg/day and body weightof 0.173 kg (RTECS 1986)

TABLE 9. Lethal and Sublethal Effects of Lead
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Mouse (C57B1 strain)	Not stated	0.125 percent of diet 150[a]	Increased number of embryos in the 4-cell stage vs. the 8-cell stage	Jacquet *et al.* (1976)
Mouse	Not stated	1.5	Reduction in success of implanted ova	Clark (1979)
Mouse	Not stated	2.2	Frequency of pregnancy reduced when dose was given 3 to 5 days after mating	Clark (1979)
Dog	2 years	100 mg/kg 2.5[b]	Inhibition of ALAD activity	Azar *et al.* (1973)
Dog	180 days	3	Anorexia and convulsions	Clark (1979)
Starling	Not stated	84 to 94 mg/kg dry weight diet; 13.3 mg/kg wet weight 4.1[b]	Significant reduction in hematocrit, ALAD activity, and brain weight	Grue *et al.* (1986)
Starling	6 days	28	100% mortality	Osborne *et al.* (1983)
Starling	6 days	3	Reduction in muscle condition and altered feeding activity	Osborne *et al.* (1983)
Red-tailed hawk	30 weeks	3	Clinical symptoms of lead poisoning	Reiser and Temple (1981)

[a] Calculated using an ingestion rate of 0.003 kg/day and bodyweight of 0.025 kg (RTECS 1987)
[b] Calculated using an ingestion rate of 23 g/day and body weight of 75 g (Terres 1980)

TABLE 10. Lethal and Sublethal Effects of Mercury
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Rat	Not stated	0.5	Reduced fertility	Khera (1979)
Rat	Not stated	0.32	NOAEL	ATSDR (1993)
Dog	During pregnancy	0.1	High incidence of stillbirths	Khera (1979)
Mink	30 days	5 mg/kg CH_3Hg in diet 0.75[b]	100% mortality	Aulerich *et al.* (1974)
Mink	5 months	10 mg/kg HgCl in diet 1.5[b]	No adverse effects on survival or reproduction	Aulerich *et al.* (1974)
Mink	93 days	1.8 mg/kg CH_3HgCl in diet 0.27[b]	Anorexia, weight loss, ataxia, convulsions	Wobeser *et al.* (1976)
Mink	100 days	0.58 CH_3Hg	No effects	Jernelov *et al.* (1976)
Starling	8 weeks	1.1 0.12[c]	Kidney lesions	Nicholson and Osborn (1984)
Zebra finch	76 days	5 mg/kg 1.75[d]	Neurological impairment and death	Scheuhammer (1988)
Zebra finch	76 days	2.5 mg/kg 0.88[d]	No observable effect	Scheuhammer (1988)
Goshawk	47 days	0.7 - 1.2	100% mortality between days 30 and 47	Borg *et al.* (1970)
Red-tailed hawks	> 1 month	1.12	Mortality; dilatation of myelin sheaths and loss of myelin	Fimreite and Karstad (1971)
Common loon	Not stated	0.3 mg/kg in diet 0.1[e]	Reproductive impairment	Barr (1986)

[a] Dose calculated based on ingestion rate of 15 g/day and body weight of 200 g (RTECS 1982)
[b] Dose calculated based on average mink body weight of 1 kg (Linscombe *et al.* 1982) and ingestion rate of 150 g/day (Auerlich *et al.* 1973)
[c] Dose calculated based on ingestion rate of 0.007 kg/day and a bodyweight of 0.0638 kg (Terres 1980)
[d] Dose in mg/kg body weight-day based on authors estimate (Scheuhammer 1988)
[e] Dose calculated based on ingestion rate of 1.5 kg/day and body weight of 4.5 kg (Newell *et al.* 1987)

TABLE 11. Lethal and Sublethal Effects of Zinc
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

SPECIES	EXPOSURE PERIOD	DOSE (mg/kgBW/day)	EFFECT	REFERENCE
Mice	3 months	5000 mg/kg 600[a]	Anemia	Walters and Roe (1965)
Mice	8 weeks	2000 mg/kg 317[a]	Reduced plasma copper, lowered hematocrit, reduced body weight and hair loss	Mulhern *et al.* (1986)
Sprague-Dawley rats	40 days	0.4% of diet 300[b]	Abnormal fetal development	Schlickler and Cox (1968)
Long-Evans rats	8 weeks	0.4% of diet 300[b]	Poor growth rate, anemia, reduction in hemoglobin and red cell volume and deficiency in copper	Cox and Harris (1960)
Dog	1 year	1000 mg/kg 25[c]	No observed adverse effect	NAS (1979)
European ferret	21 days	1527 mg/kg 371[d]	Weight loss, decrease in food intake, soft and enlarged kidneys	Straub *et al.* (1980)
Mallard	30 days	3000 mg/kg 600[e]	Leg paralysis and decreased food consumption	NAS (1979)
Domestic chicken, chicks	2 weeks	5000 mg/kg 361.3[f]	Reduction in body weight, serum cholesterol, and growth hormones; thyroid follicular cell hyperplasia and hypertrophy	Dean *et al.* (1991)
Domestic chicken, chicks	21 days	2000 mg/kg 144.5[f]	Decreased growth and anemia	Stahl *et al.* (1989)
Japanese quail	5 days	600 mg/kg 139[g]	14-day old chicks; 7% mortality, reduced food intake	Hill and Camardese (1986)

[a] Calculated using an ingestion rate of 0.003 kg/day and bodyweight of 0.025 kg (RTECS 1987)
[b] Calculated using an ingestion rate of 15 g/day and body weight of 200 g (RTECS 1987)
[c] Calculated using an ingestion rate of 250 g/day and body weight of 10 kg (RTECS 1982)
[d] Calculated using an ingestion rate of 170 g/day and body weight of 0.7 kg reported by authors
[e] Calculated using an ingestion rate of 0.25 kg/day and body weight of 1.25 kg (Newell *et al.* 1987)
[f] Calculated using an ingestion rate of 0.0125 kg/day and body weight of 0.173 kg (RTECS 1987)

TABLE 12. Effect Levels used in the Hazard Quotient Calculations for Receptor Species
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

Chemical	mg/kg body weight/day			NOAELs for Receptors of Concern (mg/kg-day)						
	NOAEL	LOAEL	LD_{50}	Mouse	Shrew	Muskrat	Fox	Mink	Robin	Kestrel
PCBs		1.27		0.127	0.127	0.127				
	1.0	5.0					1.0			
		0.096						0.0096		
		3.5							0.35	
		9								0.9
Hexachlorobenzene		2		0.2	0.2	0.2				
		2.5					0.25			
		0.15						0.015		
		4.6							0.46	
		6								0.6
Acenaphthylene										
Benzo(a)anthracene										
Benzo(a)pyrene			50	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Benzo(b)fluoranthene										
Chrysene										
Fluoranthene		250		25	25	25	25	25	25	25
Fluorene										

TABLE 12 (Cont'd). Effect Levels used in the Hazard Quotient Calculations for Receptor Species
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

	mg/kg body weight/day			NOAELs for Receptors of Concern (mg/kg-day)						
Chemical	NOAEL	LOAEL	LD_{50}	Mouse	Shrew	Muskrat	Fox	Mink	Robin	Kestrel
Naphthalene		41		4.1	4.1	4.1	4.1	4.1	4.1	4.1
Phenanthrene			700	7	7	7	7	7	7	7
Cadmium		0.23		0.023	0.023	0.023				
	0.75						0.75	0.75		
		3.31							0.33	0.33
Copper			100	1	1	1	1	1		
		23.5							2.35	2.35
Lead		1.5		0.15	0.15	0.15				
		3					0.3	0.3		
		3							0.3	
	0.87	3								0.87
Mercury	0.23	0.5		0.23	0.23	0.23				
		0.1					0.01			
		0.27						0.027		
		0.12							0.012	
		0.1								0.01

TABLE 12 (Cont'd). Effect Levels used in the Hazard Quotient Calculations for Receptor Species
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

Chemical	mg/kg body weight/day			NOAELs for Receptors of Concern (mg/kg-day)						
	NOAEL	LOAEL	LD_{50}	Mouse	Shrew	Muskrat	Fox	Mink	Robin	Kestrel
Zinc		300		30	30	30				
	25						25			
		371						37.1		
		139							13.9	13.9

TABLE 13. Daily Intake of Contaminants (mg/kg-day) by Receptor Species
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

	Mouse	Shrew	Muskrat	Red fox	Mink	Robin	Kestrel
PCBs	2.93	27.54	82.01	1.20	2.52	64.53	7.00
Hexachlorobenzene	3.90	36.72	109.34	0.70	2.09	86.03	7.79
Acenapthylene	0.001	0.010	0.030	0.026	0.089	0.023	0.065
Benzo(a)anthracene	0.020	0.184	0.547	0.004	0.017	0.431	0.040
Benzo(a)pyrene	0.022	0.207	0.615	0.004	0.019	0.484	0.043
Benzo(b)fluoranthene	0.049	0.459	1.367	0.009	0.027	1.075	0.097
Chrysene	0.017	0.161	0.478	0.003	0.010	0.376	0.034
Fluoranthene	0.046	0.436	1.297	0.008	0.030	1.022	0.091
Fluorene	0.001	0.006	0.017	0.005	0.013	0.014	0.009
Napthalene	0.002	0.018	0.053	0.002	0.009	0.042	0.008
Phenanthrene	0.037	0.352	1.048	0.013	0.055	0.825	0.089
Cadmium	0.063	0.597	1.777	0.077	0.139	1.398	0.244
Copper	0.650	6.112	18.201	0.425	0.977	14.321	1.897
Lead	1.196	11.245	33.487	0.007	0.751	26.348	2.453
Mercury	0.465	4.376	13.030	0.222	0.462	10.252	1.172
Zinc	2.603	24.478	72.896	2.963	7.223	57.356	10.315

TABLE 14. Hazard Quotients Calculated for Receptor Species
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

	Mouse	Shrew	Muskrat	Red fox	Mink	Robin	Kestrel
PCBs	**23.1**	**216.8**	**645.7**	**1.2**	**262.4**	**184.4**	**7.8**
Hexachlorobenzene	**19.5**	**183.6**	**546.7**	**2.8**	**139.6**	**187.0**	**12.9**
Acenapthylene	NC	NC	NC	NC	NC	NC	NC
Benzo(a)anthracene	NC	NC	NC	NC	NC	NC	NC
Benzo(a)pyrene	0.04	0.41	**1.23**	0.01	0.03	0.96	0.09
Benzo(b)fluoranthene	NC	NC	NC	NC	NC	NC	NC
Chrysene	NC	NC	NC	NC	NC	NC	NC
Fluoranthene	0.001	0.017	0.051	0.000	0.001	0.041	0.004
Fluorene	NC	NC	NC	NC	NC	NC	NC
Napthalene	0.001	0.004	0.013	0.001	0.002	0.010	0.002
Phenanthrene	0.005	0.050	0.150	0.002	0.008	0.118	0.013
Cadmium	**2.76**	**25.9**	**77.3**	0.10	0.19	**4.24**	0.74
Copper	0.65	**6.11**	**18.2**	0.43	0.98	**6.09**	0.81
Lead	**7.97**	**75.0**	**223.2**	0.8	**2.50**	**87.7**	**2.82**
Mercury	**2.02**	**19.02**	**56.65**	**22.2**	**17.1**	**854.4**	**117.2**
Zinc	0.09	0.82	**2.43**	0.12	0.19	**4.13**	0.74

Hazard Quotients that exceed 1 are boldfaced/shaded
NC indicates a hazard quotient was not calculated due to lack of toxicity data for a contaminant

TABLE 15. Preliminary Draft Ecological Cleanup Goals
Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

Analyte	Maximum Hazard Quotient (calculated using NOAELs)	Maximum Soil Concentration	Ecological clean up goal (ppm)
PCBs	645.7	241.2	0.37
Hexachlorobenzene	546.7	321.6	0.59
Benzo(a)pyrene	1.23	1.81	1.47
Fluoranthene	0.051	3.819	74.9
Napthalene	0.013	0.157	12.1
Phenanthrene	0.15	3.082	20.5
Cadmium	77.3	5.226	0.07
Copper	18.2	53.533	2.94
Lead	223.2	98.49	0.44
Mercury	854.4	38.324	0.04
Zinc	4.13	214.4	51.9

APPENDIX A

Hazard Quotient Calculation Spreadsheets

Fields Brook Risk Assessment
Ashtabula, Ohio
December 1994

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Uptake of Acenapthylene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet sediment	Concentration in plants	Percent diet plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration mammals	Percent diet mammals
Mouse	0.0871	0.024	0.0871	0.0399	0.0871	0.577	0.39	0
Shrew	0.0871	0.025	0.0871	0.208	0.0871	0.767	0.39	0
Muskrat	0.0871	0.094	0.0871	0.906	0.0871	0	0.39	0
Fox	0.0871	0.028	0.0871	0	0.0871	0	0.39	0.972
Mink	0.0871	0.028	0.0871	0	0.0871	0	0.39	0.422
Robin	0.0871	0.104	0.0871	0.072	0.0871	0.824	0.39	0
Hawk	0.0871	0.082	0.0871	0	0.0871	0	0.39	0.918
Kestrel	0.0871	0.082	0.0871	0	0.0871	0.403	0.39	0.395

Uptake of Benz(a)anthracene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	1.61	0.024	1.61	0.0399	1.61	0.577	0.009	0
Shrew	1.61	0.025	1.61	0.208	1.61	0.767	0.009	0
Muskrat	1.61	0.094	1.61	0.906	1.61	0	0.009	0
Fox	1.61	0.028	1.61	0	1.61	0	0.009	0.972
Mink	1.61	0.028	1.61	0	1.61	0	0.009	0.422
Robin	1.61	0.104	1.61	0.072	1.61	0.824	0.009	0
Hawk	1.61	0.082	1.61	0	1.61	0	0.009	0.918
Kestrel	1.61	0.082	1.61	0	1.61	0.403	0.009	0.395

Uptake of Benzo(a)pyrene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	1.81	0.024	1.81	0.0399	1.81	0.577	0.0004	0
Shrew	1.81	0.025	1.81	0.208	1.81	0.767	0.0004	0
Muskrat	1.81	0.094	1.81	0.906	1.81	0	0.0004	0
Fox	1.81	0.028	1.81	0	1.81	0	0.0004	0.972
Mink	1.81	0.028	1.81	0	1.81	0	0.0004	0.422
Robin	1.81	0.104	1.81	0.072	1.81	0.824	0.0004	0
Hawk	1.81	0.082	1.81	0	1.81	0	0.0004	0.918
Kestrel	1.81	0.082	1.81	0	1.81	0.403	0.0004	0.395

Uptake of Benzo(b)fluoranthene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	4.02	0.024	4.02	0.0399	4.02	0.577	0.012	0
Shrew	4.02	0.025	4.02	0.208	4.02	0.767	0.012	0
Muskrat	4.02	0.094	4.02	0.906	4.02	0	0.012	0
Fox	4.02	0.028	4.02	0	4.02	0	0.012	0.972
Mink	4.02	0.028	4.02	0	4.02	0	0.012	0.422
Robin	4.02	0.104	4.02	0.072	4.02	0.824	0.012	0
Hawk	4.02	0.082	4.02	0	4.02	0	0.012	0.918
Kestrel	4.02	0.082	4.02	0	4.02	0.403	0.012	0.395

Uptake of Cadmium by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	5.226	0.024	5.226	0.0399	5.226	0.577	1	0
Shrew	5.226	0.025	5.226	0.208	5.226	0.767	1	0
Muskrat	5.226	0.094	5.226	0.906	5.226	0	1	0
Fox	5.226	0.028	5.226	0	5.226	0	1	0.972
Mink	5.226	0.028	5.226	0	5.226	0	1	0.422
Robin	5.226	0.104	5.226	0.072	5.226	0.824	1	0
Hawk	5.226	0.082	5.226	0	5.226	0	1	0.918
Kestrel	5.226	0.082	5.226	0	5.226	0.403	1	0.395

Uptake of Chrysene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	1.407	0.024	1.407	0.0399	1.407	0.577	0.0025	0
Shrew	1.407	0.025	1.407	0.208	1.407	0.767	0.0025	0
Muskrat	1.407	0.094	1.407	0.906	1.407	0	0.0025	0
Fox	1.407	0.028	1.407	0	1.407	0	0.0025	0.972
Mink	1.407	0.028	1.407	0	1.407	0	0.0025	0.422
Robin	1.407	0.104	1.407	0.072	1.407	0.824	0.0025	0
Hawk	1.407	0.082	1.407	0	1.407	0	0.0025	0.918
Kestrel	1.407	0.082	1.407	0	1.407	0.403	0.0025	0.395

Uptake of Copper by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	53.533	0.024	53.533	0.0399	53.533	0.577	4.8	0
Shrew	53.533	0.025	53.533	0.208	53.533	0.767	4.8	0
Muskrat	53.533	0.094	53.533	0.906	53.533	0	4.8	0
Fox	53.533	0.028	53.533	0	53.533	0	4.8	0.972
Mink	53.533	0.028	53.533	0	53.533	0	4.8	0.422
Robin	53.533	0.104	53.533	0.072	53.533	0.824	4.8	0
Hawk	53.533	0.082	53.533	0	53.533	0	4.8	0.918
Kestrel	53.533	0.082	53.533	0	53.533	0.403	4.8	0.395

Uptake of Fluoranthene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	3.819	0.024	3.819	0.0399	3.819	0.577	0.0035	0
Shrew	3.819	0.025	3.819	0.208	3.819	0.767	0.0035	0
Muskrat	3.819	0.094	3.819	0.906	3.819	0	0.0035	0
Fox	3.819	0.028	3.819	0	3.819	0	0.0035	0.972
Mink	3.819	0.028	3.819	0	3.819	0	0.0035	0.422
Robin	3.819	0.104	3.819	0.072	3.819	0.824	0.0035	0
Hawk	3.819	0.082	3.819	0	3.819	0	0.0035	0.918
Kestrel	3.819	0.082	3.819	0	3.819	0.403	0.0035	0.395

Uptake of Fluorene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	0.0509	0.024	0.0509	0.0399	0.0509	0.577	0.07	0
Shrew	0.0509	0.025	0.0509	0.208	0.0509	0.767	0.07	0
Muskrat	0.0509	0.094	0.0509	0.906	0.0509	0	0.07	0
Fox	0.0509	0.028	0.0509	0	0.0509	0	0.07	0.972
Mink	0.0509	0.028	0.0509	0	0.0509	0	0.07	0.422
Robin	0.0509	0.104	0.0509	0.072	0.0509	0.824	0.07	0
Hawk	0.0509	0.082	0.0509	0	0.0509	0	0.07	0.918
Kestrel	0.0509	0.082	0.0509	0	0.0509	0.403	0.07	0.395

Uptake of Hexachlorobenzene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	321.6	0.024	321.6	0.0399	321.6	0.577	1.2	0
Shrew	321.6	0.025	321.6	0.208	321.6	0.767	1.2	0
Muskrat	321.6	0.094	321.6	0.906	321.6	0	1.2	0
Fox	321.6	0.028	321.6	0	321.6	0	1.2	0.972
Mink	321.6	0.028	321.6	0	321.6	0	1.2	0.422
Robin	321.6	0.104	321.6	0.072	321.6	0.824	1.2	0
Hawk	321.6	0.082	321.6	0	321.6	0	1.2	0.918
Kestrel	321.6	0.082	321.6	0	321.6	0.403	1.2	0.395

Uptake of Mercury by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	38.324	0.024	38.324	0.0399	38.324	0.577	2.2	0
Shrew	38.324	0.025	38.324	0.208	38.324	0.767	2.2	0
Muskrat	38.324	0.094	38.324	0.906	38.324	0	2.2	0
Fox	38.324	0.028	38.324	0	38.324	0	2.2	0.972
Mink	38.324	0.028	38.324	0	38.324	0	2.2	0.422
Robin	38.324	0.104	38.324	0.072	38.324	0.824	2.2	0
Hawk	38.324	0.082	38.324	0	38.324	0	2.2	0.918
Kestrel	38.324	0.082	38.324	0	38.324	0.403	2.2	0.395

Uptake of Napthalene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	0.157	0.024	0.157	0.0399	0.157	0.577	0.03	0
Shrew	0.157	0.025	0.157	0.208	0.157	0.767	0.03	0
Muskrat	0.157	0.094	0.157	0.906	0.157	0	0.03	0
Fox	0.157	0.028	0.157	0	0.157	0	0.03	0.972
Mink	0.157	0.028	0.157	0	0.157	0	0.03	0.422
Robin	0.157	0.104	0.157	0.072	0.157	0.824	0.03	0
Hawk	0.157	0.082	0.157	0	0.157	0	0.03	0.918
Kestrel	0.157	0.082	0.157	0	0.157	0.403	0.03	0.395

Uptake of Lead by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	98.49	0.024	98.49	0.0399	98.49	0.577	0.54	0
Shrew	98.49	0.025	98.49	0.208	98.49	0.767	0.54	0
Muskrat	98.49	0.094	98.49	0.906	98.49	0	0.54	0
Fox	98.49	0.028	98.49	0	98.49	0	0.54	0.972
Mink	98.49	0.028	98.49	0	98.49	0	0.54	0.422
Robin	98.49	0.104	98.49	0.072	98.49	0.824	0.54	0
Hawk	98.49	0.082	98.49	0	98.49	0	0.54	0.918
Kestrel	98.49	0.082	98.49	0	98.49	0.403	0.54	0.395

Uptake of PCBs by receptor species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	241.2	0.024	241.2	0.0399	241.2	0.577	11	0
Shrew	241.2	0.025	241.2	0.208	241.2	0.767	11	0
Muskrat	241.2	0.094	241.2	0.906	241.2	0	11	0
Fox	241.2	0.028	241.2	0	241.2	0	11	0.972
Mink	241.2	0.028	241.2	0	241.2	0	11	0.422
Robin	241.2	0.104	241.2	0.072	241.2	0.824	11	0
Hawk	241.2	0.082	241.2	0	241.2	0	11	0.918
Kestrel	241.2	0.082	241.2	0	241.2	0.403	11	0.395

Uptake of Phenanthrene by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	3.082	0.024	3.082	0.0399	3.082	0.577	0.105	0
Shrew	3.082	0.025	3.082	0.208	3.082	0.767	0.105	0
Muskrat	3.082	0.094	3.082	0.906	3.082	0	0.105	0
Fox	3.082	0.028	3.082	0	3.082	0	0.105	0.972
Mink	3.082	0.028	3.082	0	3.082	0	0.105	0.422
Robin	3.082	0.104	3.082	0.072	3.082	0.824	0.105	0
Hawk	3.082	0.082	3.082	0	3.082	0	0.105	0.918
Kestrel	3.082	0.082	3.082	0	3.082	0.403	0.105	0.395

Uptake of Zinc by Receptor Species

Receptor Species	Concentration in sediment	Percent diet, sediment	Concentration in plants	Percent diet, plants	Concentration Invertebrates	Percent diet Invertebrates	Concentration in mammals	Percent diet, sm mammals
Mouse	214.4	0.024	214.4	0.0399	214.4	0.577	38	0
Shrew	214.4	0.025	214.4	0.208	214.4	0.767	38	0
Muskrat	214.4	0.094	214.4	0.906	214.4	0	38	0
Fox	214.4	0.028	214.4	0	214.4	0	38	0.972
Mink	214.4	0.028	214.4	0	214.4	0	38	0.422
Robin	214.4	0.104	214.4	0.072	214.4	0.824	38	0
Hawk	214.4	0.082	214.4	0	214.4	0	38	0.918
Kestrel	214.4	0.082	214.4	0	214.4	0.403	38	0.395

Uptake of Acenapthylene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet herptiles	Concentration in fish	Percent diet fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.51	0	0.335	0	0.0056	0.19	0.0011		#DIV/0!
Shrew	0.51	0	0.335	0	0.0203	0.49	0.0099		#DIV/0!
Muskrat	0.51	0	0.335	0	0.0871	0.34	0.0296		#DIV/0!
Fox	0.51	0	0.335	0	0.3815	0.069	0.0263		#DIV/0!
Mink	0.51	0.3	0.335	0.25	0.4038	0.22	0.0888		#DIV/0!
Robin	0.51	0	0.335	0	0.0153	1.52	0.0233		#DIV/0!
Hawk	0.51	0	0.335	0	0.3652	0.11	0.0402		#DIV/0!
Kestrel	0.51	0.121	0.335	0	0.2229	0.29	0.0646		#DIV/0!

Uptake of Benz(a)anthracene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0045	0	0.11	0	0.1029	0.19	0.0195		#DIV/0!
Shrew	0.0045	0	0.11	0	0.3751	0.49	0.1838		#DIV/0!
Muskrat	0.0045	0	0.11	0	1.6100	0.34	0.5474		#DIV/0!
Fox	0.0045	0	0.11	0	0.0538	0.069	0.0037		#DIV/0!
Mink	0.0045	0.3	0.11	0.25	0.0777	0.22	0.0171		#DIV/0!
Robin	0.0045	0	0.11	0	0.2834	1.52	0.4307		#DIV/0!
Hawk	0.0045	0	0.11	0	0.1403	0.11	0.0154		#DIV/0!
Kestrel	0.0045	0.121	0.11	0	0.1361	0.29	0.0395		#DIV/0!

Uptake of Benzo(a)pyrene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0042	0	0.135	0	0.1157	0.19	0.0220	0.5	0.0440
Shrew	0.0042	0	0.135	0	0.4217	0.49	0.2066	0.5	0.4133
Muskrat	0.0042	0	0.135	0	1.8100	0.34	0.6154	0.5	1.2308
Fox	0.0042	0	0.135	0	0.0511	0.069	0.0035	0.5	0.0070
Mink	0.0042	0.3	0.135	0.25	0.0859	0.22	0.0189	0.5	0.0378
Robin	0.0042	0	0.135	0	0.3186	1.52	0.4842	0.5	0.9684
Hawk	0.0042	0	0.135	0	0.1488	0.11	0.0164	0.5	0.0327
Kestrel	0.0042	0.121	0.135	0	0.1491	0.29	0.0432	0.5	0.0865

Uptake of Benzo(b)fluoranthene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0012	0	0.01	0	0.2569	0.19	0.0488		#DIV/0!
Shrew	0.0012	0	0.01	0	0.9367	0.49	0.4590		#DIV/0!
Muskrat	0.0012	0	0.01	0	4.0200	0.34	1.3668		#DIV/0!
Fox	0.0012	0	0.01	0	0.1242	0.069	0.0086		#DIV/0!
Mink	0.0012	0.3	0.01	0.25	0.1205	0.22	0.0265		#DIV/0!
Robin	0.0012	0	0.01	0	0.7075	1.52	1.0754		#DIV/0!
Hawk	0.0012	0	0.01	0	0.3407	0.11	0.0375		#DIV/0!
Kestrel	0.0012	0.121	0.01	0	0.3345	0.29	0.0970		#DIV/0!

Uptake of Cadmium by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.155	0	0.075	0	0.3339	0.19	0.0634	0.023	2.7586
Shrew	0.155	0	0.075	0	1.2177	0.49	0.5967	0.023	25.9414
Muskrat	0.155	0	0.075	0	5.2260	0.34	1.7768	0.023	77.2539
Fox	0.155	0	0.075	0	1.1183	0.069	0.0772	0.75	0.1029
Mink	0.155	0.3	0.075	0.25	0.6336	0.22	0.1394	0.75	0.1858
Robin	0.155	0	0.075	0	0.9198	1.52	1.3981	0.33	4.2365
Hawk	0.155	0	0.075	0	1.3465	0.11	0.1481	0.33	0.4488
Kestrel	0.155	0.121	0.075	0	0.8423	0.29	0.2443	0.33	0.7402

Uptake of Chrysene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0025	0	0.025	0	0.0899	0.19	0.0171		#DIV/0!
Shrew	0.0025	0	0.025	0	0.3278	0.49	0.1606		#DIV/0!
Muskrat	0.0025	0	0.025	0	1.4070	0.34	0.4784		#DIV/0!
Fox	0.0025	0	0.025	0	0.0418	0.069	0.0029		#DIV/0!
Mink	0.0025	0.3	0.025	0.25	0.0475	0.22	0.0104		#DIV/0!
Robin	0.0025	0	0.025	0	0.2476	1.52	0.3764		#DIV/0!
Hawk	0.0025	0	0.025	0	0.1177	0.11	0.0129		#DIV/0!
Kestrel	0.0025	0.121	0.025	0	0.1167	0.29	0.0338		#DIV/0!

Uptake of Copper by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	2.1	0	1.15	0	3.4208	0.19	0.6499	1	0.6499
Shrew	2.1	0	1.15	0	12.4732	0.49	6.1119	1	6.1119
Muskrat	2.1	0	1.15	0	53.5330	0.34	18.2012	1	18.2012
Fox	2.1	0	1.15	0	6.1645	0.069	0.4254	1	0.4254
Mink	2.1	0.3	1.15	0.25	4.4420	0.22	0.9772	1	0.9772
Robin	2.1	0	1.15	0	9.4218	1.52	14.3211	2.35	6.0941
Hawk	2.1	0	1.15	0	8.7961	0.11	0.9676	2.35	0.4117
Kestrel	2.1	0.121	1.15	0	6.5398	0.29	1.8965	2.35	0.8070

Uptake of Fluoranthene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0035	0	0.115	0	0.2440	0.19	0.0464	25	0.0019
Shrew	0.0035	0	0.115	0	0.8898	0.49	0.4360	25	0.0174
Muskrat	0.0035	0	0.115	0	3.8190	0.34	1.2985	25	0.0519
Fox	0.0035	0	0.115	0	0.1103	0.069	0.0076	25	0.0003
Mink	0.0035	0.3	0.115	0.25	0.1382	0.22	0.0304	25	0.0012
Robin	0.0035	0	0.115	0	0.6721	1.52	1.0217	25	0.0409
Hawk	0.0035	0	0.115	0	0.3164	0.11	0.0348	25	0.0014
Kestrel	0.0035	0.121	0.115	0	0.3150	0.29	0.0913	25	0.0037

Uptake of Fluorene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0003	0	0.115	0	0.0033	0.19	0.0006		#DIV/0!
Shrew	0.0003	0	0.115	0	0.0119	0.49	0.0058		#DIV/0!
Muskrat	0.0003	0	0.115	0	0.0509	0.34	0.0173		#DIV/0!
Fox	0.0003	0	0.115	0	0.0695	0.069	0.0048		#DIV/0!
Mink	0.0003	0.3	0.115	0.25	0.0598	0.22	0.0132		#DIV/0!
Robin	0.0003	0	0.115	0	0.0090	1.52	0.0136		#DIV/0!
Hawk	0.0003	0	0.115	0	0.0684	0.11	0.0075		#DIV/0!
Kestrel	0.0003	0.121	0.115	0	0.0319	0.29	0.0092		#DIV/0!

Uptake of Hexachlorobenzene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.0165	0	0.0165	0	20.5502	0.19	3.9045	0.2	19.5227
Shrew	0.0165	0	0.0165	0	74.9328	0.49	36.7171	0.2	183.5854
Muskrat	0.0165	0	0.0165	0	321.6000	0.34	109.3440	0.2	546.7200
Fox	0.0165	0	0.0165	0	10.1712	0.069	0.7018	0.25	2.8073
Mink	0.0165	0.3	0.0165	0.25	9.5203	0.22	2.0945	0.015	139.6307
Robin	0.0165	0	0.0165	0	56.6016	1.52	86.0344	0.46	187.0314
Hawk	0.0165	0	0.0165	0	27.4728	0.11	3.0220	0.6	5.0367
Kestrel	0.0165	0.121	0.0165	0	26.8472	0.29	7.7857	0.6	12.9761

Uptake of Mercury by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.25	0	0.095	0	2.4489	0.19	0.4653	0.23	2.0230
Shrew	0.25	0	0.095	0	8.9295	0.49	4.3755	0.23	19.0237
Muskrat	0.25	0	0.095	0	38.3240	0.34	13.0302	0.23	56.6529
Fox	0.25	0	0.095	0	3.2115	0.069	0.2216	0.01	22.1592
Mink	0.25	0.3	0.095	0.25	2.1002	0.22	0.4620	0.027	17.1129
Robin	0.25	0	0.095	0	6.7450	1.52	10.2524	0.012	854.3697
Hawk	0.25	0	0.095	0	5.1622	0.11	0.5678	0.01	56.7838
Kestrel	0.25	0.121	0.095	0	4.0418	0.29	1.1721	0.01	117.2127

Uptake of Napthalene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.03	0	0.06	0	0.0100	0.19	0.0019	4.1	0.0005
Shrew	0.03	0	0.06	0	0.0366	0.49	0.0179	4.1	0.0044
Muskrat	0.03	0	0.06	0	0.1570	0.34	0.0534	4.1	0.0130
Fox	0.03	0	0.06	0	0.0336	0.069	0.0023	4.1	0.0006
Mink	0.03	0.3	0.06	0.25	0.0411	0.22	0.0090	4.1	0.0022
Robin	0.03	0	0.06	0	0.0276	1.52	0.0420	4.1	0.0102
Hawk	0.03	0	0.06	0	0.0404	0.11	0.0044	4.1	0.0011
Kestrel	0.03	0.121	0.06	0	0.0284	0.29	0.0082	4.1	0.0020

Uptake of Lead by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	1.4	0	0.025	0	6.2935	0.19	1.1958	0.15	7.9718
Shrew	1.4	0	0.025	0	22.9482	0.49	11.2446	0.15	74.9640
Muskrat	1.4	0	0.025	0	98.4900	0.34	33.4866	0.15	223.2440
Fox	1.4	0	0.025	0	3.2826	0.069	0.2265	0.3	0.7550
Mink	1.4	0.3	0.025	0.25	3.4119	0.22	0.7506	0.3	2.5020
Robin	1.4	0	0.025	0	17.3342	1.52	26.3480	0.3	87.8268
Hawk	1.4	0	0.025	0	8.5719	0.11	0.9429	0.87	1.0838
Kestrel	1.4	0.121	0.025	0	8.4589	0.29	2.4531	0.87	2.8196

Uptake of PCBs by receptor species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.165	0	0.0165	0	15.4127	0.19	2.9284	0.127	23.0583
Shrew	0.165	0	0.0165	0	56.1996	0.49	27.5378	0.127	216.8331
Muskrat	0.165	0	0.0165	0	241.2000	0.34	82.0080	0.127	645.7323
Fox	0.165	0	0.0165	0	17.4456	0.069	1.2037	1	1.2037
Mink	0.165	0.3	0.0165	0.25	11.4492	0.22	2.5188	0.0096	262.3781
Robin	0.165	0	0.0165	0	42.4512	1.52	64.5258	0.35	184.3595
Hawk	0.165	0	0.0165	0	29.8764	0.11	3.2864	0.9	3.6516
Kestrel	0.165	0.121	0.0165	0	24.1434	0.29	7.0016	0.9	7.7795

Uptake of Phenanthrene by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	0.105	0	0.35	0	0.1969	0.19	0.0374	7	0.0053
Shrew	0.105	0	0.35	0	0.7181	0.49	0.3519	7	0.0503
Muskrat	0.105	0	0.35	0	3.0820	0.34	1.0479	7	0.1497
Fox	0.105	0	0.35	0	0.1884	0.069	0.0130	7	0.0019
Mink	0.105	0.3	0.35	0.25	0.2496	0.22	0.0549	7	0.0078
Robin	0.105	0	0.35	0	0.5424	1.52	0.8245	7	0.1178
Hawk	0.105	0	0.35	0	0.3491	0.11	0.0384	7	0.0055
Kestrel	0.105	0.121	0.35	0	0.3069	0.29	0.0890	7	0.0127

Uptake of Zinc by Receptor Species

Receptor Species	Concentration in herptiles	Percent diet, herptiles	Concentration in fish	Percent diet, fish	Sum dietary intake	IR kg/kg BW	Daily intake mg/kg-day	NOAEL	Hazard Quotient
Mouse	24.6	0	13.65	0	13.7002	0.19	2.6030	30	0.0868
Shrew	24.6	0	13.65	0	49.9552	0.49	24.4780	30	0.8159
Muskrat	24.6	0	13.65	0	214.4000	0.34	72.8960	30	2.4299
Fox	24.6	0	13.65	0	42.9392	0.069	2.9628	25	0.1185
Mink	24.6	0.3	13.65	0.25	32.8317	0.22	7.2230	37.1	0.1947
Robin	24.6	0	13.65	0	37.7344	1.52	57.3563	13.9	4.1264
Hawk	24.6	0	13.65	0	52.4648	0.11	5.7711	13.9	0.4152
Kestrel	24.6	0.121	13.65	0	35.5674	0.29	10.3145	13.9	0.7421