APPENDIX F

BASELINE ECOLOGICAL RISK ASSESSMENT REPORT PREPARED BY THE SCIENCE COLLABORATIVE-NORTH SHORE

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Baseline Ecological Risk Assessment
Blackburn & Union Privileges Superfund Site
Walpole, Massachusetts

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 1
1.1 Objective 1
1.2 Regulatory Guidance 1
1.3 Overview 1
1.4 Organization of the Risk Assessment 2

2.0 PROBLEM FORMULATION 3
2.1 Site Background and History 3
2.2 Ecological Conceptual Model 3
2.3 Ecological Description 4
2.3.1 Wetlands 4
2.3.2 Uplands 6
2.3.3 Neponset River Surface Water and River Bottom 6
2.3.4 Neponset River Floodplain 7
2.4 Potentially Sensitive Environments 7
2.5 Reference Areas 7
2.5.1 Neponset River Reference Area 8
2.5.2 Lower Pond Reference Area 8
2.5.3 Soil Reference Area 9
2.6 Chemicals of Potential Environmental Concern by Exposure Area 9
2.7 Chemical Fate and Transport 10
2.7.1 Release Mechanisms 10
2.7.2 Fate and Transport Mechanisms 10
2.8 Identification of Receptors 11
2.8.1 Terrestrial Receptors 12
2.8.2 Aquatic and Semi-aquatic Receptors 12
2.9 Complete Exposure Pathways 15
2.10 Assessment and Measurement Endpoints 15
2.10.1 Measurement Endpoints for Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates and fish 16
2.10.2 Measurement Endpoints for Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife 17
2.10.3 Measurement Endpoints for Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site. 18

3.0 EXPOSURE ASSESSMENT 19

3.1 Data Description 19
3.1.1 COPECs in Terrestrial Environment Soil and Earthworms 21
3.1.2 COPEC in Aquatic Environments – Sediment, Surface Water, Benthic Invertebrates, Fish 23
3.2 Exposure Scenarios 26
3.2.1 General Assumptions 27
[a] the Lower Former Mill Tailrace is part of the aquatic habitat in the Neponset River and we incorporated samples from that area into our exposure analysis of the Neponset River. We also addressed exposure to sediment in the Lower Former Mill Tailrace alone as part of the uncertainty analysis. 28
3.2.2 Receptor Profiles 28
3.2.3 General Food Chain Model 29
3.2.4 Exposure Point Concentrations 30

4.0 EFFECTS ASSESSMENT 33
4.1 Assessment of Media and Tissue Concentrations and Dietary Doses 33
4.1.1 TRVs for Dietary Doses to Birds and Mammals 33
4.1.3 Residue Effect Levels in Fish and Aquatic Invertebrates 35
4.2 Estimated Toxicity or Adverse Effects Associated with the Additive Effects of Specific Categories of COPECs (Narcosis Model) 36
4.3 Sediment Toxicity 36

5.0 RISK CHARACTERIZATION 38
5.1 Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates, and fish 40
5.1.1 Measurement Endpoint 1a: Surface water concentrations at or below National Recommended Water Quality Criteria (NRWQC) 40
5.1.2 Measurement Endpoint 1b: Exposure concentrations in fish at or below published no observable adverse effects concentrations 42
5.1.3 Measurement Endpoint 1c: No significant adverse effects to benthic invertebrates from exposure to sediment. 44
5.2 Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife 47
5.3 Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site 51
5.4 Uncertainty Analysis 55
5.4.1 Uncertainty in Problem Formulation 55
5.4.2 Uncertainty in Exposure Assessment 56
5.4.3 Uncertainty in Effects Assessment 61
5.4.4 Uncertainty in Risk Characterization 67

5.5 Risk Summary..... 68

6.0 REFERENCES..... 76

LIST OF TABLES

Table 2-1 Summary of COPECs

Table 2-2 Summary of Samples by Exposure Area

Table 2-3 Assessment and Measurement Endpoints

Table 3-1 Summary Statistics of Soil Data – Floodplain

Table 3-2 Summary Statistics of Soil Data – West of South Street

Table 3-3 Summary Statistics of Soil Data – East of South Street

Table 3-4 Summary Statistics of Soil Data – Orlando Property

Table 3-5 Summary Statistics of Soil Data – Soil Reference Area

Table 3-6 Summary Statistics of Earthworm Tissue – Floodplain

Table 3-7 Summary Statistics of Earthworm Tissue – West of South Street

Table 3-8 Summary Statistics of Earthworm Tissue – East of South Street

Table 3-9 Summary Statistics of Earthworm Tissue – Orlando Property

Table 3-10 Summary Statistics of Earthworm Tissue – Soil Reference Area

Table 3-11 Summary Statistics of Sediment Data – Neponset River

Table 3-12 Summary Statistics of Sediment Data – Lewis Pond

Table 3-13 Summary Statistics of Sediment Data – Upper Former Mill Tailrace

Table 3-14 Summary Statistics of Sediment Data – Neponset River Reference Area

Table 3-15 Summary Statistics of Sediment Data – Lower Pond Reference Area

Table 3-16 Summary Statistics of Surface Water Data – Neponset River

Table 3-17 Summary Statistics of Surface Water Data – Upper Former Mill Tailrace

Table 3-18 Summary Statistics of Surface Water Data – Neponset River Reference area

Table 3-19 Summary Statistics of Benthic Invertebrate Tissue Data – Neponset River

Table 3-20 Summary Statistics of Benthic Invertebrate Tissue Data – Lewis Pond

Table 3-21 Benthic Invertebrate Tissue Data – Upper Former Mill Tailrace

Table 3-22 Summary Statistics of Benthic Invertebrate Tissue Data – Neponset River Reference Area

Table 3-23 Summary Statistics of Benthic Invertebrate Tissue Data – Lower Pond Reference Area

Table 3-24 Summary Statistics Fish Tissue Data – Neponset River

Table 3-25 Summary Statistics of Fish Tissue Data – Lewis Pond

Table 3-26 Summary Statistics of Fish Tissue Data – Lower Pond Reference Area

Table 3-27 Total Organic Carbon Data for Soil, Sediment and Surface Water

Table 3-28 Sediment pH Data

Table 3-29 Sediment Ammonia Data

Table 3-30 Benthic Invertebrate Lipid Data

Table 3-31 Fish Length and Weight Data

Table 3-32 Calculation of CTE and RME Soil EPCs

Table 3-33 Calculation of CTE and RME Sediment EPCs

Table 3-34 Calculation of CTE and RME Surface Water EPCs

Table 3-35 Calculation of CTE and RME Fish EPCs

Table 3-36 Food Chain Model Parameters for Semi-Aquatic Mammals and Piscivorous Birds

Table 3-37 Food Chain Model Parameters for Terrestrial Wildlife

Table 3-38 Calculation of Aquatic Plant Central Tendency and Reasonable Maximum EPCs for the Chronic Food Chain Models – Site

Table 3-39 Calculation of Aquatic Plant Maximum EPCs for the Acute Food Chain Models – Site

Table 3-40 Calculation of Aquatic Plant Central Tendency and Reasonable Maximum EPCs for the Chronic Food Chain Models – Reference Areas

Table 3-41 Calculation of Aquatic Plant Maximum EPCs for the Acute Food Chain Models – Reference Areas

Table 4-1 National Recommended Water Quality Criteria

Table 4-2 Whole Body Toxicity Reference Values for Fish

Table 4-3 Whole Body Toxicity Reference Values for Benthic Invertebrates

Table 4-4 Chronic Avian Toxicity Reference Values

Table 4-5 Chronic Mammalian Toxicity Reference Values

Table 4-6 Acute Mammalian Toxicity Reference Values

Table 5-1 Comparison of Site Surface Water COPECs to Water Quality Criteria – Neponset River

Table 5-2 Comparison of Site Surface Water COPECs to Water Quality Criteria – Upper Former Mill Tailrace

Table 5-3 Comparison of Fish Body Burdens to TRVs – Neponset River

Table 5-4 Comparison of Fish Body Burdens to TRVs – Lewis Pond

Table 5-5 Calculation of Fish Body Burdens to the Narcosis Model

Table 5-6 Comparison of Benthic Invertebrate Body Burdens to Residue Effect Levels – Neponset River

Table 5-7 Comparison of Benthic Invertebrate Body Burdens to Residue Effect Levels – Lewis Pond

Table 5-8 Comparison of Benthic Invertebrate Body Burdens to Residue Effect Levels – Upper Former Mill Tailrace

Table 5-9 Results of 28-Day Sediment Toxicity Tests with *Hyalella azteca*

Table 5-10 SEM-AVS Analysis

Table 5-11 Comparison of Reference Soil Chemical Concentrations to Site Soil Chemical Concentrations for COPECs Without TRVs

Table 5-12 Comparison of Reference Earthworm Chemical Concentrations to Site Earthworm Chemical Concentrations for COPECs Without TRVs

Table 5-13 Comparison of Reference Sediment Chemical Concentrations to Site Sediment Chemical Concentrations for COPECs Without TRVs

Table 5-14 Comparison of Reference Invertebrate Chemical Concentrations to Site Invertebrate Chemical Concentrations for COPECs Without TRVs

Table 5-15 Comparison of Reference Fish Chemical Concentrations to Site Fish Chemical Concentrations for COPECs Without TRVs

LIST OF FIGURES

Figure 1-1 Site Locus Plan

Figure 1-2 Site Vicinity Plan

Figure 1-3 Summary of Procedures

Figure 1-4 Selection of COPECs

Figure 2-1 Conceptual Ecological Model for Terrestrial Habitats

Figure 2-2 Conceptual Ecological Model for Aquatic Habitats

Figure 2-3 Wetland Locations and Designations in Site Vicinity Plan

Figure 2-4 Reference Areas Location Plan

Figure 2-5 Fate and Transport of Contaminants

Figure 3-1a Soil Borings/Sample Locations Near Facility

Figure 3-1b Soil Borings/Sample Locations Off-Facility

Figure 3-2 Earthworm and Co-Located Soil Samples

Figure 3-3 Sediment and Surface Water Samples

Figure 3-4 Fish Sampling Sections

Figure 3-5 Sediment Reference Area Samples

Figure 4-1 Protocol for Selecting Whole Body Residue Benchmarks

LIST OF APPENDICES AND ASSOCIATED TABLES

Appendix A Screening Level Ecological Risk Assessment

Appendix B-1 Fish Habitat Survey

Appendix B-2 Natural Heritage and Endangered Species Program Letter

Appendix C-1 Bioaccumulation Laboratory Report

Appendix C-2 Sediment Toxicity Laboratory Report

Appendix D Food Chain Models

Table D-1 Food Chain Model for Chronic Exposures – Muskrat Analysis - Neponset River

Table D-2 Food Chain Model for Chronic Exposures– Muskrat Analysis - Lewis Pond

Table D-3 Food Chain Model for Chronic Exposures – Muskrat Analysis - Upper Former Mill Tailrace

Table D-4 Food Chain Model for Chronic Exposures – Raccoon Analysis – Neponset River

Table D-5 Food Chain Model for Chronic Exposures – Raccoon Analysis – Lewis Pond

Table D-6 Food Chain Model for Chronic Exposures – Kingfisher Analysis - Ingestion of Fish in the Neponset River

Table D-7 Food Chain Model for Chronic Exposures – Kingfisher Analysis - Ingestion of Fish in Lewis Pond

Table D-8 Food Chain Model for Chronic Exposures – Great Blue Heron Analysis – Ingestion of Fish in the Neponset River

Table D-9 Food Chain Model for Chronic Exposures – Great Blue Heron Analysis – Ingestion of Fish in Lewis Pond

Table D-10 Food Chain Model for Chronic Exposures – Robin Analysis – East of South Street

Table D-11 Food Chain Model for Chronic Exposures – Robin Analysis – West of South Street

Table D-12 Food Chain Model for Chronic Exposures – Robin Analysis – Orlando Property

Table D-13 Food Chain Model for Chronic Exposures – Robin Analysis – Floodplain

Table D-14 Food Chain Model for Chronic Exposures – Short-Tailed Shrew Analysis – East of South Street

Table D-15 Food Chain Model for Chronic Exposures – Short-Tailed Shrew Analysis – West of South Street

Table D-16 Food Chain Model for Chronic Exposures – Short-Tailed Shrew Analysis – Orlando Property

Table D-17 Food Chain Model for Chronic Exposures – Short-Tailed Shrew Analysis – Floodplain

Table D-18 Food Chain Model for Acute Exposures – Muskrat Analysis - Neponset River

Table D-19 Food Chain Model for Acute Exposures – Muskrat Analysis - Lewis Pond

Table D-20 Food Chain Model for Acute Exposures – Muskrat Analysis - Upper Former Mill Tailrace

Table D-21 Food Chain Model for Acute Exposures – Raccoon Analysis – Neponset River

Table D-22 Food Chain Model for Acute Exposures – Raccoon Analysis – Lewis Pond

Table D-23 Food Chain Model for Acute Exposures – Short-Tailed Shrew Analysis – East of South Street

Table D-24 Food Chain Model for Acute Exposures – Short-Tailed Shrew Analysis – West of South Street

Table D-25 Food Chain Model for Acute Exposures – Short-Tailed Shrew Analysis – Orlando Property

Table D-26 Food Chain Model for Acute Exposures – Short-Tailed Shrew Analysis – Floodplain

Table D-27 Food Chain Model for Chronic Exposures – Muskrat Analysis - Neponset River Reference Area

Table D-28 Food Chain Model for Chronic Exposures - Muskrat Analysis - Lower Pond Reference Area

Table D-29 Food Chain Model for Chronic Exposures – Raccoon Analysis – Neponset River Reference Area

Table D-30 Food Chain Model for Chronic Exposures – Raccoon Analysis – Lower Pond Reference Area

Table D-31 Food Chain Model for Chronic Exposures – Kingfisher Analysis - Ingestion of Fish in the Lower Pond Reference Area

Table D-32 Food Chain Model for Chronic Exposures – Robin Analysis – Soil Reference Area

Table D-33 Food Chain Model for Chronic Exposures – Short-Tailed Shrew Analysis – Soil Reference Area

Table D-34 Food Chain Model for Acute Exposures – Muskrat Analysis - Lower Pond Reference Area

Table D-35 Food Chain Model for Acute Exposures – Muskrat Analysis - Neponset River Reference Area

Table D-36 Food Chain Model for Acute Exposures – Raccoon Analysis – Neponset River Reference Area

Table D-37 Food Chain Model for Acute Exposures – Raccoon Analysis – Lower Pond Reference Area

Table D-38 Food Chain Model for Acute Exposures - Short-Tailed Shrew Analysis – Soil Reference Area

Table D-39 Calculation of the Area Use Factor for the Great Blue Heron

EXECUTIVE SUMMARY

This document assesses the potential for adverse ecological effects due to exposure of aquatic organisms and wildlife to chemicals assessed in conjunction with the Remedial Investigation (RI) of the Blackburn & Union Privileges Superfund Site (Site). The term "potential adverse ecological effects" rather than the term "risk" correctly describes the results from an ecological risk assessment because the process itself produces no estimates of probability which are inherent in the definition of risk. In lieu of probabilities, this risk assessment uses a descriptive protocol to convey our confidence in potential for adverse effects.

To conduct this assessment, personnel from The Science Collaborative evaluated potential adverse ecological effects to receptors from chemicals located in terrestrial areas of the Site and downstream water bodies, including the associated floodplain. Potential adverse ecological effects were also evaluated in Reference Areas not associated with the Site. Specific details regarding the process of our analyses are described within the text of this report.

Following standard approaches used for Ecological Risk Assessments completed under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), this document describes baseline potential adverse ecological effects only – it does not draw conclusions about whether an adverse effect may be due to a chemical that is present in the environment because of Site-related activities or whether it is there because of a background condition unrelated to the Site. This document does not draw conclusions about whether chemicals are elevated in the environment over concentrations that may be expected to be naturally occurring, or whether an adverse effect is of sufficient magnitude to warrant remedial action. These matters of perspective, and the risk-management decisions that ensue, will be addressed in the forthcoming Feasibility Study (FS).

There were measured exceedances of NRWQC and Class B Massachusetts water quality criteria in surface water (including pH) within the Upper Former Mill Tailrace. Although we conclude that the weight-of-evidence indicates no significant ecological risk to aquatic receptors in the Upper Former Mill Tailrace, the compliance with ARARs in surface water will be further evaluated in the FS.

Are there potential adverse ecological effects from exposure to habitats associated with the Blackburn & Union Privileges Superfund Site?

In our professional opinion the analyses indicate that there are potential adverse ecological effects to:

aquatic invertebrates and fish from exposure to dissolved barium, copper, lead, manganese, and vanadium, and benzo(a)anthracene and benzo(a)pyrene in surface water in the Neponset River;

fish from exposure to aluminum and zinc based on whole body burdens in fish from in Lewis Pond;

kingfisher from exposure to bis(2-ethylhexyl)phthalate;

muskrat from exposure to aluminum and nickel;

raccoon from exposure to aluminum, lead, nickel, and vanadium;

songbirds from exposure to aluminum, cadmium, chromium, lead, selenium, and zinc; and,

small mammals from exposure to aluminum, lead, and vanadium.

Are there potential adverse ecological effects from exposure to habitats associated with the Blackburn & Union Privileges Superfund Site Reference Areas?

There are potential adverse effects in reference areas from exposures to Contaminants of Concern. We provide these adverse effects for the convenience of risk managers who may want this information to inform risk management decisions for the development of actionable risks as part of the forthcoming FS. In our professional opinion, these risks include:

potential adverse effects to aquatic invertebrates and fish from exposure to dissolved barium in surface water;

fish from exposure to zinc based on whole body burdens in fish;

potential adverse effects to aquatic invertebrates from exposure to nickel.

muskrat from exposure to aluminum;

raccoon from exposure to aluminum, lead, and vanadium;

potential adverse effects to songbirds due to exposure to aluminum, lead, selenium, zinc; and,

small mammals from exposure to aluminum, and vanadium.

What are the uncertainties associated with exposure to aluminum at the Blackburn &Union Privileges Superfund Site?

Risk estimates for aluminum are likely to overestimate the potential adverse ecological effects for the following reasons:

Aluminum is an abundant component of the earth's crust and occurs naturally in soils and sediments at concentrations that are generally many orders of magnitude higher than anthropogenic inputs (USEPA, 2003);

The forms of soluble aluminum, which may be toxic, are poorly understood and difficult to measure (USEPA, 2003); and

Potential adverse effects to ecological receptors at this Site are overestimated as they are at other sites, because standard methods for the analysis of aluminum are not specific to the toxic forms of aluminum.

What is the basis for potential adverse ecological effects?

The basis for calculated potential adverse ecological effects is a comparison of measured concentrations or doses of some chemicals to benchmark concentrations or doses associated with known adverse ecological effects in laboratory studies performed by other independent organizations. They are not potential adverse ecological effects based on direct observations of the biological properties or responses of animals at the Site. We observed no indications of chemical stress to organisms or wildlife that were collected at the Site as part of this investigation.

What is the purpose of discussing uncertainties and providing expressions of confidence?

The purpose of these characterizations or uncertainties is to make the reasons for our opinions as transparent as possible and to help carry the reasoning in the risk assessment into the discussions of risk management. The purpose is not to minimize potential adverse ecological effects or to bias the decision-making process. It is merely to provide perspective to the decision makers as they balance proposed actions and proposed benefits.

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1.0 INTRODUCTION

This document is a Baseline Ecological Risk Assessment (BERA) for the Blackburn and Union Privileges Superfund Site (the "Site") located in Walpole, Massachusetts (Figure 1-1), including the adjacent wetland and upland habitats, and the aquatic habitats of the on-Site and downstream reaches of the Neponset River as far as Lewis Pond; Figure 1-2). It incorporates the data collected during the Remedial Investigation (RI) completed by Sanborn, Head & Associates, Inc., is consistent with the Ecological Risk Assessment Work Plan (Revision Number 2 submitted to EPA on June 29, 2000), and responsive to comments received from the United States Environmental Protection Agency (USEPA) and Metcalf & Eddy, Inc. (on behalf of USEPA) (dated November 16, 2004; March 10, 2005; April 17, 2006; May 19, 2006 and March 23, 2007).

1.1 Objective

The objective is to describe the potential for adverse ecological effects from exposure to chemicals of potential ecological concern (COPECs) in the terrestrial and aquatic habitats of the Site.

1.2 Regulatory Guidance

This BERA follows USEPA guidance for assessment of ecological risk at contaminated sites. The specific guidance documents include:

- U.S. Environmental Protection Agency. 1998. Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F. Risk Assessment Forum. Washington, DC.
- U.S. Environmental Protection Agency. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA/540/R-97/006. Office of Solid Waste and Emergency Response. Washington, DC.
- U.S. Environmental Protection Agency. 1993. Wildlife Exposure Factors Handbook Volume I. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

1.3 Overview

This BERA continues its antecedent analysis, the Screening Level Ecological Risk Assessment (SLERA; Appendix A). The SLERA used data from the Phase 1A RI primarily to identify complete exposure pathways and COPECs that require further evaluation in the BERA. The SLERA incorporates revisions based on comments from USEPA (dated October 18, 2002).

The BERA seeks to improve the accuracy of the analysis contained in the SLERA, narrowing the bounds of uncertainty around the estimates of adverse ecological effect by using additional data, tools such as bioaccumulation and toxicity testing, and a higher level of analytical analysis. A flow chart (Figure 1-3) diagrams the ecological risk assessment process for the Site.

The BERA incorporates both the Phase 1A data evaluated in the SLERA, Phase 1B data, and six floodplain soil samples taken in 2006. Figure 1-4 shows the procedures used to select COPECs for the SLERA and BERA. This process is further described in Section 2.6 of this Report.

1.4 Organization of the Risk Assessment

The BERA follows the USEPA framework for ecological risk assessment (USEPA, 1997 and 1998). The main components of an ecological risk assessment are:

Problem Formulation- develops a site-specific conceptual model that identifies potentially complete exposure pathways, identifies and describes receptors of concern at the site, and selects assessment and measurement endpoints.

Exposure Assessment- identifies COPECs and describes the methods to estimate the magnitude of potential exposure of ecological receptors to COPECs.

Ecological Effects Assessment- summarizes and weighs available evidence regarding the potential for COPECs to cause adverse effects in exposed individuals and provides, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of adverse effects.

Risk Characterization- summarizes and integrates the exposure assessment and ecological effects assessment into estimates of potential adverse ecological effects. The risk characterization uses a weight-of-evidence approach based on:

- Comparison of concentrations of COPECs in sediment, soil and surface water to various criteria;
- Comparison of estimated dietary doses of COPECs to toxicity reference values (TRV) from the literature;
- Comparison of tissue concentrations that were measured in field-collected samples or following bioaccumulation testing to Residue Effect Levels from the literature;
- Narcosis Model to address cumulative toxicity of semi-volatile organic compounds (SVOCs); and
- Sediment toxicity tests.

The risk characterization also addresses uncertainty in the analysis of the potential for adverse ecological effects. This subsection includes identification and evaluation of sources of uncertainty in various aspects of the analysis, including model applications and the use and applicability of toxicity factors.

2.0 PROBLEM FORMULATION

This section summarizes the Site history, presents an ecological conceptual model, provides an ecological description of the various habitats at the Site and adjacent upstream and downstream areas, identifies potentially sensitive environments and sampling reference areas, selects the COPECs, discusses fate and transport mechanisms relevant to habitats at the Site and nearby areas, identifies representative receptors, specifies the complete exposure pathways, and develops assessment and measurement endpoints.

2.1 Site Background and History

This subsection is a brief summary of a more expansive Site background and history in the *Existing Data Review and Analysis Report* (SHA, 2000).

The Blackburn and Union Privileges Site is approximately one-half mile south/southeast of the center of Walpole, Massachusetts. The Site is south of the intersection of South Street and Common Street with South Street bisecting the Site in a north/south direction and the Neponset River bisecting the Site in an east/west direction. Lewis Pond is approximately 0.7 miles northwest of the Site (Figure 1-1 and 1-2).

The Site, as defined in the Administrative Order by Consent, includes 23 parcels of land over 22 acres. The Site consists of "On-Facility" and "Off-Facility" properties with residential lots and industrial facilities. The “On-Facility” properties have been industrial for several hundred years while the “Off-Facility” properties have historically been undeveloped or residential. The industrial processes conducted on “On-Facility” properties have included, but are not limited to the manufacturing of: cloth, rubber goods, asbestos brake and clutch linings, cotton and rayon flock, and instant coffee. Currently, five buildings east of South Street are being used for foundry-related activities and associated support operations.

Due to the past and present industrial processes conducted on “On-Facility” properties, metals, semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs) have been reported at the Site. Also, soil, groundwater, and surface water in some areas of the Site have a high pH (groundwater up to 14 standard units and sediment/surface water up to pH 10). See the *Existing Data Review and Analysis Report* (SHA, 2000) for location of “On-Facility and “Off-Facility” properties and a more detailed historical overview of activities at the Site.

2.2 Ecological Conceptual Model

This subsection provides the ecological conceptual model. Subsequent subsections expand upon the ecology, biological receptors, COPECs, transport mechanisms, and biological exposure routes incorporated into the conceptual model.

The conceptual model addresses:

- Environmental setting and COPECs known or suspected to exist at the Site;
- COPEC fate and transport mechanisms;

- Likely categories of potentially affected receptors; and
- Complete exposure pathways.

A complete exposure pathway occurs whenever there is a source of a COPEC, a fate and transport mechanism, which delivers a COPEC to a receptor, and an exposure route that results in biological uptake of the COPEC. Figures 2-1 and 2-2 illustrate the conceptual models for the terrestrial and aquatic habitats of the Site.

2.3 Ecological Description

A local habitat survey conducted by Normandeau & Associates, Inc. (NAI, 2001; located in Appendix C of SHA, 2002) described four general habitat types: wetlands, uplands, the Neponset River, and the Neponset River floodplains. The habitat survey contains a color-coded habitat map that shows the locations and types of all habitats from upstream of the Site to the downstream Lewis Pond. Appendix B-1 provides the results of a fish habitat survey of the reaches of the Neponset River, Lewis Pond, and the Former Mill Tailrace in the areas upstream, downstream, and adjacent to the Site.

2.3.1 Wetlands

The wetlands are eleven bordering vegetative wetlands, shallow emergent marshes, and small pools of the Neponset River. They occur upstream, adjacent to, and downstream of the Site in a generally discontinuous pattern broken by an approximately 800-foot long culvert north of South Street, and relatively long channelized reaches of the river (see Figure 2-3). These wetlands offer a diverse vegetative habitat among eleven distinctly defined wetlands that are generally less than one or two acres (the downstream seven acre Lewis Pond is the largest of these wetlands and includes emergent marsh and small open water areas. In sum, the wetlands can support invertebrates, large mammals (white tail deer) and various small mammals (e.g. mice, shrews, raccoon, muskrat), and avian predators (kingfisher, heron).

Normandeau Associates (2001 contained in SHA, 2002) provided three geographic categories of the wetlands: On-Facility Wetlands, Off-Facility Wetlands and Off-Site Wetlands. The distinctions are purely geographic, and all the wetlands are functionally either bordering vegetated wetlands of the Neponset River or distinct stretches of the river (e.g. Lewis Pond).

There are five On-Facility Wetlands (using Normandeau terminology):

> *Wetland 3, a one-half acre cattail marsh along the eastern bank of the river between South Street and an upstream abandoned railroad bed.* It has a small red maple swamp along its northern edge. Observations indicate that white tail deer, small mammals (woodchuck), painted turtles, and songbirds use the wetland.
>
> *Wetlands 4 (a red maple swamp) and 5 (shrub swamp), less than 0.2 acre habitats on the western bank of the river south of South Street.* They provide habitat cover for small birds and mammals, and a corridor for turtles.

Wetland 6 is a 0.7 acre red maple swamp just below the Neponset River Culvert on the west side of the river. Observations indicate that the wetland provides vegetative cover and a wildlife corridor for songbirds, woodpeckers, crows, titmouse, shrews, and deer.

Wetland 7 is 0.3 acre constructed shrub swamp and shallow emergent marsh adjacent to the Former Mill Tailrace. Observations indicate the presence of deer, northern wren, catbird, grackle, tufted titmouse, and cardinal. The Former Mill Tailrace contains shallow-standing water, seasonally. It is within the vegetated corridor along the Neponset River, and therefore has some wildlife habitat value.

Two Distinct Habitats of the Former Mill Tailrace

The Former Mill Tailrace has two physically distinct habitats separated by a 1.5-foot high concrete weir. The weir restricts flow in and out of the tailrace.

The Lower Former Mill Tailrace is a shallow but continuous portion of the Neponset River downstream of the "On-Facility" portions of the Site.

The Upper Former Mill Tailrace (upstream of the weir) is not generally accessible to fish from the Neponset River and Lower Former Mill Tailrace due to the presence of the concrete weir. The area also experiences low dissolved oxygen, which inhibits the growth and maintenance of prey species in this area. Normandeau (2001) noted that portions of the Former Mill Tailrace are devoid of vegetation except common reed and its habitat value is low. Downey (2003) conducted a fish habitat survey of the Upper Former Mill Tailrace and found that it is isolated, shallow, and had virtually no quality fisheries habitat, and it is unlikely that fish permanently reside in this area.

Wetland 2 is Off-Facility but on-Site. It is a 1.5-acre red maple swamp just downstream of the Lower Blackburn Dam on the western side of the Neponset River. It is a vegetative diverse riparian corridor associated with a one-half acre shrub swamp island in the middle of the river channel. Observations indicated that this wetland provides cover for small mammals, reptiles, amphibians, deer, woodpecker, and tufted titmouse.

There are five Off-Site wetlands:

Wetland 1 is a 0.4-acre shrub swamp and deep emergent marsh just upstream of the abandoned railroad bed on the south of South Street. It is interspersed with ponded water, diverse stands of shrub, emergent vegetation, and Fox grape. Observations indicated that the wetland is habitat for turtles, amphibians, waterfowl, wading birds, and songbirds.

Wetlands 8 (shrub wetland), 9 and 11 (red maple swamps) are 0.1- acre habitats downstream of the Site tucked close to the river's edge. Wetlands 9 and 11 are on the west bank, and wetland 11 is on the east bank. Their small size makes them limited as wildlife habitat, but they contribute to the riparian corridor.

Wetland 10 is Lewis Pond, a broad and shallow seven-acre marsh that is confined downstream by the West Street Dam. Water levels fluctuate periodically exposing large mudflats vegetated with purple loosestrife and cattails. The deeper waters support emergent, submerged, and floating vegetation. The edges support shrubs and a red maple swamp on the western border of the pond. The marsh provides habitat for aquatic and semi-aquatic life including muskrat, green frogs, toads, Canada geese, mallards, red-winged blackbirds, and many songbirds. Wading birds and waterfowl likely use this habitat. It is marginal habitat for some wildlife because the adjacent upland is a busy, urban, commercial district. Downey (2003; Appendix B-1) described the results of a fish habitat survey in Lewis Pond. He describes the area as poor quality fish habitat that may support sparse populations of bullheads, redfin pickerel, sunfishes, minnows, and shiners. According to Downey, more riverine species are unlikely to inhabit this area.

2.3.2 Uplands

The uplands are generally small and too disconnected to provide breeding territories. They include residential lawn, mowed fields, small white pine, oak forest, and industrialized property with its attendant compacted and covered soil. The upland supports small mammals, songbirds, and terrestrial invertebrates. Normandeau Associates (2001) provided three geographic categories of uplands: On-Facility Uplands; Off-Facility Uplands; and Off-Site Uplands. The distinctions are purely geographic.

The On-Facility Uplands include industrial developed properties, a few open habitats and small stands of high terrace floodplain forest. The cultural grasslands (mowed areas) are too small to provide breeding territories for grassland birds. There is a small high terrace floodplain forest along the Neponset River north of the facility. Observations indicated that the non-industrial areas may support feeding birds, raccoon, fox, and small mammals.

The Off Facility and Off-Site Uplands are residential yards, high terrace floodplain forest in undeveloped areas along the Neponset River adjacent to Wetland 2 and east of Wetland 7, and along the southwest edge of Lewis Pond. Observations indicated that these uplands may support blue jay, cardinals, small mammals, and deer.

2.3.3 Neponset River Surface Water and River Bottom

Normandeau (2001) contained in SHA, 2002 described the Neponset River's surface water and benthic environment. The river is generally 20 feet wide and two feet deep. Upstream it is a riffle and run environment over a cobble bottom, until it runs through a small sandy wetland before entering an approximately 400- foot long culvert that runs adjacent to and through the Site. Downstream of the culvert, the river is a steep-sided cobbled stream until it begins to meander through Lewis Pond, an extensive emergent wetland and small open water area. Immediately downstream of Lewis Pond, the river encounters a dam with a control weir in Walpole Center. The river supports benthic invertebrates and a warm water fishery.

Downey (2003; Appendix B-1) described the results of a fish habitat survey in the reach of the Neponset River in the areas adjacent to the Site. He concludes that the reaches of the river from 50 to 100 meters downstream of the Site are moderate quality fish habitat suitable for fish populations adapted to fast shallow riffle/runs such as minnows, darters, and possibly suckers. Some lentic species (e.g. sunfish) from the upstream Blackburn Pond may be transient in this river reach.

2.3.4 Neponset River Floodplain

The 100-year floodplain of the Neponset River is approximately 60 to 450 feet wide and encompasses bordering wetlands and residential or commercial properties all along its length. Most of the floodplain is residential and will support small mammals and provide feeding areas for songbirds.

2.4 Potentially Sensitive Environments

In accordance with Massachusetts guidance, we identified habitats of rare wildlife and certified vernal pools, priority sites of rare species habitats and exemplary natural communities, and areas of critical concern on or near the Site area.

Habitats of Rare Wildlife and Certified Vernal Pools & Priority Sites of Rare Species Habitats and Exemplary Natural Communities

According to the *Massachusetts Natural Heritage Atlas 12th edition, 2006*, there are no habitats of rare wildlife or certified vernal pools near the Site. The nearest habitat of rare wildlife is approximately one-mile southeast of the Site. The Site is unlikely to affect this habitat because the Neponset River flows northwest from the Site.

Massachusetts Areas of Critical Environmental Concern

The Site is not in a Massachusetts Area of Critical Environmental Concern. The Site is unlikely to influence the nearest Area of Critical Environmental Concern, The Fowl Meadow/Ponkapoag Bog that is approximately 3.5 miles northeast of the Site.

The Massachusetts Natural Heritage and Endangered Species Program is not aware of any rare plants or animals or exemplary natural communities in the area of the Site (Appendix B-2).

2.5 Reference Areas

According to EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA, 2002):

> A "background reference area" is an area where background samples are collected for comparison with samples collected on site. The reference area should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but has not been affected by activities on the site.

> "Background" is defined as substances or locations that are not influenced by the releases from a site and are usually described as naturally occurring or anthropogenic: (1) Naturally occurring substances are present in the environment in forms that have not been influenced by human activity. (2) Anthropogenic substances are natural and human-made substances present in the environment as a result of human activities (not specifically related to the CERCLA site in question).

We selected reference areas in consultation with the USEPA during the scoping phase of the BERA. Figure 2-4 shows the location of the reference areas relative to the Site. We provide data and calculated risks from exposure in reference areas in this BERA. These data may inform the FS and the remedy decision-making process.

2.5.1 Neponset River Reference Area

We selected an area just upstream of the Site in the Neponset River as the Neponset River Reference Area. The reference area samples included sediment samples, surface water samples and sediment samples for benthic invertebrate bioaccumulation tests. The COPEC concentrations in samples from the Neponset River Reference Area represent background, that is, the levels of contaminants that would exist in the absence of influence of contamination from the Site and that are consistently present in the environment in the vicinity of the Site. These data may inform the FS and the remedy decision-making process.

2.5.2 Lower Pond Reference Area

Personnel from the Science Collaborative reviewed United States Geological Survey (USGS) topographic maps and the Massachusetts Geographical Information System (GIS) land cover type maps, prior to August 20, 2001 to identify several potential reference areas for Lewis Pond. On August 20, 2001, Nikki Roy of Sanborn, Head & Associates, Inc. (SHA), Katherine Fogarty, P.E. of MCA, and Tony Rodolakis, Ecological Risk Assessor and Senior Environmental Scientist, of Metcalf & Eddy (M&E) performed reconnaissance level visits to these sediment sampling reference areas in the southeastern Massachusetts area. We assessed potential candidate reference areas based on their resemblance to Lewis Pond in terms of similarity of shoreline and surrounding development; and to a lesser degree, stream/pond morphology and vegetation.

We selected Lower Pond in Norwood, Massachusetts as the reference area for Lewis Pond, based on these considerations. Sediment and fish were collected from this area. Lower Pond was also used as the reference area for Neponset River fish. Fish were not collected from the Neponset River Reference Area because fish present in that portion of the Neponset River might be exposed to downstream sediment and surface water that has been impacted by the Site. Although risk managers may use the concentrations at the Lower Pond Reference Area for providing perspective during the FS and remedy decision-making process, they do not represent background concentrations.

2.5.3 Soil Reference Area

The Soil Reference Area is an undeveloped area in the floodplain of the Neponset River upstream of the Site. Floodplain soil samples and co-located composite soil and earthworm samples were collected from the Soil Reference Area. COPEC concentrations in samples from this area represent background. These data may inform the FS and the remedy decision-making process.

2.6 Chemicals of Potential Environmental Concern by Exposure Area

The *Existing Data Review and Analysis Report* (EDRA; SHA, 2000) reported that metals and SVOCs, especially polycyclic aromatic hydrocarbons (PAHs), are present at the Site. VOCs associated with petroleum contamination and total petroleum hydrocarbon (TPH) fractions are also present in some areas of the Site. It also reported that in some areas of the Site, soil, groundwater, and surface water have a high pH (groundwater up to 14 standard units (s.u.) and sediment/surface water up to pH 10 s.u.).

Section 2.2 of the SLERA (Appendix A) describes the selection of COPECs carried through the Phase IB sampling effort and the BERA (Figure 1-4). The selection process considered detection limits, detection frequencies, and ecotoxicological screening levels, and did not consider background concentrations or other historical information. COPECs in this BERA are those identified in the SLERA, except for chemicals that were never detected in the ecologically accessible areas of the Site (i.e., those evaluated in this BERA) are excluded (e.g. pesticides). Table 2-1 summarizes COPECs by media and exposure area.

We subdivided the On-Site soil exposure area evaluated in the SLERA into three separate exposure areas: West of South Street, East of South Street, and the Orlando Property (Figure 1-2). COPECs selected for the On-Site soil exposure area in the SLERA were applied to the three sub-areas evaluated in the BERA.

As described in subsection 2.3.1, we also divided the Former Mill Tailrace sediment and surface water exposure areas into two separate exposure areas: Upper Former Mill Tailrace and Lower Former Mill Tailrace (Figure 1-2), based on the habitat assessment performed by Normandeau & Associates, Inc. The Upper Former Mill Tailrace was evaluated for COPECs selected for the Former Mill Tailrace in the SLERA. The Lower Former Mill Tailrace was evaluated as part of the Neponset River for COPECs selected for the Neponset River in the SLERA. Table 2-2 shows the samples that are included in each exposure area.

The COPECs are measured chemicals at the Site that the SLERA (Appendix A) indicated might cause an adverse ecological effect based on a set of screening criteria and comparison to screening ecotoxicological values without consideration of historical activities at the Site. Therefore, the assessment may retain some COPECs that are not explicitly related to historical Site activities.

2.7 Chemical Fate and Transport

Figure 2-5 illustrates how chemicals may have moved from source areas to ecological habitats on the Site. It shows:

- Release mechanisms from source areas (e.g., "On-Facility" industrial processes);
- Exposure locations (e.g., the areas to which release mechanisms deliver chemicals);
- Fate and transport mechanisms (physical and chemical processes that partition chemicals among various environmental media at the exposure locations); and
- Exposure media (environmental media from which organisms or humans may be exposed to chemicals).

2.7.1 Release Mechanisms

Figure 2-5 shows four release mechanisms that may have operated at the South Street Site. They include: on-Site land-based deposition of contaminated soil; accidental releases of liquids; historical discharge to the settling basins and Former Mill Tailrace; and on-Site discharges to the Neponset River.

On-Site land-based deposition of contaminated soil may have resulted from historical placement of contaminated fill-soils; historical disposal of solid materials; or residue from historical Site operations such as coal burning. Once in the soil, chemicals may be taken up by soil invertebrates or plants, or may leach into the groundwater and migrate with the groundwater flow to other receptors.

Accidental releases of liquids containing acids, bases, and various hydrocarbon products may have been released from the facility (including underground and aboveground storage tanks) to locations accessible to ecological receptors.

Historical discharges to the settling basins and tailrace include chemicals released to the unlined settling basins that may have leached into the groundwater and migrated with the groundwater flow to ecological receptors. Chemicals released to the tailrace could adhere to sediments or migrate with surface water into the Neponset River.

Possible historical discharges from the facility may have entered the Neponset River and former Lower Mill Pond.

2.7.2 Fate and Transport Mechanisms

Physical, chemical, and biological transport mechanisms that are likely to affect the distribution of the detected chemicals in the observed habitats on, proximate to, and downstream of the Site include:

Deposition of particles in runoff from the Site to bordering vegetated wetlands, Neponset River and Lewis Pond surface water and sediment, and the Neponset River floodplain;

Dissolution of chemicals from sediments or suspended sediments to surface water of the Neponset River and Lewis Pond;

Dissolution of chemicals from Site soil to groundwater with subsequent migration either directly, or by way of the Former Mill Tailrace to surface water or sediment of the Neponset River;

Transport of particles from erosive areas to depositional areas in the Neponset River and Lewis Pond;

Bioaccumulation and potential biomagnification from soil invertebrates in floodplain soil, wetlands soil, and terrestrial soil to small mammals and songbirds; and

Bioaccumulation and potential biomagnification from benthic invertebrates in Neponset River and Lewis Pond sediments to fish, piscivorous birds, and semi-aquatic mammals.

2.8 Identification of Receptors

This subsection:

Identifies species of ecological receptors and provides the rationale for their selection as representative of the species that occur or are likely to occur at the Site;

Provides an ecological characterization of each receptor for eventual use in developing the exposure assessment.

The selected receptors represent those types of organisms most likely to encounter the COPECs at the Site. These receptors include a reasonable (although not comprehensive) cross-section of the major functional and structural components of the ecosystem under study based on:

- Relative abundance and ecological importance within the selected habitats;
- Availability and quality of applicable toxicological literature;
- Relative sensitivity to the COPECs;
- Trophic status;
- Relative mobility and local feeding ranges; and
- Ability to bioaccumulate COPECs.

The selected species represent different feeding guilds. Coexisting members of guilds have similar habitat requirements, dietary habitats, and functional relationships with other species in the habitat. The underlying assumption in this approach is that an evaluation of the potential exposure of the representative species approximates exposure to all guild members.

2.8.1 Terrestrial Receptors

Songbirds and Insectivorous Mammals

Songbirds and mammals are potential receptors at the Site because they:

- Can be exposed through incidental ingestion of contaminated soils; and
- Can be exposed through ingestion of contaminated prey, such as invertebrates (e.g., earthworms).

The American robin (*Turdus migratorius*) breeds in open woodlands, woodland edges, and clearings. Their major foods are wild and cultivated fruits, earthworms, and insects. Their diet varies from 32% soil invertebrates in the summer to 93% in the spring with the remaining percentage consisting of fruit (USEPA, 1993). For this assessment, it was assumed that the diet consisted entirely of earthworms. Their territories range from 0.4 to 2 acres and can reach densities of over 100 birds per 100 acres. Their preferred habitats are grassy fields and orchards. They are migratory and may remain on Site from March to November. We did not employ temporal use factors because there is no empirical evidence that a three-month interruption in exposure reduces a chronic toxic response.

American robin are representative species because they:

- Have a high exposure to chemicals in soil through their ingestion of worms, and other sediment/soil invertebrates;
- Have a small home range; and
- Occur on Site.

The short-tailed shrew (*Blarina brevicauda*) is a voracious predator of small invertebrates and other vertebrates. They occur in timbered and open habitat, and are especially common along stream banks and meadows with tall grass. Earthworms are the major prey, but they also eat millipedes, insects and occasional mice and voles. For this assessment, it was assumed that the food in their diet consisted of 100% earthworms.

Short-tailed shrew are representative species because they:

- Represent small predatory mammals at the Site;
- Have a high exposure to chemicals in soil through their ingestion of earthworms, and other sediment/soil invertebrates; and
- Are likely to occur in the study area.

2.8.2 Aquatic and Semi-aquatic Receptors

Warm-water Fish

Warm-water fish are potential receptor species at the Site because they:

- Can forage at the Site;

- Can be exposed to contaminated sediments and surface waters;
- Can be exposed through consumption of contaminated prey items, such as benthic invertebrates and other small fish; and
- Occur in the Site area.

The bluegill (*Lepomis macrochirus*) is medium-sized fish in the sunfish family. Although not native to Massachusetts, these species has adapted to many freshwater habitats. The diet of this species and other sunfish consists of small worms, insects, and crustaceans. Bluegills can live up to 6 years.

The redfin pickerel (*Esox americanus americanus*) is a close relative of the chain pickerel. Redfin pickerel can be distinguished by their reddish fins and rear-facing teardrop. Redfin pickerel live in the same waters as the chain pickerel, but are more tolerant of murky waters of beaver ponds and swamps. Redfin pickerel will rarely grow longer than one foot. The diet of this fish consists of small fish and to some extent aquatic insects and various other invertebrates.

The white sucker (*Catostomus commersoni*) is a common bottom feeder in large streams or weedy areas of lakes. The diet of this fish consists of crustaceans and insect larvae, mollusks and algae in bottom ooze. This fish can reach 20 inches in length.

The American eel (*Anguilla rostrata*) lives in rivers and streams hidden under rocks or burrowed into the mud. Eels consume aquatic insects, crustaceans and fish. This species can live from 5 to 20 years.

These fish species were selected for analysis of concentrations of COPECs in their tissues. The tissue concentrations are used to assess potential adverse effects to the fish themselves as well as to consumers (e.g. piscivorous birds) of the fish.

Benthic Invertebrates as a Prey Item for Fish

Benthic invertebrates are potential receptor species at the Site because they:

- Are relatively immobile and would be exposed to chemicals in the sediment of the Site;
- Provide food for bottom-feeding fish and wildlife; and
- Are likely to occur in the Site area.

Piscivorous birds are potential receptors at the Site because they:

- Can be exposed through ingestion of contaminated prey, such as invertebrates and fish, and
- Are likely to occur in the Site area.

We considered that the incidental ingestion of sediment by piscivorous birds is negligible because these piscivores forage in the water column, not from the sediments.

The great-blue heron (*Ardea herodias*) lives in both saltwater and freshwater environments. It consumes primarily fish, though it also eats small amphibians, larger invertebrates (crabs, crayfish, etc.), insects, and occasionally small mammals (Terres, 1980). Its varied carnivorous and piscivorous diet places it high up on the food web and means that it is susceptible to adverse effects resulting from bioaccumulation of COPECs. Since it was observed in the area, it is a reasonable representative of piscivorous wading birds using the Site wetlands. For the BERA, we assume that the food in the diet of the heron consists of 100% fish from the Site and water bodies within 3.1 km of the Site (Table 3-36). Using the nine largest water bodies within this radius, we calculate an area use factor of 0.14 (Appendix D-39); therefore we assume that the great-blue heron consumes 14% of its diet on the Site.

The belted kingfisher (*Ceryle alcyon*) lives in both saltwater and freshwater environments. It consumes mostly smaller fishes, but will also eat large invertebrates (crabs, crayfish, etc.), small amphibians, insects, and mollusks. It usually nests in burrows dug in banks along water bodies (Terres, 1980). The kingfisher is chosen to represent small piscivorous birds that use the Site habitat. For the BERA, we assume that the food in the diet of the kingfisher consists of 100% fish from the Site. We conservatively did not assume either an area or temporal Site use factor.

Semi-aquatic Mammals

Semi-aquatic mammals that feed on aquatic species are potential receptors at the Site because they:

- Can be exposed through incidental ingestion of contaminated sediment;
- Can be exposed through ingestion of contaminated food items, such as invertebrates and aquatic plants; and
- Are likely to occur in the Site area.

The muskrat is a semi-aquatic large rodent that inhabits freshwater and brackish environments. It lives either on the bank of a water body or in a lodge constructed in the water body. The muskrat feeds largely on aquatic plants, but depending on location and time of year may also consume aquatic invertebrates (crayfish, crabs, etc.), small amphibians, turtles, fish, mollusks, or young birds. We assumed that the muskrat diet consists of 95% plants and 5% invertebrates.

The raccoon is likely to be present because the Site and surrounding areas consist of its preferred types of habitat (wetlands and suburban residential areas). The raccoon is known to consume aquatic invertebrates, fish, insects, mollusks, annelids, bird eggs, small passerine birds, small mammals such as squirrels, and plants (Chapman and Feldhamer, 1982). Aquatic species may make up only a small portion of the raccoon diet if other sources of food (e.g. domestic or commercial trash) are readily available. We assumed that the raccoon diet consists of 30% fish, 30% invertebrates, and 40% plants. The omnivorous raccoon is likely to eat higher concentrations of bioaccumulative COPECs because it feeds higher on the food chain (where bioaccumulation results in higher concentrations) than an herbivorous muskrat.

2.9 Complete Exposure Pathways

The potentially complete exposure pathways on the Site and adjacent, proximate, and downstream habitats include:

Aquatic invertebrates, benthic invertebrates, fish, and semi-aquatic organisms exposed to chemicals in surface water in the Neponset River and its associated wetlands and Lewis Pond through direct contact, ingestion, and uptake across the gills;

Benthic organisms exposed to chemicals in sediment in the Neponset River and its associated wetlands, Lewis Pond, and the Former Upper Mill Tailrace through direct contact and ingestion of prey;

Terrestrial plants exposed to chemicals in On-Facility surface soils through root uptake;

Terrestrial invertebrates exposed to chemicals in On-Facility surface soils through ingestion and direct contact;

Higher-level aquatic and semi-aquatic consumers exposed to chemicals in prey and plants from surface water and sediment;

Higher-level semi-aquatic mammals exposed to chemicals from incidental ingestion of sediment;

Higher-level semi-aquatic mammals exposed to chemicals from ingestion of surface water;

Higher-level terrestrial consumers exposed to chemicals in prey exposed to contaminated soil;

Higher-level terrestrial consumers exposed to chemicals from incidental ingestion of soil; and

Higher-level terrestrial consumers exposed to chemicals from incidental ingestion of surface water.

2.10 Assessment and Measurement Endpoints

Assessment endpoints are expressions of the environmental value to be protected at a site. Assessment endpoints are often not directly measurable. When this occurs, the assessment employs measures of effects. These are biological or measurable ecological characteristics that reflect the assessment endpoint (USEPA, 1997) and are usually determined using a weight-of-evidence approach that takes into consideration the strength of association between the measure of effects and assessment endpoint, data quality, and study design and execution. Table 2-3 summarizes the assessment endpoints and measurement endpoints for the BERA and the data types required for their evaluation.

2.10.1 Measurement Endpoints for Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates and fish

Aquatic invertebrates are subject to exposure to COPECs in surface water, benthic invertebrates are subject to exposure to COPECs in surface water and sediment, and fish that forage in the Neponset River or Lewis Pond are subject to exposure to COPECs in water and sediment, or by consumption of contaminated prey. Indirect effects to fish could occur if COPECs in sediments affect the abundance of macroinvertebrates that are prey for the fish.

Measurement Endpoint 1a: Surface water concentrations at or below National Recommended Water Quality Criteria (USEPA, 2004a)

Rationale: Accumulation of COPECs from surface water by the gills may have an adverse effect on the survival, growth, and reproduction of fish. COPECs in surface water may also have adverse effects on the survival, growth, and reproduction of aquatic invertebrates.

Approach: This evaluation is a comparison of measured concentrations of COPECs in Site surface water to corresponding water quality criteria, which are protective of fish and the aquatic invertebrates. For COPECs where National Recommended Water Quality Criteria (NRWQC) are not available, we compared measured concentrations in surface water to Tier II Secondary Chronic Values (Tier II SCVs) calculated using the Great Lakes Water Quality Initiative Tier II methodology in Suter and Tsao (1996).

Measurement Endpoint 1b: Exposure concentrations in fish tissue at or below published no observable adverse effects concentrations

Rationale: Fish exposed to COPECs in their diets or in water may accumulate these COPECs in their tissues. Such accumulation may result in adverse effects on the survival, growth and reproduction of the fish.

Approach: The evaluation is:

> A comparison of COPECs in whole fish from the Site to corresponding Residue Effect Levels based on measured body burdens. We used the U.S. Army Corps of Engineers' Environmental Residue Effects Database (USACE, 2004) as a source of information; and
>
> Application of the Narcosis Model (McCarty et al., 1992) to evaluate the potential for adverse effects to fish from the additive effects of hydrophobic organics.

Measurement Endpoint 1c: No significant adverse effects to benthic invertebrates from exposure to sediment

Rationale: Benthic invertebrates exposed to COPECs in their diets or in sediment may accumulate these COPECs in their tissues. Such accumulation may result in adverse effects to these animals or indirect effects on fish that consume them.

Approach: The evaluation is:

> A comparison of concentrations of COPECs in benthic invertebrate tissue (measured in bioaccumulation tests with Lewis Pond, Neponset River and Former Upper Mill Tailrace sediments) with Residue Effect Levels obtained from the U.S. Army Corps of Engineers' Environmental Residue Effects Database (USACE, 2004), and a USEPA database (Jarvinen and Ankley, 1999); and
>
> A comparison of toxicity tests on Site sediment to control and reference area sediment toxicity tests. Specifically, the assessment used the 28-day sediment toxicity test with *Hyallela azteca,* previously described in detail in the Phase 1B-1 Remedial Investigation Work Plan (SHA, 2002). Statistically significant decreases in survival, reproduction, and growth of organisms exposed to test sediments relative to references and controls may be related to the presence of COPECs or to other factors, such as differences in sediment grain size, organic carbon content, hydrogen sulfide, pH and concentrations of ammonia. As an additional line of evidence regarding potential toxicity of sediment to benthic invertebrates, a discussion of these factors is included.

2.10.2 Measurement Endpoints for Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife

Aquatic wildlife that forage at the Site are subject to exposure to COPECs through ingestion of prey such as fish or benthic invertebrates, or by incidental ingestion of sediment during foraging.

Measurement Endpoint 2: Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife.

Rationale: Some semi-aquatic wildlife species (such as the kingfisher and heron) eat primarily fish, whereas other wildlife may eat plants (e.g., muskrat) and benthic invertebrates as a portion of their diet (e.g., raccoons). While foraging for food, some wildlife receptors (e.g., the muskrat and raccoon) incidentally consume sediment. This endpoint evaluates the potential adverse effects to wildlife species by exposure through the diet and by incidental ingestion of sediment.

Approach: The evaluation is a comparison of doses of COPEC to effect doses based on the literature. COPEC concentrations in fish were based on whole body concentrations (direct measurements or reconstructions from fillet and carcass data). Benthic invertebrates were subject to bioaccumulation testing and measurement of whole body concentrations of COPEC, and plant concentrations were modeled using literature values and concentrations of COPECs in Site sediments. Sediments were also sampled and analyzed for COPECs. The concentrations in fish, plants, benthic macroinvertebrates, and sediments were used in the multi-pathway exposure model for wildlife receptors that considers uptake of COPECs from food and sediment. Potential exposures to wildlife that use the Site habitat were compared to appropriate No Observed-Adverse-Effects-Levels (NOAELs) and Lowest Observed-Adverse-Effects-Levels (LOAELs).

2.10.3 Measurement Endpoints for Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site.

Songbirds and small mammals that forage at the Site could be exposed to COPECs by ingestion of contaminated prey items, such as soil invertebrates, or by incidental ingestion of soil that occurs while foraging.

Measurement Endpoint 3: Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife

Rationale: Some terrestrial wildlife species (e.g., American robin and short-tailed shrew) consume soil invertebrates. Ingestion of plant material may also be an exposure route, but we assumed that the worst-case exposure was through ingestion of earthworms because they have greater soil contact and higher lipid content (hence bioaccumulation potential) than plants. While foraging for food, some wildlife receptors (e.g., the robin and shrew) incidentally consume soil. This endpoint evaluates the potential adverse effects to wildlife species by exposure through the diet and by incidental ingestion of soil.

Approach: The evaluation was a comparison of dietary doses of COPECs for American Robins and short-tailed shrews to effect doses obtained from the literature. Earthworms were collected from several locations across the Site and analyzed for COPECs. Soils were also sampled and analyzed for COPECs. The concentrations in soil invertebrates and soil were used in the multi-pathway exposure model for wildlife receptors that considers uptake of COPECs from food and soil. Potential exposures to wildlife that use the Site habitat were compared to appropriate NOAELs and LOAELs.

3.0 EXPOSURE ASSESSMENT

The exposure assessment describes exposure concentrations and dietary doses of COPEC based on Site-specific considerations. Specifically, we used:

Exposure concentrations of COPECs in various environmental media (e.g. soil, sediment, surface water, and tissue); and

Estimates of dietary doses to wildlife based on a multi-media exposure model and measured concentrations in soil, earthworm tissue, sediment, fish tissue, benthic invertebrate tissue from laboratory bioaccumulation testing with Site sediment, and calculated concentrations of plant tissue.

3.1 Data Description

This BERA relies on analytical data that SHA collected and analyzed from the Site and reference areas during the Phase 1A and Phase 1B Remedial Investigations conducted in 2001 and 2002/2003, respectively, and six floodplain soil samples taken in 2006. Table 2-2 shows the samples included in each exposure area.

The BERA included Site data from analysis of samples obtained in:

Soil in four terrestrial exposure areas: the Floodplain, West of South Street, East of South Street and the Orlando Property;

Earthworms from the four terrestrial exposure areas listed above;

Lewis Pond, Neponset River, and Upper Former Mill Tailrace sediment, including sediment toxicity test data;

Neponset River[1] and Upper Former Mill Tailrace surface water;

Aquatic invertebrate tissue data from bioaccumulation tests with Lewis Pond, Neponset River and Upper Former Mill Tailrace sediments; and

Fish in Lewis Pond and the Neponset River.

The BERA included reference area data from analysis of samples obtained in:

Soil in the floodplain and an undeveloped upland area near the Neponset River southeast (upstream) of the Site;

[1] Note that the Neponset River includes the Lower Former Mill Tailrace.

Earthworms in an undeveloped upland area near the Neponset River southeast (upstream) of the Site;

Upstream Neponset River and Lower Pond sediment, including sediment toxicity test data;

Upstream Neponset River surface water;

Aquatic invertebrate tissue data from bioaccumulation tests with Upstream Neponset River and Lower Pond sediments; and

Fish in Lower Pond.

New Environmental Horizons, Inc. (NEH) performed a validation and usability review of all the data used in this Baseline Ecological Risk Assessment.

The data were treated as follows:

- Data that were rejected by NEH (i.e. "R" qualified) were not used in the risk assessment.
- If a chemical was not detected in any samples from a given exposure area and a given medium, then we did not include the chemical in the analysis of potential ecological effect for that medium in that exposure area. The analytical program included robust risk-based detection limits and a strong data validation program. Therefore, any chemicals present below detection limits are expected to be below risk-based levels.
- If a chemical was detected in one or more samples for a given exposure area, ½ the reporting limit was used for the non-detects. Upon the recommendation of NEH, in cases where the qualified non-detected result (UJ) has an reporting limit that is a method detection limit or a low-level reporting limit, due to the uncertainty in the non-detected reporting limit for these data, the "whole" reporting limit, rather than 1/2 the reporting limit, was used. This is a conservative approach based on professional judgment.
- Field replicates of soil, sediment, and earthworm samples were generally collected as "splits," rather than co-located samples. If the concentrations in the sample pair were above the detection limits, the precision requirement was used to determine how the sample pair data were treated. When the precision requirement was not met, the higher concentration measured in the sample pair was used to represent the concentration at that sampling location. When the precision requirement was met for the field replicate samples, the average concentration of the sample pair was used. If the concentrations in the sample pair were both below the detection limits, the lower of the two detection limits was used. If the concentration was detected in one of the pair but not the other, the detected concentration was used.
- Field duplicates of surface water samples were collected as separate samples at the same sampling location (co-located). If the concentrations in the sample pair were above the detection limits, the precision requirement was used to determine how the sample pair data were treated. When the precision requirement was not met for a large number of compounds in the sample pair, the sample and its field duplicate were treated as two

separate samples in the data summary statistics and the exposure point concentration calculation. When the precision requirement was met for the field duplicate samples for most of the compounds, the higher concentration in the sample pair was used to represent the concentration at that sampling location. If the concentrations in the sample pair were both below the detection limits, the lower of the two detection limits were used. If the concentration was detected in one of the pair but not the other, the detected concentration was used.

We prepared data summary statistics for COPECs in all of the media listed (Tables 3-1 to 3-26). These included: detection frequency, minimum and maximum concentration detected, average of the detected concentrations, and the minimum and maximum of the detection limits for non-detects. The 95% upper confidence limit (UCL) of the mean for the detected concentrations with a sample size of 4 or more (calculated using ProUCL™ software (USEPA, 2004b)) is shown for each medium in tables 3-32 to 3-35.

3.1.1 COPECs in Terrestrial Environment Soil and Earthworms

The BERA addresses those COPECs identified in the SLERA (Appendix A). The BERA used Site soil samples from the 0-1 foot sampling interval, except for SB-49 & SB-50 that were from the 0 to 4 foot interval (Figures 3-1a and 3-1b). All the soil samples were collected as part of the Phase 1A sampling except for three soil samples (FP-05/0-1, FP-06/0-1, FP-09/0-1) from the Floodplain exposure area that were collected during the Phase 1B RI. We also used composite soil samples (FPW-1, FPW-2, FPW-3) collected as part of the Phase IB RI earthworm sampling.

Soil samples were collected from the four terrestrial exposure areas. We did not use data derived from the analysis of samples from under buildings, pavement or from the Area of Containment (which has a 2.5 feet soil cap) because these areas are ecologically inaccessible. Chemicals detected only in inaccessible areas were not included as COPECs in the BERA.

Soil samples from the Site collected during Phase 1A sampling were analyzed for VOCs, SVOCs, PAHs, metals, cyanide, polychlorinated biphenyls (PCBs), pesticides and total organic carbon (TOC). Soil samples collected at floodplain sampling locations during Phase 1B sampling were analyzed for PAHs and two SVOCs, metals, TOC, grain size and percent solids. The matching soil samples collected during earthworm sampling were analyzed for metals, PAHs, and other SVOCs identified as COPECs in terrestrial environments at the Site. Cyanide, PCB's and pesticides were screened out as COPECs. Therefore, they are not considered further in this report.

Soil

Tables 3-1 through 3-4 present the summary statistics for the measured COPECs detected in soil from four terrestrial environments:

Table 3-1 presents the summary statistics for the COPECs detected in soil from the Floodplain;

Table 3-2 presents the summary statistics for the COPECs detected in soil from the area West of South Street;

Table 3-3 presents the summary statistics for the COPECs detected in soil from the area East of South Street;

Table 3-4 presents the summary statistics for the COPECs detected in soil from the Orlando Property; and

Table 3-5 presents the summary statistics for the COPECs detected in soil from the Soil Reference Area, including ten samples from the floodplain reference area and three samples from an upland area southeast (upstream) of the Site. The ten floodplain samples were individual grabs from 0 to 6 inches below the ground surface (bgs). Three of the samples were composite samples (approximately three to six subsamples per composite) co-located with earthworm samples from no more than six inches bgs. The reference area grab samples were analyzed for VOCs, SVOCs, PAHs, metals, weak acid dissociation (WAD) cyanide, AVS/SEM, and TOC. Soil samples co-located with earthworms were analyzed for metals and SVOCs that were identified as COPECs in terrestrial environments at the Site.

Earthworms

Personnel From The Science Collaborative collected three composite earthworm samples from each terrestrial exposure area (Figure 3-2): Floodplain, West of South Street, East of South Street, the Orlando Property downstream of the Site, and the Soil Reference Area). The composite earthworm samples were each composed of sub-samples from three to six sub-locations, and were analyzed for metals, PAHs, and other SVOCs that were identified as COPECs in soil environments at the Site. Tissue samples were also analyzed for percent lipids.

Tables 3-6 through 3-9 present the summary statistics for the soil COPECs in earthworm tissue from four terrestrial environments:

Table 3-6 presents the summary statistics for the COPECs detected in earthworm tissue from the Floodplain;

Table 3-7 presents the summary statistics for the COPECs detected in earthworm tissue from the area West of South Street;

Table 3-8 presents the summary statistics for the COPECs detected in earthworm tissue from the area East of South Street;

Table 3-9 presents the summary statistics for the COPECs detected in earthworm tissue from the Orlando Property; and

Table 3-10 presents the summary statistics for the COPECs detected in earthworm tissue from the Soil Reference Area.

3.1.2 COPEC in Aquatic Environments – Sediment, Surface Water, Benthic Invertebrates, Fish

The BERA addresses those COPECs identified in the SLERA (Appendix A).

Sediments

The sediment sampling in the aquatic environments included:

> Thirteen sediment samples in Lewis Pond (ten collected in 2001 during the Phase IA investigation, and three in 2002 during the Phase 1B investigation);
>
> Thirteen sediment samples in Neponset River (ten collected in 2001, including two from the lower Former Mill Tailrace, and three in 2002); and
>
> Four samples in the Upper Former Mill Tailrace (three collected in 2001, and one in 2002).

All sediment samples were collected from the sediment-water interface to a depth of 6 inches (Figures 3-3 and 3-5). Samples in the 2002 sampling round were collected from a subset of the 2001 sampling locations.

In the Phase 1A sampling round, sediment samples were analyzed for metals, VOCs, SVOCs, cyanide, AVS-SEM, TOC and grain size. In 2002, samples were analyzed for those VOCs, PAHs SVOCs, and metals identified as COPECs in the aquatic environments adjacent to or downstream from the Site. Cyanide was screened out as a COPEC in the SLERA. Therefore, it is not considered further in this report.

Tables 3-11 through 3-13 present summary statistics for measured COPECs from the Phase 1A and 1B investigations combined for each separate exposure area. The COPECs include only those retained by individual exposure area in the SLERA. Additional data included TOC for sediment and surface water (Table 3-27), pH in sediment samples and sediment for exposure toxicity tests (Table 3-28), and ammonia in sediment samples (Table 3-29).

> Table 3-11 presents the summary statistics for the COPECs detected in sediment from the Neponset River;
>
> Table 3-12 presents the summary statistics for the COPECs detected in sediment from the Lewis Pond; and
>
> Table 3-13 presents the summary statistics for the COPECs detected in sediment from the Upper Former Mill Tailrace.

The sediment reference area for the Neponset River and the Upper Former Mill Tailrace is the upstream reach of the Neponset River (the Neponset River Reference Area), and the sediment reference area for Lewis Pond was Lower Pond. Sediment samples were analyzed for metals, VOCs, SVOCs, PAHs, cyanide, TOC and grain size. Cyanide was screened out as a COPEC in the SLERA. Therefore, it is not considered further in this report.

Table 3-14 presents the summary statistics for the COPECs detected in sediment from the Neponset River Reference Area; and

Table 3-15 presents the summary statistics for the COPECs detected in sediment from the Lower Pond Reference Area.

Surface Water

The surface water sampling in the aquatic environments included:

Ten surface water samples from five locations in the Neponset River; and

Two samples with duplicates from one location in the Upper Former Mill Tailrace.

Surface water samples were collected in April and August of 2001 (Figure 3-3). Surface water was not collected in Lewis Pond because it was assumed that samples collected upstream in the Neponset River would represent potential concentrations discharging to surface water from on-Site sources. The various sources of urban runoff between the Site and Lewis Pond and around Lewis Pond are potential contributors to surface water chemistry. Surface water samples were analyzed for VOCs, SVOCs, PAHs, metals, cyanide, and TOC. Cyanide was screened out as a COPEC in the SLERA. Therefore, it is not considered further in this report. Measurements of pH were also made in surface water samples (Table 3-28).

Table 3-16 presents the summary statistics for the COPECs detected in surface water from the Neponset River; and

Table 3-17 presents the summary statistics for the COPECs detected in surface water from the Upper Former Mill Tailrace.

The reference area for the Neponset River and Upper Former Mill Tailrace is the reach of the Neponset River immediately upstream from the Site. Surface water samples were analyzed for VOCs, SVOCs, PAHs, metals, cyanide, and TOC. Cyanide was screened out as a COPEC in the SLERA and. therefore, is not considered further in this report.

Table 3-18 presents the summary statistics for the COPECs detected in surface water from the Neponset River Reference Area.

Aquatic Invertebrates

Aquatec Biological Sciences performed 28-day bioaccumulation tests with the test organism *Lumbriculus variegatus* (EPA/600/R-99/064 Method 100.3) using three sediment samples from Lewis Pond, three sediment samples from the Neponset River, and one sediment sample from the Upper Former Mill Tailrace. The Bioaccumulation Test Report is included in Appendix C-1. Chemicals analyzed in invertebrate tissue include metals, PAHs, and other SVOCs identified as COPECs in aquatic environments during the COPEC screening step of this analysis, and percent

lipids. VOCs were not analyzed because they are unlikely to bioaccumulate in invertebrate tissue.

Table 3-19 presents the summary statistics for the COPECs detected in benthic invertebrates subjected to bioaccumulation testing with sediments from the Neponset River;

Table 3-20 presents the summary statistics for the COPECs detected in benthic invertebrates subjected to bioaccumulation testing with sediments from Lewis Pond; and

Table 3-21 presents the summary statistics for the COPECs detected in benthic invertebrates subjected to bioaccumulation testing with sediments from Upper Former Mill Tailrace.

The reference area for the Neponset River and the Upper Former Mill Tailrace benthic invertebrate bioaccumulation is an area in the Neponset River upstream of the Site (the Neponset River Reference Area), and the reference area for Lewis Pond is Lower Pond, in Norwood, Massachusetts. Chemicals analyzed in invertebrate tissue include metals, PAHs, and other SVOCs identified as COPECs in aquatic environments in the SLERA, and percent lipids. VOCs were not analyzed because they are unlikely to bioaccumulate in invertebrate tissue.

Table 3-22 presents the summary statistics for the COPECs detected in benthic invertebrates subjected to bioaccumulation testing with sediments from the Neponset River Reference Area; and

Table 3-23 presents the summary statistics for the COPECs detected in benthic invertebrates subjected to bioaccumulation testing with sediments from the Lower Pond Reference Area.

Table 3-30 presents the lipid data for benthic invertebrates

Fish

Whole body fish samples consisting of one individual fish per sample were submitted for analysis of metals, PAHs and other SVOCs that were identified as COPECs in aquatic environments. The VOCs were not analyzed because they are unlikely to bioaccumulate in fish tissue. COPECs were analyzed in five whole body samples collected in Lewis Pond, and four whole body samples collected in the Neponset River (Figure 3-4).

Fish samples were not collected from the Upper Former Mill Tailrace (see Section 2.3.1 for the distinction between Upper and Lower Former Mill Tailrace) because it is physically isolated, provides little habitat for supporting a permanent, resident fish population (Appendix B-1), and is frequently dry (observations by SHA personnel), and was dry during the period of fish sampling. Therefore, in terms of exposure, we did not consider the Upper Former Mill Tailrace as fishery habitat. We consider it a vegetated wetland habitat.

The Lower Former Mill Tailrace has unrestricted communication with the Neponset River, and likely supports forage fish (Appendix B-1). This lower portion is a part of the Neponset River and is included in the Neponset River evaluation.

The fish collected at the Site locations included bluegill, redfin pickerel, white sucker and American eel.

Table 3-24 presents the summary statistics for the COPECs detected in fish tissue from the Neponset River;

Table 3-25 presents the summary statistics for the COPECs detected in fish tissue from the Lewis Pond.

The fish collected at the Lower Pond Reference Area were bluegill and largemouth bass. The bluegills were analyzed as whole body samples. The largemouth bass were analyzed as fillet samples for the human health risk assessment. Only two bluegill of sufficient size for whole body analysis were collected from Lower Pond. Therefore, we estimated whole body concentrations from an analysis of the carcasses and fillets of the largemouth bass that were filleted for the human health assessment. We calculated a whole body largemouth bass concentration for each analyte as:

$$Whole\ Body\ Concentration = \frac{(Concen._{Fillet} * Mass_{Fillet}) + (Concen._{Carcass} * Mass_{Carcass})}{(Mass_{Fillet} + Mass_{Carcass})}$$

To estimate an average concentration for any chemical detected at least once in a given exposure area and medium we:

- Used one-half the detection limit of the non-detected samples
- Assigned a ‘U” (non-detect) qualifier to the calculated whole body concentration if a “U” qualifier was reported for the fillet and carcass data;
- Assigned a “J” (estimated) qualifier to the whole body concentration qualifier if one of either the fillet or carcass results was qualified with “U”; and
- Used benzoic acid in the carcass as a surrogate for whole body concentration because benzoic acid was analyzed in the carcass, but not in the fillet.

Table 3-26 presents the summary statistics for the COPECs detected in fish tissue from the Lower Pond Reference Area.

Fish length and weight data are presented in Table 3-31.

3.2 Exposure Scenarios

This subsection describes the exposure scenarios applied in the BERA. Each exposure is expressed as either a discrete value (dietary dose, a concentration in surface water, sediment, or biological tissue) or is a physical exposure (sediment toxicity testing).

The description of the exposure scenarios includes:

A summary of the general assumptions that identify each representative receptor, the exposure media that it encounters, the exposure route, the type of data upon which we based the exposure estimate, and the separate exposure zones (subsection 3.2.1);

Receptor profiles that expand upon the specific exposure assumptions for each representative receptor (3.2.2);

A description of the general exposure model for estimating dose to wildlife (3.2.3); and

A description of the statistic used to express the exposure point concentration or calculate the dose (3.2.4).

3.2.1 General Assumptions

Terrestrial Exposures

Within the terrestrial environments, the representative receptors included the short-tailed shrew and the American robin. The general exposure assumptions for these receptors were:

Species	Exposure Media	Exposure Route	Basis for Exposure Estimates	Exposure Zones
Short-Tailed Shrew	Earthworms; Soil; Surface Water	Ingestion	Measured COPEC concentrations in earthworms and soil	East of South Street; West of South Street; Orlando Property; Floodplain; Neponset River (surface water)
American Robin	Earthworms; Soil; Surface Water	Ingestion	Measured COPEC concentrations in earthworms and soil	East of South Street; West of South Street; Orlando Property; Floodplain; Neponset River (surface water)

Aquatic Exposures

Within the aquatic environment, the representative receptors included: Fish, Benthic Invertebrates, Great Blue Heron, Kingfisher, Muskrat, and Raccoon. The general exposure assumptions for these organisms included:

Species	Exposure Media	Exposure Route	Basis for Exposure Estimates	Exposure Zones [a]
Fish	Surface water	Ingestion; Direct Contact	Measured COPEC concentrations in surface water and fish tissue	Neponset River and Lewis Pond
Benthic Invertebrates	Sediment	Ingestion; Direct Contact	Measured COPEC concentrations in tissue from bioaccumulation testing; direct exposure to sediment in toxicity testing	Neponset River; Lewis Pond; Upper Former Mill Tailrace

Species	Exposure Media	Exposure Route	Basis for Exposure Estimates	Exposure Zones [a]
Great Blue Heron	Fish	Ingestion	Measured COPEC concentrations in fish whole body tissue	Neponset River; Lewis Pond
Kingfisher	Fish	Ingestion	Measured COPEC concentrations in fish whole body tissue	Neponset River; Lewis Pond
Muskrat	Aquatic Plants; Benthic Invertebrates; Sediment;	Ingestion	Calculated COPEC concentrations in plants; Measured COPEC concentrations in benthic invertebrates and sediment	Neponset River; Lewis Pond; Upper Former Mill Tailrace
Raccoon	Aquatic Plants; Benthic Invertebrates; Sediment; Fish	Ingestion	Calculated COPEC concentrations in plants; Measured COPEC concentrations in fish, benthic invertebrates, and sediment	Neponset River; Lewis Pond

[a] the Lower Former Mill Tailrace is part of the aquatic habitat in the Neponset River and we incorporated samples from that area into our exposure analysis of the Neponset River. We also addressed exposure to sediment in the Lower Former Mill Tailrace alone as part of the uncertainty analysis.

3.2.2 Receptor Profiles

The receptor profiles summarize the parameters and assumptions for calculating an average daily dose of a chemical to a particular receptor. These parameters are body weight, normalized food ingestion rate, normalized sediment ingestion rate, main dietary components, and foraging ranges. Foraging ranges of all receptors except the Great Blue Heron were assumed to be less than or equal to the size of the site. We did not apply temporal use factors because there is no empirical evidence that a temporal interruption in exposure reduces a chronic toxic response. We used a profile for the female of a species if it was separately available because they tend to be more sensitive to chemicals as a result of reproductive differences (Sample and Suter, 1994).

The Wildlife Exposure Factor Handbook (USEPA, 1993) provides ranges of typical body weights, ingestion rates of water, food, sediment, as well as foraging areas for many wildlife species. Sample and Suter (1994) provide default values of these parameters for several species, including the American robin, Great Blue Heron, and short-tailed shrew. In some cases, the Wildlife Exposure Factor Handbook lists several values for a particular parameter. In those cases, we specified the study from which the value was selected. When neither the Wildlife Exposure Factor Handbook nor Sample and Suter (1994) provide information on a particular parameter of a receptor (e.g., percentage of sediment/soil in the diet) we consulted and specified other sources.

Tables 3-36 and 3-37 summarize profiles for the aquatic and terrestrial receptors respectively. Note that:

- Food ingestion rates were normalized to body weight;
- Beyer et al. (1994) provides the percentage of sediment/soil in diet for the raccoon;
- We assumed that the rates of incidental sediment ingestion for the Great Blue Heron and the belted kingfisher are negligible because they prey upon fish in the water column;
- From the normalized food ingestion rate (IR_{food}) and percentage of sediment/soil in diet, the normalized sediment/soil ingestion rate was determined.

3.2.3 General Food Chain Model

We estimated exposure doses of COPEC to wildlife and piscivorous birds that:

- Are bioaccumulative (note that the VOCs do not meet this criteria);
- Have sufficient information to allow estimates of concentrations in food; and
- Have available toxicity endpoints expressed as a dose.

The general model for estimating doses of COPECs to songbirds, aquatic birds, and small mammals is:

$$ExposureDose_{(oral)} = [(Conc_{food} * IR_{food}) + (RAF * Conc_{soil/sediment} * IR_{soil/sediment}) + (Conc_{sw} * IR_{water}) * a / f_a$$

where:

Exposure $Dose_{(oral)}$	=	receptor's daily dose of a COPEC (mg/kg-day);
$Conc_{food}$	=	Exposure point concentration of the COPEC (mg/kg wet) in the food (estimated);
IR_{food}	=	Daily food ingestion rate normalized to body weight (kg/kg-day) expressed in terms of wet weight/wet weight;
RAF	=	Relative availability factor for COPECs in soil/sediment via incidental ingestion of wetland soil; in this case 100% availability of COPECs in soil is assumed (RAF = 1);
$Conc_{soil/sediment}$	=	Exposure point concentration of the COPEC (mg/kg dry weight) in the relevant exposure zone;
$IR_{soil/sediment}$	=	Daily incidental ingestion rate of soil/sediment normalized to body weight (kg/kg/day) expressed in terms of dry weight/dry weight;
$Conc_{water}$	=	Exposure point concentration of the COPEC (mg/liter) in water;
IR_{water}	=	Daily incidental ingestion rate of water normalized to body weight (l/kg/day) expressed in terms of wet weight/dry weight
A/fa	=	Area of the Site (or region of interest within the Site)/total foraging area of the receptor. Where this ratio is greater than 1, it defaults to 1.

3.2.4 Exposure Point Concentrations

For acute exposures, we used the maximum exposure point concentration in each medium for each exposure zone. We used the 95% upper confidence limit (UCL) on the mean concentration in each medium in each exposure zone as the exposure point concentration for chronic exposure. We used the Central Tendency Exposure (CTE) to estimate the potential for adverse ecological effects and a Reasonable Maximum Exposure (RME) as an estimate to help express confidence in that estimation.

We calculated the CTE by:

- Calculating the 95% UCL on the mean using ProUCL™ software if 4 or more samples were available,
- Comparing the 95% UCL to the maximum detected concentration, and
- Using the 95% UCL as the CTE concentration or using the average concentration if the 95% UCL exceeds the maximum detected concentration.
- The average concentration was used if 3 or fewer samples were available for UCL calculation.

We calculated the RME by:

- Calculating the 95% UCL on the mean using ProUCL™ software if 4 or more samples were available,
- Comparing the 95% UCL to the maximum detected concentration, and
- Using the 95% UCL as the RME concentration or using the maximum detected concentration if the 95% UCL exceeds the maximum detected concentration.
- The maximum concentration was used if 3 or fewer samples were available for UCL calculation.

The exposure point concentrations (EPCs) for each COPEC were the 95% UCL, maximum detected, or average concentrations within each medium and exposure zone [Tables 3-6 through 3-10 (worms), 3-19 through 3-23 (benthic invertebrates), 3-32 through 3-35 (soil, sediment, surface water, fish)].

Where there was a potential for adverse ecological effects (see Section 5), EPCs for those COPECs were developed for corresponding reference Site media.

Exposure Point Concentrations – Short-Tailed Shrew and American Robin

For terrestrial wildlife (short-tailed shrew and American robin) the exposure estimates were calculated doses of COPEC based on CTE and RME of measured concentrations in earthworms and soil in each exposure zone.

Exposure Point Concentrations – Fish and Benthic Invertebrates

For fish and benthic invertebrates, the exposure estimates were based on concentrations of COPECs measured and detected in whole body tissue.

For piscivorous birds and semi-aquatic wildlife (Great Blue Heron, Kingfisher, Muskrat, and Raccoon) the exposure estimates were calculated doses of COPEC based on their measured concentrations in fish, benthic invertebrates, and sediment, as appropriate. The exposures from plant tissue were calculated based on a literature-derived biota-sediment accumulation factor (BSAF) specific to plants applied to the sediment exposure point concentration in each exposure zone.

Acute Exposure to Mammals

We calculated acute exposure to mammals (the only group for which corresponding acute toxicity data are broadly available). The acute exposure case assumes constant exposure to maximum fish, invertebrate, plant, and sediment concentrations of COPECs. The exposure concentrations in plant tissue were the product of a BSAF for plants and the maximum sediment exposure point concentration in each exposure zone.

Exposure to Aquatic Plants – Estimated Concentrations

We modeled COPEC concentrations in aquatic plants using BSAFs specific to plants. The $BSAF_{plant}$ value is the ratio of the concentration in plants to the concentration in sediment. The calculated concentration in plants is the product of the concentration in sediment and the $BSAF_{plant}$ value. Massachusetts Department of Environmental Protection (MADEP) (1995) summarizes the literature for $BSAF_{plant}$ values for common contaminants in soil. For chemicals for which MADEP does not provide a plant uptake factor, we used values from Baes et al. (1984). BSAFs were available for all metal COPECs but not organic COPECs. We assumed:

- Sediment-to-plant concentration factors are the same as soil-to-plant concentration factors because wetland plants and aquatic rooted plants are in intimate contact with moist or wet soil particles and generally translocation through the roots is the major exposure route;
- The highest available BSAF reported for different plant species and/or tissues provides a conservative estimate of uptake into aquatic or semi-aquatic plant tissue; and
- A plant moisture content of 80% (Sample and Suter, 1994).

The CTE and RME sediment EPCs for each aquatic location (Neponset River, Lewis Pond and Upper Former Mill Tailrace) were multiplied by the chemical-specific $BSAF_{plant}$ to develop the aquatic plant EPCs (Table 3-38) for use in the chronic food chain models.

The maximum sediment EPCs for each aquatic location (Neponset River, Lewis Pond and Upper Former Mill Tailrace) were multiplied by the chemical-specific $BSAF_{plant}$ to develop the aquatic plant EPCs (Table 3-39) for use in the acute food chain models.

Where there was a potential for chronic or acute adverse effects to the herbivorous receptors at the Site (see Section 5), EPCs for those COPECs were developed for reference Site media. The CTE and RME sediment EPCs (for chronic food chain models) and maximum sediment EPCs (for acute food chain models) for the reference areas were also multiplied by the BSAFs to develop aquatic plant EPCs (Tables 3-40 and 3-41).

4.0 EFFECTS ASSESSMENT

This section presents the methods and information incorporated into:

- The assessment of those specific doses (Toxicity Reference Values or TRVs), surface water concentrations (National Recommended Water Quality Criteria, USEPA, 2004a), and tissue concentrations (Residue Effect Levels) of a COPEC that indicate a potentially adverse effect;
- Estimated toxicity or adverse effects associated with the additive effects of specific categories of COPEC (Narcosis Model); and
- The levels of toxicity estimated from direct experimental exposure to sediment.

These effect levels or estimates of toxicity provide an external comparison to the corresponding estimated exposure doses, measured concentrations in surface water, measured concentrations in tissue levels, or measured toxicity. Ultimately, this comparison provides a basis for quantitative estimation of potential adverse effects.

4.1 Assessment of Media and Tissue Concentrations and Dietary Doses

4.1.1 TRVs for Dietary Doses to Birds and Mammals

The TRVs include chronic and acute (for mammals only) NOAELs and LOAELs for the avian and mammalian species derived from laboratory studies and reported in the literature. The NOAEL is the highest dose of a particular chemical at which no adverse effects are observed in the test species. The LOAEL is the lowest dose of a particular chemical at which adverse effects are observed in the test species. NOAELs and LOAELs are daily doses of chemicals expressed in mg/kg/d.

Data Sources

The preferred source for TRVs for birds and mammals in this assessment was Sample et al. (1996). If an avian TRV was unavailable for a specific COPEC in Sample et al., we obtained it from the USEPA ECOTOXicology on-line database, USEPA-Office of Pesticide Effects Database, and/or other scientific literature.

If mammalian TRVs were not available in Sample et al. (1996), we obtained them from the latest versions of toxicological profiles compiled by the Agency of Toxic Substances and Disease Registry (ATSDR), the USEPA Integrated Risk Information System (IRIS), and/or scientific literature.

For chronic risk from nickel, we used the NOAEL TRV from USEPA's unreleased Nickel Eco-SSL document (2.03 mg/kg bw/day), and a LOAEL calculated as the geometric mean of all reproductive and growth LOAELs from Table 6-1 in the Nickel Eco-SSL document (12.1 mg/kg bw/day). For the acute risk calculations, we calculated a NOAEL as the geometric mean of all reproductive and growth NOAELs from studies with durations of 5 days or less reported in Table 6-1 of the Nickel Eco-SSL document (57 mg/kg bw/day).

Selection of TRVs

We obtained TRVs from studies that met the following criteria:

- Close taxonomic relationship between the test species and the receptor species;
- Ecologically relevant endpoints – Endpoints, such as reproduction, development, growth, and mortality, were chosen because they can lead to population-level effects;
- Appropriate exposure duration – Acute studies of 10 days for birds and 20 days for mammals, and chronic studies longer than 70 days for birds and 1 year for mammals or for shorter periods during critical life stages; and
- Appropriate exposure route – Studies in which the test species received the chemical dose by diet were preferred to those in which the test species received an oral capsule or by gavage.

If only subchronic studies were available for selecting chronic TRVs, an Acute to Chronic Ratio of 10 (Sample et al., 1996) was applied. If the authors of a selected study provided only a LOAEL, then the LOAEL was divided by a factor of 10 to estimate a NOAEL.

Tables 4-4 and 4-5 list chronic, COPEC-specific NOAELs and LOAELs for the avian and mammalian receptors, respectively. Table 4-6 lists acute, COPEC-specific NOAELs and LOAELs for mammalian receptors.

Potential adverse effects from exposure to COPECs for which toxicological studies were not available could not be evaluated. COPECs for which TRVs are unavailable are discussed in the uncertainty section (Section 5.4) of this Report.

Extrapolation of TRVs

Not many toxicity studies exist for the raccoon, shrew and muskrat, therefore TRVs (either NOAEL or LOAEL) were derived from rat and mouse studies using this allometric relationship described by Sample et al. (1996):

$$NOAEL_w = NOAEL_t \{bw_t/bw_w\}^{1/4}$$

where:

$NOAEL_w$ is the NOAEL for the wildlife species in question;

$NOAEL_t$ is the NOAEL for the test species;

bw_t is the body weight of the test species; and

bw_w is the body weight of the wildlife species in question.

Note that smaller animals will have higher NOAELs because, according to Sample et al. (1996),

the smaller animals tend to have higher metabolic rates and are more resistant to toxic chemicals.

Consistent with USEPA's *Eco-SSL Standard Operating Procedure (SOP) # 6: Derivation of Wildlife Toxicity Reference Value (TRV)* (USEPA, 2003), we did not calculate species-specific nickel TRVs using an allometric adjustment to account for interspecies sensitivity. Since the nickel TRVs are derived from several studies with different test species, a body weight for the test species is not available to make this adjustment. USEPA states in their SOP #6 document (USEPA, 2003) that the Wildlife TRV database does not currently have enough information to develop an approach to predict interspecies sensitivity to nickel. Therefore, we used the same nickel TRVs for all mammalian wildlife receptors.

4.1.2 Surface Water Benchmarks

Table 4-1 shows the surface water benchmarks for COPECs detected at the Site. Surface water criteria are not available for the following surface water COPECs: barium, cobalt, manganese, vanadium, PAHs, 2-butanone (MEK), and 4-nitroaniline.

4.1.3 Residue Effect Levels in Fish and Aquatic Invertebrates

Residue Effect Levels for aquatic life are based on body burdens of COPECs in animal tissues that correspond with observed toxicological effects.

Data Sources

The US Army Corps of Engineers Engineering Research and Development Center (ERDC), developed the Environmental Residue Effects Database (ERED) (US Army Corps of Engineers - USACE, 2004). The ERED compiles reports from the literature on adverse effects of chemicals based on their whole body concentrations in aquatic organisms. The database consists of such information for various fresh and saltwater species of fish and invertebrates. The ERDC conducts a quality control review on entries and updates the database annually. USEPA provides a similar database compiled (Jarvinen and Ankley, 1999). This BERA used both sources for development of Residue Effect Levels for organic and inorganic chemicals.

Selection of Residue Effect Levels

Figure 4-1 depicts the decision process for selecting fish and invertebrate Residue Effect Levels. Because the Site is a freshwater habitat, only studies of freshwater species were considered. If the selected study provided only a Lowest-Observed-Effect-Dose (LOED), then the LOED was divided by a factor of 10 to estimate a No-Observed Effect Dose (NOED). This method was applied to both fish and invertebrate species. Tables 4-2 (fish) and 4-3 (benthic invertebrates) present the test species, residue effect level, observed effect, literature reference, and other information.

The potential for cumulative adverse effects from PAHs and other semi-volatile organic compounds was assessed through the application of the Narcosis Model (see Section 4.2 for details).

4.2 Estimated Toxicity or Adverse Effects Associated with the Additive Effects of Specific Categories of COPECs (Narcosis Model)

The assessment uses the narcosis model to assess the potential effects of PAHs and hydrophobic organics in fish. The narcosis model is preferred to a TRV approach because:

- The narcosis model addresses cumulative effects of non-polar compounds;
- The primary mode of action of the organic COPECs is narcosis; and
- Few tissue-based TRVs are available for these compounds

Narcosis due to organic chemicals in aquatic organisms is defined as a nonspecific reversible disturbance in the function of the cell membrane caused by the accumulation of chemicals in the hydrophobic phases of the organism (van Wezel and Opperhuizen, 1995). Experimental work demonstrated that the critical body residue for the acute lethal effect of nonpolar narcotic chemicals is fairly constant at 2 to 8 mmol chemical/kg wet weight tissue (McCarty, 1991). Measured concentrations of COPECs in fish tissues are used to determine the wet weight body burdens of organic compounds. A potential for acute adverse effects is predicted for those wet weight body burdens of organic compounds greater than 2 mmol chemical/kg wet weight. We assumed that a concentration of 0.2 to 0.8 mmol chemical/kg wet weight is protective of the chronic narcotic effects of organic chemicals in fish tissues.

4.3 Sediment Toxicity

A 28-day sediment toxicity test was performed with the freshwater amphipod *Hyalella aztecta (Method 100.4HA28; see Appendix C-2 for the toxicity report).* Seven surficial (0-6 inches) samples were tested: two from the Neponset River, one from Lewis Pond, one from the Upper Former Mill Tailrace, one from the Neponset River Reference Area, and two from the Lower Pond Reference Area. Eight replicates were made for each sample and the results were averaged. The endpoints of interest for this test were survival, reproduction and growth because these endpoints may directly affect the abundance of benthic invertebrates that serve as a prey base for fish (Endpoint 1)

In addition to sediment toxicity tests, some of the factors that control sediment toxicity were evaluated, including sulfide, TOC, and pH. Sulfide and TOC can reduce the toxicity of metals in sediment by reducing their availability to invertebrates. We calculated (SEM-AVS)/f_{oc} values for all sediment samples for which data was available and evaluated toxicity based on USEPA (1999) guidelines. USEPA (1999) has identified a toxicity scale based on observations from the literature. According to this scale, if the excess SEM exceeds 3,000 umol/ g_{OC}, the sediments are "likely to be toxic" to benthic invertebrates. If the excess SEM is between 130 umol/ g_{OC} and 3,000 umol/ g_{OC} the sediments are of "uncertain toxicity", and if the amount of excess SEM is less than 130 umol/ g_{OC} the sediments are "unlikely to be toxic" to benthic invertebrates (USEPA, 1999). It is important to note that excess SEM may be present and available to biota, but can be at levels below those that cause toxicity. This analysis is presented in subsection 5.1.3.2. TOC and pH data are presented in Tables 3-27 and 3-28, respectively.

High levels of pH can influence sediment toxicity due to mobilization of metals and increase sediment toxicity by increasing ammonia (NH_3) concentrations (see discussion in section 5.4.3.2). Ammonia and pH were measured in sediment samples and during sediment toxicity tests. Data for pH and ammonia are presented in Tables 3-28 and 3-29, respectively.

5.0 RISK CHARACTERIZATION

This section compares the exposure and effects information to characterize potential adverse ecological effects relative to the stated assessment endpoints:

> Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates, and fish
>
> Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife
>
> Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site

The comparison is the ratio of exposure concentrations, doses, or body burdens to the analogous toxicity factor expressed as:

$$HQ = EPC/TF$$

where:

HQ	=	hazard quotient;
EPC	=	calculated dietary dose, measured concentration, or measured body burden reflecting exposure;
TF	=	the selected toxicity factor appropriate for the chemical and receptor (in this case NOAEL, LOAEL and effects concentrations).

Interpretation of Hazard Quotients

While the BERA seeks to reduce the uncertainty and conservatism of the SLERA, it includes conservative (i.e. ecologically protective) assumptions proportional to the level of uncertainty. The multiplicative nature of the exposure and food chain models compounds many of these individually conservative assumptions. Our interpretation of the hazard quotients recognizes the uncertainty and the conservatism of the BERA.

We used two pairs of individually calculated hazard quotients for each receptor to interpret potential adverse effect from chronic exposure to each COPEC in each exposure area. These pairs included an HQ based on comparison of a NOAEL or NOED and a LOAEL or LOED to an EPC derived from:

- The CTE case; and
- The RME case.

The CTE case is the basis for the chronic risk conclusions, but the CTE and the RME cases contribute to judgments about the level of confidence in the risk conclusions. It is our opinion that a compound whose HQ exceeds 1 based on the RME, but not the CTE case, does not

represent a potential risk but rather No Significant Risk (NSR) because the assessment incorporates multiple levels of conservative elements.

Each characterization of potential adverse ecological effects includes a statement of risk level as either No Significant Risk (NSR) or Potential Risk and an accompanying statement of confidence (high, moderate, low). The characterization assumes "potential adverse ecological effect" and "risk" are the same, although there is no probability of incremental change associated with the former.

The following matrices provide the interpretation of the possible combinations of HQs. In the matrices:

N = an HQ based on comparison of the results of a case to its appropriate NOAEL or NOED; and,

L = an HQ based on comparison of the results of a case to its appropriate LOAEL or LOED.

Interpretive Matrix - Chronic

Central Tendency (CTE)	Reasonable Maximum (RME)	Risk Conclusion	Confidence Level
N ≤1	N ≤1	NSR	High
N ≤1	N> 1 and L ≤1	NSR	High
N ≤1	N> 1 and L> 1 or NA	NSR	Moderate
N>1 and L≤1 or NA	N>1 and L≤1 or NA	Potential Risk	Low
N>1 and L≤1	N>1 and L>1	Potential Risk	Moderate
N> 1 and L> 1	N> 1 and L >1	Potential Risk	High

NA = Not Available

Interpretive Matrix - Acute

Maximum	Risk Conclusion	Confidence Level
N ≤1	NSR	High
N>1 and L≤1 or NA	Potential Risk	Low
N> 1 and L> 1	Potential Risk	High

NA = Not Available

The confidence level differs from the interpretive matrix above in cases where there was no appropriate LOED or LOAEL and we used another toxicity factor (for example, an ED50, the dose at which 50% of the population experiences an observed effect). In these cases, effects may occur at lower levels than the effect level. For this reason, the confidence level for a potential risk is reported as one level higher than shown in the matrix, and the confidence level for no significant risk is reported as one level lower.

Providing Perspective

In cases where the risk conclusion is potential risk, a comparison of HQs and/or COPEC concentrations between the Site and the reference area will be made in the Feasibility Study to provide perspective for the risk managers. This comparison does not change the conclusions regarding total site risk, but can be used to facilitate discussion of risk management.

5.1 Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates, and fish

This section presents the risk results for Assessment Endpoint 1.

The methods for characterization of each measurement endpoint include:

Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates, and fish

Measurement Endpoint	Method for Risk Characterization
Surface water concentrations at or below National Recommended Water Quality Criteria.	Comparison of Surface Water Concentrations of COPECs in Neponset River and the Upper Former Mill Tailrace to National Recommended Water Quality Criteria (or Tier II SCVs when NRWQC are not available)
Exposure concentrations in fish at or below published no observable adverse effects concentrations.	Comparison of Whole Body Fish Tissue Concentrations in the Neponset River and Lewis Pond to Residue Effect Levels Comparison of the results of the narcosis model for organic compounds to benchmarks
No significant adverse effects to benthic invertebrates from exposure to sediment.	Comparison of Benthic Invertebrate Tissue Concentrations in the Neponset River, Lewis Pond, and the Upper Former Mill Tailrace to Residue Effect Levels Comparison of Toxicity in Neponset River, Lewis Pond, and Upper Former Mill Tailrace sediments to laboratory controls and to reference area toxicity tests

5.1.1 Measurement Endpoint 1a: Surface water concentrations at or below National Recommended Water Quality Criteria (NRWQC)

Method of Analysis

This endpoint indicates potential adverse ecological effects from a COPEC if the maximum measured dissolved concentration exceeds its corresponding National Recommended Water Quality Criteria (or Tier II SCV when NRWQC are not available). Dissolved criteria comparisons are an accurate measure (relative to total) of the potential for toxic effects because dissolved concentrations are not affected by organic matter. Therefore, in the following analyses, we based our opinion regarding risk on the concentrations of dissolved chemicals.

Risk Characterization

This comparison indicates that there is a potential for adverse effects to aquatic invertebrates and/or fish at the Neponset River and Upper Former Mill Tailrace. There were also surface water benchmark exceedances for barium and manganese at the Neponset River Reference Area.

Exposure Zone	Results of Comparison	Opinion Regarding Potential Risk	Sources of Uncertainty
Neponset River (Table 5-1) [a]	Aluminum – total; Barium – total and dissolved; Cadmium - total and dissolved; Chromium – total; Copper - total and dissolved; Iron – total; Lead – total and dissolved; Manganese – total and dissolved; Nickel - total; Vanadium – total and dissolved; Zinc – total; Benzo(a)anthracene and Benzo(a)pyrene exceed their NRWQC or Tier II SCV.	There is potential risk to aquatic invertebrates and fish from exposure to dissolved barium, copper, lead, manganese, and vanadium; and Benzo(a)anthracene and Benzo(a)pyrene in surface water in the Neponset River.	NRWQC and Tier II SCVs do not exist for all COPECs. The detection limit for dissolved cadmium exceeds its NRWQC.
Upper Former Mill Tailrace (Table 5-2)	Aluminum – total; Barium – total and dissolved; Copper – total and dissolved; Iron – total; Lead – total and dissolved; Manganese – total; Vanadium – total and dissolved; Nickel – total; Zinc– total; Benzo(a)anthracene and Benzo(a)pyrene exceed their respective NRWQC or Tier II SCV.	There is potential risk to aquatic invertebrates from exposure to dissolved barium, copper, lead, and vanadium; Benzo(a)pyrene and Benzo(a)anthracene in surface water in the Upper Former Mill Tailrace. There is no potential for adverse effects to fish at the Upper Former Mill Tailrace because the area is not habitat for fish.	NRWQC and Tier II SCVs do not exist for all COPECs. The detection limits for cadmium exceed NRWQCs.
Neponset River Reference Area (Tables 5-1 and 5-2)	Barium – total and dissolved and Manganese – total exceed their respective Tier II SCVs at the Neponset River Reference Area	There is potential risk to aquatic invertebrates and fish from exposure to dissolved barium in surface water in the Neponset River Reference Area.	NRWQC and Tier II SCVs do not exist for all COPECs. The detection limits for cadmium, lead, and benzo(a)anthracene exceed their respective NRWQCs or Tier II SCVs.

[a] It is assumed that samples collected in the Neponset River represent potential concentrations discharging to surface water from on-Site sources and thus represent potential exposures for receptors in Lewis Pond downstream of the Site.

The NRWQC for pH for chronic freshwater exposures is 6.5 – 9 standard units. In addition, Class B Massachusetts water quality criteria (314 CMR 4.05(3)(b)(3) specify that the pH "shall be in the range of 6.5 to 8.3 standard units and not more than 0.5 units outside of the background range". As shown in Table 3-28, pH measurements in one Neponset River surface water sample

(SW-105/08-01-01), and one surface water sample collected from the Lower Former Mill Tailrace (SW-107/08-01-01) exceeded the Class B Massachusetts water quality criterion of 8.3. Also, surface water pH measurements in the Upper Former Mill Tailrace (samples SW-106/03-20-01, and SW-106/04-04-01) exceeded the NRWQC of 9.0 for chronic exposures, as well as the Class B Massachusetts water quality criterion of 8.3.

5.1.2 Measurement Endpoint 1b: Exposure concentrations in fish at or below published no observable adverse effects concentrations

The evaluation methods for this measurement endpoint were:

- A comparison of measured or reconstructed whole body tissue concentrations of COPECs (metals) in fish to corresponding residue effects levels;
- Application of the narcosis model to measured or reconstructed whole body tissue concentrations of organics.

5.1.2.1 Comparison of Whole Body Fish Tissue Concentrations of COPEC Metals to Residue Effect Levels

Method of Analysis

We characterized potential adverse ecological effects from exposure to whole body concentrations of COPEC metals in the Neponset River (Table 5-3) and Lewis Pond (Table 5-4) by comparing the measured concentrations to residue effect levels and applying the interpretive matrix provided in Section 5.0. Table 5-4 also shows the results for corresponding COPECs at the Lower Pond Reference Area.

Risk Characterization

In the Neponset River, whole body concentrations of zinc exceeded NOED for the CTE and RME scenarios.

Interpretive Matrix -Neponset River – Whole Fish Tissue COPECs

COPECs with N or L > 1 (Table 5-3)	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Zinc	N(4) L(0.4)	N(6) L(0.6)	Potential risk	Low	Food ingestion; uptake across gills	Residue effect levels do not exist for all COPECs.

HQ = Hazard Quotient
N = NOED Hazard Quotient>1
L = LOED Hazard Quotient>1
NSR = No Significant Risk

In Lewis Pond, whole body concentrations of aluminum and zinc exceeded NOEDs for the CTE and RME scenarios:

Interpretive Matrix – Lewis Pond – Whole Fish Tissue COPECs

COPECs with N or L > 1 (Table 5-4)	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Aluminum	N (2)	N (2)	Potential Risk	Low	Food ingestion; uptake across gills	Residue effect levels do not exist for all COPECs.
Zinc	N (8), L (0.8)	N (8), L(0.8)	Potential risk	Low	Food ingestion; uptake across gills	

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in the Neponset River and Lewis Pond:

Interpretive Matrix – Lower Pond Reference Area Fish (Reference Area for Lewis Pond and Neponset River Fish) – Whole Fish Tissue COPECs

COPECs (Table 5-4)	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Aluminum	N (1)	N (1)	NSR	High	Food ingestion; uptake across gills	Residue effect levels do not exist for all COPECs.
Zinc	N (4), L (0.4)	N (4), L (0.4)	Potential risk	Low	Food ingestion; uptake across gills	

5.1.2.2 Narcosis Model

Method of Analysis

We calculated wet weight body burdens of hydrophobic organic COPECs (PAHs and other SVOCs) in fish and compared them to the critical body residue for the acute lethal effect of nonpolar narcotic chemicals of 2 mmol chemical/kg wet weight and the critical body residue for chronic narcotic effects of 0.2 mmol chemical/kg wet weight.

Risk Characterization

Table 5-5 presents the results of applying the narcosis model to the CTE and RME concentrations of organic compounds in whole body fish tissue. The data indicate that the CTE and RME concentrations of organic compounds in fish tissue did not exceed 2 mmol/kg for acute effects or 0.2 mmol/kg for chronic effects. This measurement endpoint indicates no potential effect upon fish in the Neponset River or Lewis Pond from exposure to organic compounds.

5.1.3 Measurement Endpoint 1c: No significant adverse effects to benthic invertebrates from exposure to sediment.

The evaluation methods for this measurement endpoint were:

- A comparison of measured whole body tissue concentrations of COPECs in benthic invertebrates subjected to bioaccumulation testing with sediments to corresponding residue effects levels; and
- Chronic toxicity tests with a freshwater amphipod to evaluate whether sediments can support a benthic community.

5.1.3.1 Comparison to Residue Effect Levels Values for Metals

Method of Analysis

We characterized potential for adverse effects from whole body concentrations of COPEC metals in benthic invertebrates in the Neponset River (Table 5-6), Lewis Pond (Table 5-7), and the Upper Former Mill Tailrace (Table 5-8) using the interpretive matrix provided in Section 5.0. Whole body concentrations for benthic invertebrates were determined following bioaccumulation tests using *Lumbriculus variegatus*.

Risk Characterization – Neponset River

At the Neponset River (Table 5-6), nickel exceeded its NOED for the CTE and RME scenario:

Interpretive Matrix -Neponset River – Invertebrate Tissue from Bioaccumulation Testing

COPECs with N or L > 1	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Nickel	N(6) L(0.6)	N(8) L(0.8)	Potential Risk	Low	Ingestion, Direct Contact	The Effect Level for Ni is based on an ED50 and the NOED is an estimated value. Residue effect levels do not exist for all COPECs

Risk Characterization – Lewis Pond

At Lewis Pond (Table 5-7), benthic invertebrate whole body concentrations of nickel exceeded the LOED and NOED residue effect levels for the CTE and RME scenarios:

Interpretive Matrix –Lewis Pond - Invertebrate Tissue from Bioaccumulation Testing

COPECs with N or L > 1	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Nickel	N (20), L (2)	N (30), L (3)	Potential Risk	High	Ingestion, Direct Contact	The Effect Level for Ni is based on an ED50 and the NOED is an estimated value. Residue effect levels do not exist for all COPECs.

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in Lewis Pond:

Interpretive Matrix – Lower Pond Reference Area – Invertebrate Tissue from Bioaccumulation Testing

COPECs with N or L > 1	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Nickel	N (8), L (0.8)	N (8), L (0.8)	Potential risk	Low	Ingestion, Direct Contact	Based on one sample. The Effect Level for Ni is based on an ED50 and the NOED is an estimated value. Residue effect levels do not exist for all COPECs.

Risk Characterization – Upper Former Mill Tailrace

At the Upper Former Mill Tailrace (Table 5-8), the benthic invertebrate whole body concentration of nickel exceeded the NOED residue effect levels.

Interpretive Matrix – Upper Former Mill Tailrace - Invertebrate Tissue from Bioaccumulation Testing

COPECs with N or L > 1	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Nickel	N (8), L (0.8)	N (8), L (0.8)	Potential Risk	Low	Ingestion and Direct Contact	Based on one sample; The Effect Level for Ni is based on an ED50 and the NOED is an estimated value; Residue effect levels do not exist for all COPECs.

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in the Neponset River and Upper Former Mill Tailrace:

Interpretive Matrix – Reference Area for Upper Former Mill Tailrace and Neponset River – Invertebrate Tissue from Bioaccumulation Testing

COPECs with N or L > 1	CTE Scenario (HQ)	RME Scenario (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk	Sources of Uncertainty
Nickel	N (7), L (0.7)	N (7), L (0.7)	Potential risk	Low	Ingestion; Direct Contact	Based on one sample; The Effect Level for Ni is based on an ED50 and the NOED is an estimated value; Residue effect levels do not exist for all COPECs.

5.1.3.2 Sediment Toxicity Test Results

As presented in Table 5-9, there were no instances of significant toxicity ($P<0.05$ for growth or mortality) to the freshwater amphipod *H. azteca* for any of the sediment samples collected for toxicity testing from the Neponset River (n=2), Lewis Pond (n=1) or the Upper Former Mill Tailrace (n=1). No toxicity tests were performed on sediment samples from the Lower Former Mill Tailrace as part of this BERA. Therefore, we cannot conclude that no significant toxicity exists for this section of the Neponset River habitat based on toxicity tests. We addressed this issue by examining the potential for toxicity based on sediment concentrations in the Lower Former Mill Tailrace (subsection 5.4.3.2).

As an additional line of evidence regarding the potential toxicity of sediment to benthic organisms, AVS-SEM was analyzed in sediments collected from the Neponset River, Lewis Pond and the Upper Former Mill Tailrace. Table 5-10 presents the results of the (SEM-AVS)/f_{oc} calculation. None of the samples are in the "likely to be toxic" category (see Section 4.3). All

Upper Former Mill Tailrace samples had SEM/AVS ratios of less than one and moderately high (1-13%) TOC concentrations. Lewis Pond also has high levels of TOC (5-15%). High levels of TOC tend to decrease the toxicity of metals in sediment. As a result, all of the Upper Former Mill Tailrace and Lewis Pond sediment samples are in the "unlikely to be toxic" category. TOC concentrations are lower in most of the Neponset River samples. Two Neponset River sediment samples with TOC concentrations less of 0.2% are in the "uncertain toxicity" category.

The results of the toxicity tests and the evaluation of AVS-SEM data support the conclusion that Lewis Pond, Neponset River, and Upper Former Mill Tailrace sediments do not pose a risk to the benthic invertebrates. There is uncertainty associated with this conclusion because hazard quotients for nickel based on bioaccumulation testing with *L. variegatus* indicate a potential adverse ecological effect. There is additional uncertainty (see subsection 5.4.3.2) associated with this conclusion for Lewis Pond, because the metals concentrations at the location of the single toxicity test in Lewis Pond (LP-01) were not the highest concentrations detected in sediment from the pond.

5.2 Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife

Measurement Endpoint 2a: Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife

Method of Analysis

The method for evaluating this endpoint was a comparison of calculated doses of COPEC to receptors with corresponding TRVs. This subsection provides the results of the food chain models for semi-aquatic wildlife: muskrat, raccoon, kingfisher, and Great Blue Heron.

We ran the models for:

- The chronic (CTE and RME scenarios);
- The acute (maximum exposure and acute TRV);
- Each COPEC associated with each exposure area; and
- COPECs that had a corresponding TRV available in the literature.

Appendix D provides the results of the semi-aquatic food chain models for:

- Chronic risk to female Muskrat in the Neponset River, Lewis Pond, and the Upper Former Mill Tailrace (Tables D-1 to D-3), and in reference areas (Tables D-27 and D-28);
- Acute risk to female Muskrat in the Neponset River, Lewis Pond, and the Upper Former Mill Tailrace (Tables D-18 to D-20), and in reference areas (Tables D-34 and D-35);
- Chronic risk to female Raccoon in the Neponset River and Lewis Pond (Tables D-4 to D-5), and in reference areas (Tables D-29 and D-30);

- Acute risk to female Raccoon in the Neponset River and Lewis Pond (Tables D-21 to D-22), and in reference areas (Tables D-36 and D-37);
- Chronic risk to the female Kingfisher in the Neponset River and Lewis Pond (Tables D-6 and D-7), and in the Lower Pond Reference Area (Table D-31);
- Chronic risk to the female Great Blue Heron in the Neponset River and Lewis Pond (Tables D-8 to D-9).

Note that we did not characterize potential adverse ecological effects to the raccoon, Great Blue Heron, or kingfisher in the Upper Former Mill Tailrace because it is not a fish habitat and fish are a source of food to these receptors in the food chain models. We assumed that the risk to muskrat (due to sediment and plant ingestion) addresses risk to mammals grazing in the Upper Former Mill Tailrace.

Risk Characterization – Chronic Risk

In Lewis Pond, the Neponset River, and the Upper Former Mill Tailrace several calculated doses exceeded their corresponding TRVs for either the chronic CTE or chronic RME scenario:

		Exposure Case		Risk Characterization		
Exposure area & species	**COPECs with N or L > 1**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Lewis Pond; Belted kingfisher	bis(2-ethylhexyl) phthalate	N (4)	N (4)	Potential risk	Low	Fish ingestion
Neponset River; Belted kingfisher	bis(2-ethylhexyl) phthalate	N (3)	N (3)	Potential risk	Low	Fish ingestion
Lewis Pond; Muskrat	Aluminum	N (20), L (2)	N (20), L (2)	Potential risk	High	Sediment, invertebrate, & plant ingestion
	Nickel	N(4) L(0.7)	N(4) L(0.7)	Potential risk	Low	Sediment, invertebrate and plant ingestion
Neponset River; Muskrat	Aluminum	N (20), L (2)	N (20), L (2)	Potential risk	High	Sediment & invertebrate ingestion
Upper Former Mill Tailrace; Muskrat	Aluminum	N (40), L (4)	N (40), L (4)	Potential risk	High	Sediment, water, invertebrate, & plant ingestion
Lewis Pond; Raccoon	Aluminum	N (100), L (10)	N (100), L(10)	Potential risk	High	Sediment, invertebrate, plant, & fish ingestion

		Exposure Case		Risk Characterization		
Exposure area & species	**COPECs with N or L > 1**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
	Lead	N (6), L (0.6)	N (6), L (0.6)	Potential risk	Low	Sediment ingestion
	Nickel	N(2) L(0.4)	N(2) L(0.4)	Potential risk	Low	Sediment, plant, and fish ingestion
	Vanadium	N (3), L (0.3)	N (4), L (0.4)	Potential risk	Low	Sediment ingestion
Neponset River; Raccoon	Aluminum	N (100), L (10)	N (100), L (10)	Potential risk	High	Sediment & invertebrate ingestion
	Vanadium	N (2), L (0.2)	N (2), L (0.2)	Potential risk	Low	Sediment and invertebrate ingestion

Results for the Great Blue Heron are not shown on the above table because none of the calculated doses exceeded their corresponding TRVs for this species.

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in Lewis Pond, the Neponset River, and the Upper Former Mill Tailrace. The Lower Pond Reference Area is the reference area for Lewis Pond and for fish tissue in Neponset River. The Neponset River Reference Area is the reference area for the Neponset River (except fish tissue) and Upper Former Mill Tailrace.

		Exposure Case		Risk Characterization		
Exposure area & species	**COPECs**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Lower Pond Reference Area; Belted kingfisher	bis(2-ethylhexyl) phthalate	NC	NC	NA	NA	NA
Neponset River Reference Area; Muskrat	Aluminum	N (10), L (1)	N (10), L (1)	Potential risk	Low	Sediment & invertebrate ingestion
Lower Pond Reference Area; Muskrat	Aluminum	N (30), L (3)	N (30), L (3)	Potential risk	High	Sediment, invertebrate, & plant ingestion
	Nickel	N (0.4) L (0.07)	N (0.4) L (0.07)	NSR	High	NA

		Exposure Case		Risk Characterization		
Exposure area & species	**COPECs**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Lower Pond Reference Area; Raccoon	Aluminum	N (200), L (20)	N (200), L (20)	Potential risk	High	Sediment, invertebrate, plant, & fish ingestion
	Lead	N (1), L (0.1)	N (1), L (0.1)	NSR	High	NA
	Vanadium	N (5), L (0.5)	N (5), L (0.5)	Potential risk	Low	Sediment ingestion
	Nickel	N (0.3) L (0.05)	N (0.3) L (0.05)	NSR	High	NA
Neponset River Reference Area; Raccoon	Aluminum	N (60), L (6)	N (60), L (6)	Potential risk	High	Sediment, invertebrate, & fish ingestion
	Vanadium	N (2), L (0.2)	N (2), L (0.2)	Potential risk	Low	Sediment & invertebrate ingestion

Notes:
NC = not calculated (the chemical was not detected [ND] in the Lower Pond Reference Area fish)

Risk Characterization - Acute Risk

In Lewis Pond, the Neponset River, and the Upper Former Mill Tailrace several calculated doses exceeded their corresponding TRVs for the acute scenario:

Exposure Area & Species	COPECs with N or L > 1	Acute Exposure Case (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk
Neponset River; *Muskrat*	Aluminum	N (2), L (0.2)	Potential Risk	Low	Sediment ingestion
Lewis Pond; *Muskrat*	Aluminum	N (2), L (0.2)	Potential Risk	Low	Sediment ingestion
Upper Former Mill Tailrace; *Muskrat*	Aluminum	N (3), L (0.3)	Potential Risk	Low	Sediment ingestion
Neponset River; *Raccoon*	Aluminum	N (10), L (1)	Potential Risk	Low	Sediment ingestion
Lewis Pond; *Raccoon*	Aluminum	N (10), L (1)	Potential Risk	Low	Sediment & invertebrate ingestion
	Lead	N (2), L (0.2)	Potential Risk	Low	Sediment ingestion

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in Lewis Pond, the Neponset River, and the Upper Former Mill

Tailrace:

Exposure Area & Species	COPECs	Acute Exposure Case (HQ)	Risk Conclusion	Confidence Level	Pathway Driving Risk
Lower Pond Reference Area; *Muskrat*	Aluminum	N (3), L (0.4)	Potential Risk	Low	Sediment ingestion
Neponset River Reference Area; *Muskrat*	Aluminum	N (0.7), L (0.07)	NSR	High	NA
Neponset Reference Area; *Raccoon*	Aluminum	N (4), L (0.4)	Potential Risk	Low	Sediment & invertebrate ingestion
Lower Pond Reference Area; *Raccoon*	Aluminum	N (20), L (2)	Potential Risk	High	Sediment & invertebrate ingestion
	Lead	N (0.3), L (0.03)	NSR	High	NA

Notes:
1)Lower Pond fish concentrations were used as the reference for Lewis Pond and the Neponset River.
2)The Neponset River reference area was used for the Neponset River and the Upper Former Mill Tailrace

5.3 Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site

Measurement Endpoint 3a: Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife.

Method of Analysis

The method for evaluating this endpoint was a comparison of calculated doses of COPEC to receptors with corresponding TRVs. This subsection provides the results of the food chain models for terrestrial wildlife: robin and short-tailed shrew.

We ran the models for:

- The chronic (CTE and RME scenarios);
- The acute (maximum exposure and acute TRV for short-tailed shrew)
- Each COPEC associated with each exposure area;
- COPECs that had a corresponding TRV available in the literature.

Appendix D provides the results of the terrestrial food chain models in the East of South Street, West of South Street, Orlando Property, and Floodplain areas for:

- Chronic risk to robins – Tables D-10 to D-13, and the reference area (Table D-32);
- Chronic risk to short-tailed shrews – Tables D-14 to D-17, and the reference area (Table D-33)
- Acute risk to short-tailed shrews - Tables D-23 to D-26, and the reference area (Table D-38);

Risk Characterization – Chronic Risk

In the terrestrial areas East of South Street, West of South Street, Orlando Property, and the Floodplain, several calculated doses exceeded their corresponding TRV for the chronic CTE and/or chronic RME scenario:

		Exposure Case		Risk Characterization		
Exposure Area & Species	**COPECs with N or L > 1**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
East of South Street; *American robin*	Aluminum	N (4)	N (6)	Potential risk	Low	Earthworm ingestion
	Arsenic	N (1), L (0.6)	N (3), L (1)	NSR	High	Earthworm ingestion
	Cadmium	N (1), L (0.09)	N (2), L (0.1)	NSR	High	Earthworm ingestion
	Lead	N (20), L (2)	N (40), L (4)	Potential risk	High	Earthworm & soil ingestion
	Selenium	N (3), L (1)	N (6), L (3)	Potential risk	Moderate	Earthworm ingestion
	Zinc	N (6), L (0.7)	N (10), L (1)	Potential risk	Low	Earthworm ingestion
West of South Street; *American robin*	Aluminum	N (5)	N (8)	Potential risk	Low	Earthworm ingestion
	Chromium	N (1), L (0.3)	N (2), L (0.4)	NSR	High	Earthworm ingestion
	Lead	N (10), L (1)	N (10), L (1)	Potential risk	Low	Earthworm & soil ingestion
	Selenium	N (3), L (1)	N (4), L (2)	Potential risk	Moderate	Earthworm ingestion
	Zinc	N (5), L (0.6)	N (6), L (0.7)	Potential risk	Low	Earthworm ingestion
Orlando Property; *American robin*	Aluminum	N (3)	N (3)	Potential risk	Low	Earthworm ingestion
	Cadmium	N (1), L (0.1)	N (3), L (0.2)	NSR	High	Earthworm ingestion
	Lead	N (30), L (3)	N (60), L (6)	Potential risk	High	Earthworm ingestion
	Selenium	N (10), L (5)	N (20), L (8)	Potential risk	High	Earthworm ingestion
	Zinc	N (7), L (0.7)	N (10), L (1)	Potential risk	Low	Earthworm ingestion

		Exposure Case		Risk Characterization		
Exposure Area & Species	**COPECs with N or L > 1**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Floodplain; *American robin*	Aluminum	N (4)	N (6)	Potential risk	Low	Earthworm ingestion
	Cadmium	N (2), L (0.1)	N (2), L (0.2)	Potential risk	Low	Earthworm ingestion
	Chromium	N (3), L (0.5)	N (4), L (0.7)	Potential risk	Low	Earthworm ingestion
	Lead	N (40), L (4)	N (50), L (5)	Potential risk	High	Earthworm & soil ingestion
	Selenium	N (2), L (1)	N (3), L (2)	Potential risk	Moderate	Earthworm ingestion
	Zinc	N (6), L (0.6)	N (8), L (0.9)	Potential risk	Low	Earthworm ingestion
East of South Street; *Short-tailed shrew*	Aluminum	N (200), L (20)	N (200), L (20)	Potential risk	High	Earthworm & soil ingestion
	Arsenic	N (0.9)	N (2)	NSR	High	Earthworm ingestion
	Lead	N (0.9), L (0.09)	N (2), L (0.2)	NSR	High	Earthworm ingestion
	Selenium	N (2), L (1)	N (3), L (2)	Potential risk	Moderate	Earthworm ingestion
	Vanadium	N (3), L (0.3)	N (4), L (0.4)	Potential risk	Low	Earthworm ingestion
West of South Street; *Short-tailed shrew*	Aluminum	N (200), L (20)	N (300), L (30)	Potential risk	High	Earthworm & soil ingestion
	Selenium	N (2), L (1)	N (2), L (1)	Potential risk	Low	Earthworm ingestion
	Vanadium	N (4), L (0.4)	N (5), L (0.5)	Potential risk	Low	Earthworm ingestion
Orlando Property; *Short-tailed shrew*	Aluminum	N (100), L (10)	N (100), L (10)	Potential risk	High	Earthworm & soil ingestion
	Lead	N (1), L (0.1)	N (2), L (0.2)	NSR	High	Earthworm ingestion
	Selenium	N (6), L (4)	N (10), L (6)	Potential risk	High	Earthworm ingestion
	Vanadium	N (2), L (0.2)	N (2), L (0.2)	Potential risk	Low	Earthworm ingestion
Floodplain; *Short-tailed shrew*	Aluminum	N (100), L (10)	N (200), L (20)	Potential risk	High	Earthworm & soil ingestion
	Lead	N (2), L (0.2)	N (2), L (0.2)	Potential risk	Low	Earthworm ingestion
	Selenium	N (1), L (0.8)	N (2), L (1)	NSR	High	Earthworm ingestion
	Vanadium	N (4), L (0.4)	N (5), L (0.5)	Potential risk	Low	Earthworm ingestion

Notes:
HQ = hazard quotient; L = LOAEL-based; N = NOAEL-based; NSR = no significant risk

The following table presents the corresponding reference area hazard quotients for the chemicals that exceeded their TRVs in the terrestrial areas:

		Exposure Case		Risk Characterization		
Exposure Area & Species	**COPECs**	**CTE (HQ)**	**RME (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Soil Reference Area; *American robin*	Aluminum	N (4)	N (6)	Potential risk	Low	Earthworm & soil ingestion
	Arsenic	N (0.6), L (0.2)	N (1), L (0.4)	NSR	High	NA
	Cadmium	N (0.7), L (0.05)	N (0.7), L (0.05)	NSR	High	NA
	Chromium	N (0.7), L (0.1)	N (0.9), L (0.2)	NSR	High	NA
	Lead	N (30), L (3)	N (50), L (5)	Potential risk	High	Earthworm ingestion
	Selenium	N (2), L (1)	N (4), L (2)	Potential risk	Moderate	Earthworm ingestion
	Zinc	N (2), L (0.2)	N (3), L (0.3)	Potential risk	Low	Earthworm ingestion
Soil Reference Area; *Short-tailed shrew*	Aluminum	N (200), L (20)	N (200), L (20)	Potential risk	High	Earthworm & soil ingestion
	Arsenic	N (0.4)	N (0.6)	NSR	High	NA
	Lead	N (1), L (0.1)	N (2), L (0.2)	NSR	High	Earthworm ingestion
	Selenium	N (1), L (0.9)	N (2), L (2)	NSR	Moderate	Earthworm ingestion
	Vanadium	N (3), L (0.3)	N (4), L (0.4)	Potential risk	Low	Earthworm ingestion

Risk Characterization – Acute Risks

In the terrestrial areas East of South Street, West of South Street, Orlando Property, and the Floodplain, the calculated doses of aluminum exceeded the corresponding TRVs for the acute short-tailed shrew scenario:

		Exposure Case	Risk Characterization		
Exposure Area & Species	**COPECs with N or L > 1**	**Acute Exposure Case (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
East of South Street; *Short-tailed shrew*	Aluminum	N (10), L (1)	Potential Risk	Low	Earthworm & soil ingestion

		Exposure Case	Risk Characterization		
Exposure Area & Species	**COPECs with N or L > 1**	**Acute Exposure Case (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
West of South Street; *Short-tailed shrew*	Aluminum	N (20), L (2)	Potential Risk	High	Earthworm & soil ingestion
Orlando Property; *Short-tailed shrew*	Aluminum	N (9), L (0.9)	Potential Risk	Low	Earthworm & soil ingestion
Floodplain; *Short-tailed shrew*	Aluminum	N (10), L (2)	Potential Risk	High	Earthworm & soil ingestion

Notes:
HQ = hazard quotient; L = LOAEL-based; N = NOAEL-based; NSR = no significant risk

The following table presents the corresponding reference area hazard quotients for aluminum:

		Exposure Case	Risk Characterization		
Exposure Area & Species	**COPEC**	**Acute Exposure Case (HQ)**	**Risk Conclusion**	**Confidence Level**	**Pathway Driving Risk**
Soil Reference Area; *Short-tailed shrew*	Aluminum	N (10), L (1)	Potential Risk	Low	Earthworm & soil ingestion

5.4 Uncertainty Analysis

The BERA seeks to improve the accuracy of the analysis contained in the SLERA, narrowing the bounds of uncertainty around the estimates of risk by using additional data and tools such as bioaccumulation and toxicity testing and bioaccumulation modeling. This section of the report identifies the major sources of uncertainty along with actions that have been taken to manage this uncertainty within the assessment.

5.4.1 Uncertainty in Problem Formulation

The problem formulation phase establishes the elements of the assessment that focus and bound the analysis. This section of the risk assessment selects assessment and measurement endpoints and identifies receptors. The assessment endpoints encompass the important ecological groups that are of concern for the Site. The measurement endpoints examine characteristics of these ecological groups that are relevant to the assessment endpoints. The receptors that were chosen for this assessment cover the range of types of organisms that are expected to be found at the Site. Uncertainty in this phase of the assessment is expected to be low.

Uncertainty may exist in the selection of COPECs. This risk assessment selects COPECs based on frequency of detection and a comparison of maximum concentrations of COPECs at the Site to risk-based concentrations (RBCs) based on the Phase 1A data only. Although the Phase 1B data were not included for purposes of COPEC selection, the Phase 1A soil, sediment, and surface water data are of sufficient quality to identify COPECs at the Site and uncertainty in COPEC selection is expected to be low.

5.4.2 Uncertainty in Exposure Assessment

The exposure assessment estimates the magnitude of actual and/or potential ecological exposure to COPECs. Factors that introduce varying degrees of uncertainty into the exposure assessment are described below.

5.4.2.1 Exposure Point Concentrations

As with any risk characterization, there are uncertainties associated with the analytical data. For example, there is uncertainty introduced into the analysis with regard to estimated values below detection limits and the treatment of non-detects. A conservative approach is taken in assigning non-detects a value of one-half the sample detection limit, or in cases recommended by NEH, a value equal to the whole detection limit. In assigning a value of one half of the detection limit, the analysis captures those chemicals that may be present at the Site but have been reported as non-detect due to either matrix interferences or the presence of the chemical below the reporting limit. Chemicals that were never detected in a given medium were not included (i.e., the concentration was assumed to be zero) because robust risk-based detection limits were used from the beginning of the analytical program, and a strong data validation program was in place. Therefore, chemicals below detection limits were generally below risk-based levels.

Wherever possible, this assessment used the 95% UCL on the mean as a conservative measure of the exposure concentration. However, in some instances, this was not possible, because too few samples were available from a particular area and medium to calculate an UCL, or because the UCL exceeded the maximum concentration. In these cases, the maximum concentration was used to evaluate exposure for the RME case, and the average concentration was used to evaluate exposure for the CTE case. In this manner, uncertainty due to small sample size is addressed by the difference between the CTE and RME cases.

Use of composite samples for earthworm tissue reduces the number of samples needed to obtain an estimate of mean concentrations. Concentrations in individual earthworms are averaged, and variation between individual earthworms will tend to be masked. However, since a single earthworm makes up a small portion of the daily diet of the receptors evaluated in the BERA that consume earthworms (e.g. Shrew, Robin), composite samples are thought to better represent their exposures even over a relatively short time span (i.e., acute assessment). In addition, multiple composite samples were taken in each exposure area.

There is additional uncertainty associated with the earthworm tissue concentrations from the reference area due to death of worms during the depuration process in the OSR-2-W worms used in this assessment. The effect on exposure estimates is that the early death of the worms probably

resulted in decreased depuration and therefore an overestimate of total COPEC concentrations, due to the presence of soil in the guts of the earthworms.

There is uncertainty associated with aquatic invertebrate tissue sampling due to small sample size of 1 at the Upper Former Mill Tailrace and at the Reference areas.

> The benthic invertebrate body burdens used in the assessment were the product of bioaccumulation testing rather than the results from field-collected invertebrates. Some uncertainty is introduced by using the results of laboratory bioaccumulation testing. However, the bioaccumulation testing occurred for 28 days, which has been shown to be a sufficient time for invertebrates to accumulate contaminants from their surrounding (Ingersoll, 2001). Therefore, the uncertainty due to the use of bioaccumulation testing rather than data from field-collected invertebrates is likely to be relatively small.

The invertebrate bioaccumulation data did not include measurements of COPECs from bioaccumulation tests on sediments in the Lower Former Mill Tailrace. There is therefore, some uncertainty associated with short-term exposures in this specific, localized area of the Neponset River. We addressed this uncertainty by:

> Estimating the concentrations of Neponset River COPECs in benthic invertebrates from the Lower Former Mill Tailrace based on site-specific BSAFs and USDOE regression equations for metals and the metals concentrations detected in sediment samples from the Lower Former Mill Tailrace (we did not estimate concentrations of organics because many do not have an acute TRV and for others we did not have any site specific detections in tissue that would allow us to calculate a BSAF);
>
> Re-running the muskrat and raccoon acute food chain models with these calculated invertebrate COPEC concentrations (and using the previously described sediment, surface water, plant, and fish COPEC concentrations for the acute models);
>
> Estimating potential adverse ecological effects by calculating HQs (only for those COPECS for which acute benchmarks are available) using the acute NOED and LOED in the models. We used the USDOE screening models (USDOE, 1998) to estimate benthic tissue concentrations for lead and nickel (see following matrix):

Estimates of Benthic Tissue for Lead and Nickel
Model Equation: log(y) = a+ b log(x) From USDOE, 1998

y = chemical concentration in organism
x = chemical concentration in sediment
a= log transformed y intercept (empirically derived)
b = slope (empirically derived)

Chemical (mg/Kg)	Maximum Sediment Concentration Measured in Lower Former Mill Tailrace	a	b	Organism Concentration (mg/Kg dry wt)	Organism Concentration (mg/Kg wet wt)
Lead	850	-0.515	0.653	25.00	5.000
Nickel	93.1	-0.44	0.695	8.48	1.696

Note: coefficients are from USDOE Table 3.

For the remaining metals (aluminum, barium, cobalt and vanadium), we calculated site specific BSAFs as the maximum ratio of invertebrate tissue to sediment concentrations obtained from bioaccumulation tests using Lewis Pond sediments (because these sediments and the Lower Former Mill Tailrace sediments had similar grain size and TOC concentration).

As summarized on the tables below, the results of these substitutions into the acute food chain model for raccoon and muskrat returned a potential adverse effect to these receptors from aluminum (with a low confidence level):

Estimated Acute Risk to Raccoon in the Lower Former Mill Tail Race

Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Exposure Dose mg/kg/day
Aluminum	**10**	2	8.0	77.0	1.17E+02
Barium	0.9	0.3	33	98	3.06E+01
Cobalt	0.01	Bench NA	12.3	NA	1.22E-01
Lead	0.3	0.03	19	194	5.47E+00
Nickel	0.03	Bench NA	57	NA	1.87E+00
Vanadium	0.06	0.02	8.0	20	4.87E-01

Estimated Acute Risk to Muskrat in the Lower Former Mill Tail Race

Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Exposure Dose mg/kg/day
Aluminum	**3**	0.3	11.4	111	2.96E+01
Barium	0.2	0.05	47	141	7.21E+00
Cobalt	0.002	Bench NA	17.7	NA	3.73E-02
Lead	0.06	0.006	28	278	1.79E+00
Nickel	0.06	Bench NA	57	NA	3.28E+00
Vanadium	0.01	0.004	11	29	1.21E-01

There is uncertainty associated with fish tissue exposure concentrations because fish of different species, sizes, and ages were collected. The fish collected from the Site were five bluegills, three American eels, three white sucker, two largemouth bass, and one redfin pickerel. The total lengths of those fish ranged from 11 cm to 13 cm for bluegills, 34.5 cm to 73.5 cm for eels, 25.1 to 43.3 for white suckers, and 28.8 to 36.9 for largemouth bass. The total length of the one redfin pickerel was 14.5 cm. With the exception of the redfin pickerel, the body sizes of the fish caught and used in the BERA all fall within the average size ranges for the respective species (McClane, 1978). There could be larger and smaller fish at the Site that the sampling event failed to capture. With some chemicals, the body burdens of larger, older fish are greater than those in smaller, younger fish, because they have been exposed for longer periods of time. Had we captured larger fish and included those fish in the calculations, our estimates of risk might have been higher. Conversely, had we captured smaller fish and included those fish in the calculations, our estimates of risk might have been lower. Since the fish caught from the Site were of average size, it is likely these fish represent the typical body burdens found in fish at the Site.

Whenever there was sufficient tissue to do so, whole body tissue concentrations were used to evaluate exposure. At the Lower Pond reference area, only two bluegill of sufficient size for whole body analysis were collected. Therefore, we estimated whole body concentrations from an analysis of the carcasses and fillets of the largemouth bass that were filleted for the human health assessment. There is uncertainty associated with using this calculated data rather than whole body measured data. For this reason, at the Neponset River, while only four fish samples of sufficient size were collected rather than the goal of five, we did not use reconstructed data for this exposure point because of the additional uncertainty inherent in doing so.

BSAFs were used to estimate COPEC concentrations in plant tissue. The estimated tissue concentrations were then used in food chain models to evaluate potential adverse ecological effects to wildlife. In general, the use of BSAFs in this manner leads to an overestimate of the potential adverse ecological effects, because the BSAFs are typically developed to be conservative. As discussed in Section 3.2.4, BSAFs were not available for all COPECS detected in sediment, leading to some uncertainty in the evaluation.

5.4.2.2 Reference Areas

There is uncertainty associated with choosing reference locations to represent background conditions at the Site. Reference locations should be as similar as possible to Site locations without being impacted by Site-related releases. Site and reference soil and sediment should be as similar as possible in their characteristics, including TOC concentrations and grain size. Biota should ideally be of similar species, length and weight between Site and reference locations.

The fish sampling returned different groups of species from each area. The species collected at the Neponset River were bluegill, American eel, and white sucker. The species collected at Lewis Pond were bluegill, American eel, redfin pickerel, and white sucker. The species collected at the Lewis Pond reference area were large mouth bass and bluegill. Despite the species difference between Lewis Pond and its reference area, the lengths and weights of the fish had similar ranges. The ranges in lengths of fish collected in Lewis Pond and the Lower Pond Reference Area were 118-433 mm and 120-369 mm, respectively. The ranges in weights of fish collected in Lewis Pond and the Lower Pond Reference Area were 20-983 g and 25-849 g, respectively.

5.4.2.3 Temporal Uncertainty

The present assessment represents conditions at certain points in time and may not reflect future conditions at the Site. For example, sedimentation may continue to bury and isolate chemicals, thereby reducing exposure to benthic invertebrates and the organisms that prey upon them.

5.4.2.4 Food Chain Model

There are inherent uncertainties in the use of the food chain model because the model incorporates simplifying assumptions to represent a complex ecological system. For example, food chain models assume that chemicals in food and incidentally ingested sediment are completely available to the receptor. This may overestimate the potential adverse ecological effects depending on the fraction of the ingested dose that is available. For example, risk estimates for aluminum are likely to overestimate the potential adverse ecological effects for the following reasons:

- Aluminum is an abundant component of the earth's crust and occurs naturally in soils and sediments at concentrations that are generally many orders of magnitude higher than anthropogenic inputs (USEPA, 2003);
- The forms of soluble aluminum, which may be toxic, are poorly understood and difficult to measure (USEPA, 2003);
- Potential adverse effects to ecological receptors at this site are overestimated as they are at other sites, because standard methods for the analysis of aluminum are not specific to the toxic forms of aluminum.

The actual diets of the species examined in the food chain models include a larger diversity of food types than are represented in the BERA. This assessment assumes that exposure from

consumption of particular prey types can be estimated on the basis of concentrations in particular food items that are representative of the prey type. For example, the food chain model assumes that measured concentrations in *Lumbriculus variegatus*, used in the bioaccumulation tests accurately represent concentrations in benthic invertebrate species consumed by ecological receptors present at the Site. For terrestrial receptors (robin and shrew), earthworms were assumed to make up 100% of the food in the diet. This is a generally conservative assumption given that earthworms are highly exposed to soil and would likely take up more contaminants than insects, fruits or other components of the diets of robins and shrews.

There is also uncertainty in the ingestion rates of wildlife. Studies were used that present conservative estimates of quantity of food and sediment in each species diet (USEPA 1993, Beyer, 1994). In some cases, for example the raccoon, no food ingestion rate data are available, so a conservative allometric equation was used to estimate the food ingestion rate based on the diet and body size. The ingestion rate assumptions used in the food chain model are conservative to limit the chance of underestimating the potential adverse ecological effects in the face of uncertainty.

5.4.3 Uncertainty in Effects Assessment

Little toxicity information is available for ecological receptors in the natural environment. As a result, much of the uncertainty in an ecological risk assessment lies in the assessment of potential effects.

5.4.3.1 Surface Water Benchmarks

There were no NRWQC or Tier II SCVs available for several PAHs and 4-nitroaniline. Quantitative evaluation of the potential for adverse ecological effects specifically from these chemicals in surface water was not performed. The narcosis model provides one line of evidence that there is no potential for adverse effects from PAHs and other SVOCs to fish.

In cases where total metals concentrations in surface waters at the Site exceed NRWQC or Tier II SCVs but dissolved metals concentrations do not, the potential for adverse ecological effects is probably low because the availability of total metals is mitigated by the presence of organic matter in natural waters.

5.4.3.2 Sediment Toxicity Testing

Although invertebrate toxicity testing with whole sediment carries great weight as a measure of effects to invertebrates, there is some uncertainty inherent in this testing. The selection of a species to use (amphipod vs. chironomids) may possibly bias the outcome. Amphipods are thought to be more sensitive to the effects of contaminants, but they are also thought to avoid contact in a laboratory situation with highly contaminated sediments.

The collection of sediment from its environment, transfer to the laboratory, and subsequent use in toxicity testing may change the toxicity of the sediment. Contaminants may become more available and therefore more toxic because of the disturbance involved. On the other hand,

preparation of the samples for analysis may aerate anoxic sediments causing oxidation of some COPCs, resulting in more or less toxicity.

One way the toxicity of *in situ* sediment may differ from that measured in sediment toxicity tests is that the pH may be affected. The pH of the Tailrace sediment sample (TR-3) is 9.4 in situ, but the overlying water during the toxicity test ranged from 7.5 to 8.2 over the course of the experiment (Table 3-28). Ammonia in this sediment sample is elevated above ammonia in reference sediment (Table 3-29). Ammonia is more toxic at higher pH because ammonia (NH_3) is more toxic than the ammonium ion (NH_4^+). The negative logarithm of the acidity constant (pKa) for ammonia is 9.24. The ratio of ammonia to ammonium ion is related to the pH as follows:

$$\log\left(\frac{[NH_3]}{[NH_4^+]}\right) = pH - pKa$$

The majority of ammonia nitrogen is therefore expected to be in the form of NH_3 *in situ* at pH 9.4, and this level of NH_3 is expected to be approximately ten times or more than the maximum NH_3 concentration in the toxicity test at pH 7.5 to 8.2. Because we expect more ammonia *in situ* than in the toxicity test, it is possible that sediment in the Upper Tailrace could pose adverse effects that were not observed in the toxicity test and the conclusion of no significant risk to benthic invertebrates in the Upper Former Mill Tailrace is uncertain.

As stated in Section 4.3, high levels of pH can also influence sediment toxicity due to mobilization of metals. A pre-requisite for metal toxicity is that an organism must be able to take it up (i.e. the metal must be soluble). In sediments, metals may be dissolved in the aqueous phase in sediment pore water, sorbed to sediment particles or present in relatively insoluble mineral phases. The metals in the dissolved phase are potentially bioavailable, and thus potentially toxic. For many metals in aquatic systems, it is the free ionic form which is believed to be responsible for toxicity. The pH of an aquatic system is an important variable in controlling the speciation and solubilization of metals (Stumm and Morgan, 1996). Depending on the particular metal, solubility can decrease or increase as pH increases.

In general, for cationic metals (e.g., aluminum, copper, iron, lead, manganese, nickel), at low pH sorption decreases and thus more metals are found in the dissolved phase. At high pH, solubility of metals in the dissolved phase decreases and association with dissolved ligands increases, potentially decreasing bioavailability of these cationic metals. Generally, the patterns of dissolution and sorption are reversed for metalloids (such as arsenic and selenium) and metals (chromium, antimony, vanadium) that exist as anionic species (USEPA, 2004c). Therefore, high pH can potentially increase toxicity for anionic metals, but potentially decrease toxicity for cationic metals.

There is uncertainty associated with the sediment toxicity testing due to the potential for spatial variation in contaminant distribution in the sediments. For example, in the Lower Former Mill Tailrace sediment concentrations of aluminum, lead, manganese, nickel, and 19 SVOCs exceed their maximum sediment concentrations at stations where we measured toxicity (see following

matrix). These exceedances are generally between factors of 1 to 2, but may be greater as shown in the following matrix. This source of uncertainty may lead to an underestimate of potential ecological risks in the Lower Former Mill Tailrace.

	Maximum Sediment Concentration at Tox Test Locations	Lower Former Mill Tailrace Samples				[Lower Mill TR] > [Tox Test Locations]?	[Lower Mill TR] higher by a factor of:
		TR-4		TR-5			
Metals (mg/kg)							
Aluminum	7000	10500		14000		YES	2
Antimony	0.495					No	---
Arsenic	8.8					No	---
Barium	140	59.3		135		No	---
Beryllium	0.63	0.41	U	0.5		No	---
Cadmium	2					No	---
Chromium	220					No	---
Cobalt	13	9.1		10.1		No	---
Copper	90					No	---
Iron	13000					No	---
Lead	700	850		419		YES	1.2
Manganese	1100	355		2340		YES	2.1
Mercury	0.66	0.11		0.16		No	---
Nickel	16	93.1	J	44.5	J	YES	5.8
Selenium	0.94	0.36		0.56		No	---
Silver	0.34					No	---
Thallium	0.19	0.095	J	0.1	J	No	---
Vanadium	47	32.6	J	48.4	J	YES	1.0
Zinc	250	143		219		No	---
SVOC (ug/kg)							
2,4-Dimethylphenol	ND (210)	72	J	270	U	a	---
2-Methylnaphthalene	145	730		420		YES	5.0
4-Methylphenol	ND (210)	190	J	150	J	a	---
Acenaphthene	235	600		220		YES	2.6
Acenaphthylene	470	1300		460		YES	2.8
Anthracene	745	1400		520		YES	1.9
Benzo[a]anthracene	2400	4000		1200		YES	1.7
Benzo[a]pyrene	2650	3200		1200	J	YES	1.2
Benzo[b]fluoranthene	2650	4600		2000	J	YES	1.7
Benzo[g,h,i]perylene	950	1600		270	J	YES	1.7
Benzo[k]fluoranthene	2450	3800		1400	J	YES	1.6
Benzoic acid	290	620	J	500	J	YES	2.1
Benzyl alcohol	ND (210)	54	J	57	J	a	---
bis(2-Chloroethoxy)methane	205					No	---
bis(2-Ethylhexyl)phthalate	4400	110	J	290		No	---
Butylbenzylphthalate	235					No	---
Carbazole	430	630		170	J	YES	1.5
Chrysene	3050	4500		1500		YES	1.5
Dibenz[a,h]anthracene	310	240		100	J	No	---
Dibenzofuran	175					No	---
Fluoranthene	5500	9000		2300		YES	1.6
Fluorene	375	870		340		YES	2.3
Indeno[1,2,3-cd]pyrene	1050	1800		430	J	YES	1.7
Naphthalene	215	920		510		YES	4.3
Phenanthrene	3700	6900		1700		YES	1.9
Pyrene	5150	8500		3600		YES	1.7
VOCs (ug/kg)							
2-Butanone (MEK)	130					No	---
Acetone	520					No	---
Carbon disulfide	8.6	10	J	15	J	YES	1.7
Chloromethane	2.7					No	---
o-Xylene	2.1					No	---
p/m-Xylene	6.3					No	---

a The detected concentration in Lower Former Mill Tailrace samples is lower than the detection limit in samples from toxicity testing locations.

In Lewis Pond, the maximum COPEC sediment concentrations are generally 2 to 10 times higher than the concentrations of COPECs in sediment at the toxicity testing location (LP-01). The maximum concentration of nickel (510 mg/kg at LP-06) is approximately nine or more times greater than the concentrations measured at other locations in Lewis Pond (range: 8.6 – 57.9

mg/kg). This source of uncertainty may lead to an underestimate of potential ecological risks in Lewis Pond.

	Sediment Concentrations at Tox Test Location (LP-01/12-18-02)		Maximum Sediment Concentration in Lewis Pond	[Max Lewis Pond] > [Tox Test Location]?	[Max Lewis Pond] higher by a factor of:
Metals (mg/kg)					
Aluminum	4500	J	11000	YES	2.4
Barium	43		127	YES	3.0
Beryllium	0.3		0.89	YES	3.6
Cadmium	0.6	J	8	YES	13
Chromium	220		410	YES	1.9
Cobalt	5.6	J	25	YES	4.5
Copper	90		180	YES	2.0
Lead	240	J	7600	YES	32
Manganese	280	J	1010	YES	3.6
Mercury	0.17		0.9	YES	5.3
Nickel	9		510	YES	59
Selenium	0.5		1.3	YES	2.5
Silver	0.20	U	1.9	YES	9.5
Thallium	0.10	U	0.14	YES	1.4
Vanadium	18		84.6	YES	4.7
Zinc	160		477	YES	3.0
PAHs (ug/kg)					
2-Methylnaphthalene	27		190	YES	7.0
Acenaphthene	31		230	YES	7.4
Acenaphthylene	470		900	YES	1.9
Anthracene	300		1100	YES	3.7
Benzo[a]anthracene	1800		3400	YES	1.9
Benzo[a]pyrene	1800		3700	YES	2.1
Benzo[b]fluoranthene	1300		4000	YES	3.1
Benzo[g,h,i]perylene	650		650	No	---
Benzo[k]fluoranthene	1300		3900	YES	3.0
Chrysene	1900		4100	YES	2.2
Dibenz[a,h]anthracene	230		250	YES	1.1
Fluoranthene	2700		6100	YES	2.3
Fluorene	51		360	YES	7.1
Indeno[1,2,3-cd]pyrene	720		720	No	---
Naphthalene	61		760	YES	12
Phenanthrene	690		2700	YES	3.9
Pyrene	2100		7300	YES	3.5
Other SVOCs (ug/kg)					
2,4-Dimethylphenol	210	U	610	YES	2.9
4-Methylphenol	210	U	550	YES	2.6
Benzoic acid	120	J	1600	YES	13
Benzyl alcohol	210	UJ	100	a	---
bis(2-Ethylhexyl)phthalate	400	U	3000	YES	7.5
Carbazole	210	U	280	YES	1.3
VOCs (ug/kg)					
Acetone	350		440	YES	1.3
Carbon disulfide	4	J	8.2	YES	2.2
Methyl tert-butyl ether (MTBE)	5	U	2.7	a	---

a The maximum detected concentration in Lewis Pond sediment is lower than the detection limit in the sediment sample at the toxicity testing location (LP-01/12-18-02).

5.4.3.3 Narcosis Model

Various uncertainties are associated with the use of the narcosis model to assess risk to aquatic organisms. For example, the narcosis model uses a quantitative structure-activity relationship (QSAR) for toxicity and bioconcentration to estimate the tissue concentration of hydrophobic narcotic organic chemicals that are associated with 50% mortality in fish populations in laboratory bioassays. These calculated estimates suggest that mortality by acute narcosis occurs at an average whole body concentration of about 2 to 8 mmol/kg wet wt of organism (McCarty and Mackay, 1992). This estimate of the critical body residue (CBR) generally agrees with the limited amount of data on measured CBRs for neutral hydrophobic narcotic chemicals. The critical residue associated with chronic effects has been estimated to be a factor of ten lower or 0.2 to 0.8 mmol/kg. Note, however, that the critical body residue is an estimate of the residue that is associated with mortality and does not consider or account for potentially more sensitive effects, such as growth, reproduction, or other effects.

To address this and other uncertainties, chronic sediment toxicity tests were used to evaluate the potential for chronic effects to the animals that are closely associated with sediments. We did not observe significant effects in the sediment toxicity tests. Therefore, we do not expect PAHs and other organic chemicals to pose a potential for adverse ecological effects to benthic invertebrates and fish in the aquatic environments of the Site.

5.4.3.4 TRVs for Aquatic Biota and Wildlife

There may be considerable uncertainty in the development of toxicity benchmarks for wildlife. Scant data are available on effects on wildlife. Therefore, it is usually necessary to extrapolate from laboratory studies on species other than those selected as receptors. The magnitude of uncertainty associated with this extrapolation is unknown, but is often estimated to be within a factor of ten (Dourson and Stara, 1983). Appropriate TRVs that included LOAEL/NOAEL pairs were selected whenever possible. If a pair was not available but a LOAEL was, then we applied a factor of 10 to estimate a NOAEL. In a few cases, LOAELs were based on 50% effect levels rather than a true LOAEL, because no appropriate LOAEL was available. In these cases, including nickel in benthic invertebrates, the confidence level of a conclusion of potential risk is higher than for a LOAEL-based effect level, and the confidence level of a conclusion of no significant risk is lower than for a LOAEL-based effect level.

In several cases, no appropriate TRVs are available. The uncertainties associated with this data gap are discussed in detail below. For example, there are several residue effect levels available for nickel on ERED, however, no whole body RELs are available. Therefore, the ERED database did not offer an appropriate TRV for comparison against the whole body nickel concentrations measured in fish from the Neponset River.

5.4.3.5 Risks Associated With COPECs That Lack Toxicity Factors

There is a clear source of uncertainty in the analysis of total potential adverse ecological effects associated with the absence of toxicity factors for various COPECs in each habitat. In the absence of acceptable toxicity factors, we cannot calculate a HQ for these chemicals. We

addressed this source of uncertainty by providing the average and range of concentrations for this subset of COPECs in each habitat and the corresponding statistics in reference media or biota from reference areas. Also, except in the Lower Former Mill Tailrace, the potential toxicity of sediment was evaluated directly by toxicity testing. Comparison of these data may be useful for providing perspective during the FS and the remedy decision-making process.

Risk In Terrestrial Soil

For those COPECs that do not have toxicity factors for at least one receptor, Tables 5-11 (soil) and 5-12 (earthworms) show their concentrations in terrestrial habitats and the corresponding reference area. These tables may inform the feasibility study or decision making process.

Among the four metals (antimony, cobalt, iron, and thallium), there were no acceptable toxicity factors for the robin or shrew.

There were no total PAH and few individual PAH toxicity factors for shrews (for birds there is a total PAH toxicity factor).

There are no toxicity factors to assess hazards associated with terrestrial exposures to petroleum hydrocarbon fractions. However, we assumed that the assessment of PAHs sufficiently represented hazards associated with petroleum hydrocarbons.

We assumed no hazards associated with VOCs due to their inability to bioaccumulate.

Risk In Aquatic Environments

Table 5-13 (sediment), 5-14 (invertebrates) and 5-15 (fish) show concentrations of COPECs in aquatic habitats and the reference area for which there was either no Toxicity Reference Value or Residue Effect Level for at least one of the aquatic receptors. These tables may inform the feasibility study or decision making process.

There were no TRVs or Residue Effect Levels for barium, cobalt, iron, manganese, and thallium.

There is no appropriate chromium TRV for benthic invertebrates. Although there is uncertainty associated with the spatial distribution of sediment toxicity, the results of the single toxicity test sample in Lewis Pond (Table 5-9) indicated there was no significant toxicity (growth or mortality) to the freshwater amphipod *H. azteca* from sediment exposure. Therefore, chromium is unlikely to pose a potential for adverse effects to benthic invertebrates at Lewis Pond.

An effect concentration for total PAHs was available for birds, and the food chain models indicate no potential adverse ecological effects to Great Blue Heron and kingfisher from exposure to total PAHs at Lewis Pond and the Neponset River. Appropriate effect concentrations for mammals exposed to PAHs are not available. Therefore, the potential for adverse effects to aquatic mammals from PAH is uncertain.

Among other SVOCs that lacked a toxicity factor:

2,4-dimethyphenol is a COPEC in Lewis Pond and the Upper Former Mill Tailrace sediment, but it was not detected in invertebrate tissue from these areas (i.e., from bioaccumulations tests completed on sediment from these areas). These data indicate that there is no biological exposure to this compound through the food chain, and therefore no potential for adverse ecological effects.

4-methyphenol is a COPEC in Lewis Pond and the Upper Former Mill Tailrace sediment, but it was not detected in invertebrate tissue from the Upper Former Mill Tailrace. These data indicate that there is no biological exposure to this compound through the food chain, and therefore no potential for adverse ecological effects at the Upper Former Mill Tailrace.

Bis(2-ethylhexyl)phthalate is a COPEC at Lewis Pond, the Neponset River, and the Former Upper Mill Tailrace, but it was not detected in invertebrate tissue from these areas. These data indicate that there is no biological exposure to this compound through consumption of invertebrates and therefore no adverse effects associated with this pathway.

Carbazole is a COPEC in Lewis Pond, the Neponset River, and the Former Upper Mill Tailrace sediment, but it was not detected in invertebrate tissue from these areas. These data indicate that there is no biological exposure to this compound through the food chain, and therefore no potential for adverse ecological effects.

Di-n-octylphthalate is a COPEC in the Neponset River sediment, but it was not detected in invertebrate tissue from this area. These data indicate that there is no biological exposure to this compound through the food chain, and therefore no potential for adverse ecological effects.

VOCs were analyzed in sediment, but not benthic invertebrates due to VOCs' general inability to bioaccumulate. Among VOCs that lacked a toxicity factor:

Acetone is a COPEC in Lewis Pond sediment.

Carbon disulfide is a COPEC in Lewis Pond and Upper Former Mill Tailrace sediment.

MTBE is a COPEC in Lewis Pond.

5.4.4 Uncertainty in Risk Characterization

This assessment calculates HQs using both NOAELs (or NOEDs) and LOAELs (or LOEDs) and CTE and RME exposure point concentrations to assist in evaluating uncertainty in the risk estimates. The assessment concludes that NOAEL HQs that are less than one for the CTE case do not indicate potential adverse ecological effects, and NOAEL HQs that exceed one for the CTE case do indicate potential adverse ecological effects. Use of no effects concentrations is conservative because they are, by definition, below the effect concentration. The confidence

level of each risk conclusion is dependant on the LOAEL HQs and the RME NOAEL HQ's as illustrated in the Interpretive Matrix in Section 5.0.

The assessment endpoints for this assessment are the potential for adverse ecological effects on *populations* of aquatic organisms and wildlife. The assessment uses the hazard quotient approach, which predicts potential impact to individuals. The simplifying assumption is made, that if a NOAEL HQ for a measurement endpoint based on growth, reproduction, or survival exceeds one, that there is a potential for adverse ecological effects to the population. However, impacts to individuals may not always impact the population. This conservative assumption is used because few methods exist to predict population-level effects.

In some cases, conflicting lines of evidence reduce the confidence level of the result. For example, nickel HQs for the benthic invertebrates exposed to the Lewis Pond sediment indicate a potential for adverse effects. However, the effect level for this evaluation is based on an effect on growth (Table 4-3), and the direct toxicity testing indicated no measurable effect on growth. In this case, we concluded that there is no potential risk to benthic invertebrates due to exposure to nickel because we placed more weight on empirical observation than on the effect level for the same endpoint.

We estimated risk to the heron assuming an area use factor of 14%. There are a number of factors that could contribute to the actual foraging behavior of herons in the vicinity of the site. However, even if 100% site use was assumed for the heron, which is likely an overestimate, HQs for the female Great Blue Heron in the Neponset River and Lewis Pond would still be less than or equal to one for both the chronic CTE and chronic RME scenarios.

5.5 Risk Summary

Per standard approaches used for Ecological Risk Assessments completed under the Comprehensive Environmental Response, Restoration and Liability Act, this document describes baseline potential adverse ecological effects only – it does not draw conclusions about whether an adverse effect may be due to a chemical that is present in the environment because of Site-related activities or whether it is there because of some other background condition unrelated to the Site. It does not draw conclusions about whether chemicals are elevated in the environment over concentrations that may be expected to be naturally occurring, or whether an adverse effect is of sufficient magnitude to warrant remedial action. These matters of perspective, and the risk-management decisions that ensue, will be addressed in the forthcoming FS.

Assessment Endpoint 1: Sustainability of local populations of aquatic invertebrates, benthic invertebrates, and fish

Lewis Pond

The findings of the BERA indicate the following with respect to the potential for adverse ecological effects associated with the sustainability of benthic invertebrates and warm-water fish in Lewis Pond:

Concentrations of COPECs in invertebrates from bioaccumulation testing with sediments of Lewis Pond indicate no potential hazard with the exception of nickel. The effect level for nickel is based on an effect on growth, and results from direct toxicity testing at one location indicated no measurable effect on growth. Although there is uncertainty associated with these results, available data indicate there is unlikely to be an effect on benthic invertebrates due to exposure to nickel in Lewis Pond.

There were no instances of significant toxicity (growth or mortality) to the freshwater amphipod *H. azteca* for the single sediment samples collected for toxicity testing from Lewis Pond. The maximum concentration of nickel in sediment in Lewis Pond was 510 mg/kg at LP-06. The sample for toxicity was taken at LP-01, where the measured nickel concentration was less than 50 mg/kg. There is therefore uncertainty in the conclusion of no significant toxicity from nickel for all areas of the pond. The AVS-SEM data support the conclusion that sediments are non-toxic to benthic invertebrates. Therefore, although there is uncertainty associated with these results, available data indicate there is unlikely to be an adverse ecological effect on benthic invertebrates due to exposure to nickel in Lewis Pond.

Measured COPEC metals in Lewis Pond fish tissue were below NOAEL Residue Effect Levels, with the exception of aluminum and zinc. There is potential for adverse effects from aluminum and zinc to fish at Lewis Pond. The data indicate that the CTE and RME concentrations of organics in fish tissue from Lewis Pond did not exceed 2 mmol/Kg for acute effects or 0.2 mmol/kg for chronic effects. This measurement endpoint indicates no potential effect upon fish in Lewis Pond from exposure to organic compounds.

In conclusion, there is a potential for adverse effects to fish at Lewis Pond (aluminum and zinc exposure). There is limited evidence for the potential of significant risk to benthic invertebrates at Lewis Pond.

Neponset River

The findings of the BERA indicate the following with respect to the potential for adverse ecological effects associated with the sustainability of benthic invertebrates and warm-water fish in the Neponset River:

In the Neponset River, dissolved barium, copper, lead, manganese, and vanadium and benzo(a)anthracene and benzo(a)pyrene exceed NRWQC (or Tier II SCV where NRWQC are not available), indicating potential adverse effects to fish and aquatic invertebrates.

Concentrations of COPECs in benthic invertebrates from bioaccumulation testing with sediments of the Neponset River were below NOAEL Residue Effect Levels with the exception of nickel. The effect level for nickel is based on an effect on growth, and direct toxicity testing indicates no measurable effect on growth. Therefore, we do not believe that there is an effect on benthic invertebrates due to exposure to nickel in the Neponset River.

There were no instances of significant toxicity (growth or mortality) to the freshwater amphipod *H. azteca* for any of the sediments collected from the Neponset River. The AVS-SEM data support the conclusion that sediments are non-toxic to benthic invertebrates. Therefore, we conclude that those sediments do not pose a potential for adverse ecological effects to benthic invertebrates.

No toxicity tests were performed on sediment samples from the Lower Former Mill Tailrace as part of this BERA. Therefore, we cannot conclude that no significant toxicity exists for this section of the Neponset River habitat based on toxicity tests. The lack of toxicity tests in the Lower Former Mill Tailrace may lead to an underestimate of the ecological risks in the Lower Former Mill Tailrace. There is therefore uncertainty in the conclusion of no potential risk to benthic invertebrates in this portion of the Neponset River habitat.

In the Neponset River, whole body concentrations of zinc in fish exceeded NOED for the CTE and RME scenario.

The data indicate that the CTE and RME concentrations of organics in fish tissue from the Neponset River did not exceed 2 mmol/kg for acute effects or 0.2 mmol/kg for chronic effects. This measurement endpoint indicates no potential effect upon fish in the Neponset River from exposure to organic compounds.

Surface water pH in one Neponset River sample (SW-105/08-01-01) and one surface water sample collected from the Lower Former Mill Tailrace sample (SW-107/08-01-01) exceeded the Class B Massachusetts water quality criterion for pH of 8.3.

In conclusion, there is a potential for adverse effects to fish and invertebrates in the Neponset River from surface water exposures of several COPEC as indicated by exceedances of surface water benchmarks and the exceedance of one residue effect level (zinc) in fish.

Exceedances of NRWQCs and Class B Massachusetts water quality criteria in surface water (including those for pH) will be addressed in the Feasibility Study.

Upper Former Mill Tailrace

The findings of the BERA indicate the following with respect to the potential for adverse ecological effects associated with the sustainability of benthic invertebrates and warm-water fish in the Upper Former Mill Tailrace:

Dissolved concentrations of barium, copper, lead, and vanadium, and benzo(a)pyrene and benzo(a)anthracene in surface water exceed their respective NRWQC (or Tier II SCV where NRWQC are not available) in the Upper Former Mill Tailrace, indicating potential risk to benthic invertebrates. Note that this does not result in potential adverse ecological effects to the warm water fishery in the Neponset River because observations of the conditions in the Upper Former Mill Tailrace indicate that it is not a fish habitat, and it is physically isolated from the waters of the Neponset River.

Concentrations of COPECs in invertebrates from bioaccumulation testing with sediments of the Upper Former Mill Tailrace indicate no significant risk with the exception of nickel. However, the effect level for nickel is based on an effect on growth, and results from direct toxicity testing from one location indicated no measurable effect on growth. Although there is uncertainty associated with these results, available data indicate there is unlikely to be an effect on benthic invertebrates due to exposure to nickel in Upper Former Mill Tailrace.

There were no instances of significant toxicity (growth or mortality) to the freshwater amphipod *H. azteca* in the single sediment sample collected for toxicity testing from the Upper Former Mill Tailrace. This sample is assumed to represent the conditions within the small habitat area in the Upper Former Mill Tailrace. The AVS-SEM data support the conclusion that sediments are non-toxic to benthic invertebrates. Although there is uncertainty associated with these results, available data indicate there is unlikely to be an adverse ecological effect on benthic invertebrates due to exposure to nickel in the Upper Former Mill Tailrace.

Surface water pH measured in the Upper Former Mill Tailrace exceeded the NRWQC of 9.0 for chronic exposures, as well as the Class B Massachusetts water quality criterion of 8.3.

While exceedances of NRWQC/Tier II SCVs for the above-listed metals potentially indicate adverse ecological effects associated with the sustainability of benthic invertebrates, this concern is not supported by sediment bioaccumulation testing, sediment toxicity tests, or sediment AVS/SEM data. The Upper Former Mill Tailrace is a wetland habitat in which sediment exposures dominate over surface water exposures. Therefore, we conclude that the weight-of-evidence indicates no significant ecological risk to aquatic receptors in the Upper Former Mill Tailrace. There are also no potential adverse ecological effects to the warm water fishery in the Neponset River from the chemical impacts in the Upper Former Mill Tailrace because observations of the conditions in the Upper Former Mill Tailrace indicate that it is not a fish habitat, and it is physically isolated from the waters of the Neponset River.

Exceedances of NRWQCs and Class B Massachusetts water quality criteria in surface water (including those for pH) will be addressed in the Feasibility Study.

Lower Pond Reference Area

The findings of the BERA indicate the following with respect to the potential for adverse ecological effects associated with the sustainability of benthic invertebrates and warm-water fish in Lower Pond:

Concentrations of nickel in benthic invertebrates exceeded the NOED. However, the effect level for nickel is based on an effect on growth, and direct toxicity testing indicates no measurable effect on growth. Therefore, we do not believe that there is an effect on benthic invertebrates due to exposure to nickel in Lower Pond.

Whole body concentrations of zinc in fish exceeded NOED for the CTE and RME scenario.

Neponset River Reference Area

The findings of the BERA indicate the following with respect to the potential for adverse ecological effects associated with the sustainability of benthic invertebrates and warm-water fish in the Neponset River Reference Area:

The dissolved concentration of barium exceeds Tier II SCVs indicating potential adverse effects to fish and aquatic invertebrates.

Concentrations of nickel in benthic invertebrates exceeded the NOED. However, the effect level for nickel is based on an effect on growth, and direct toxicity testing indicates no measurable effect on growth. Therefore, we do not believe that there is an effect on benthic invertebrates due to exposure to nickel in the Neponset River Reference Area.

Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife

The following table summarizes the findings of the BERA with respect to the potential for adverse ecological effects associated with the survival, growth, and reproduction of local populations of aquatic wildlife at the site and in reference areas. In the table:

L - Indicates potential adverse ecological effects with a low confidence level.

M - Indicates potential adverse ecological effects with a medium confidence level.

H - Indicates potential adverse ecological effects with a high confidence level.

Aquatic		bis(2-ethylhexyl)phthalate	Aluminum (1)		Lead		Nickel	Vanadium
		chronic	chronic	acute	chronic	acute	chronic	chronic
Lewis Pond	Kingfisher	L						
	Muskrat		H	L			L	
	Raccoon		H	L	L	L	L	L
Neponset River	Kingfisher	L						
	Muskrat		H	L				
	Raccoon		H	L				L
Upper Former Mill Tailrace	Muskrat		H	L				
Lower Pond Reference	Kingfisher	NA						
	Muskrat		H	L				
	Raccoon		H	H				L
Neponset River Reference	Kingfisher							
	Muskrat		L					
	Raccoon		H	L				L

Notes:

NA – Indicates that a hazard quotient was not calculated because the chemical was not detected in Lower Pond Reference area fish.

(1) In general, risk estimates for aluminum are likely to overestimate the potential adverse ecological effects for the following reasons:

- Aluminum is an abundant component of the earth's crust and occurs naturally in soils and sediments at concentrations that are generally many orders of magnitude higher than anthropogenic inputs (USEPA, 2003);
- The forms of soluble aluminum, which may be toxic, are poorly understood and difficult to measure (USEPA, 2003); and
- Potential adverse effects to ecological receptors at this Site are overestimated as they are at other sites, because standard methods for the analysis of aluminum are not specific to the toxic forms of aluminum.

While bis(2-ethylhexyl)phthalate, lead, nickel, and vanadium pose potential risk at varying degrees of confidence in one or more areas, these risks have not yet been compared to background risks (e.g., the potential risks in Lower Pond and the Neponset River reference area, and/or the distribution and occurrence of these contaminants at the Site). This analysis will be performed in order to add perspective to these potentially adverse ecological effects as part of the forthcoming FS.

Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations on the Site

The following table summarizes the findings of the BERA with respect to the potential for adverse ecological effects associated with maintenance of terrestrial birds and small mammals on-Site and at the reference area. In the table:

L - Indicates potential risk with a low confidence level.

M - Indicates potential risk with a medium confidence level.

H - Indicates potential risk with a high confidence level.

		Aluminum (1)		Cadmium	Chromium	Lead	Selenium	Vanadium	Zinc
Terrestrial		chronic	acute	chronic	chronic	chronic	chronic	chronic	chronic
East of South St.	Robin	L				H	M		L
	Shrew	H	L				M	L	
West of South St.	Robin	L				L	M		L
	Shrew	H	H				L	L	
Orlando Property	Robin	L				H	H		L
	Shrew	H	L				H	L	
Floodplain	Robin	L		L	L	H	M		L
	Shrew	H	H			L		L	
Soil Reference Area	Robin	L				H	M		L
	Shrew	H	L					L	

Notes:

(1) In general, risk estimates for aluminum are likely to overestimate the potential adverse ecological effects for the following reasons:

- Aluminum is an abundant component of the earth's crust and occurs naturally in soils and sediments at concentrations that are generally many orders of magnitude higher than anthropogenic inputs (USEPA, 2003);
- The forms of soluble aluminum, which may be toxic, are poorly understood and difficult to measure (USEPA, 2003); and
- Potential adverse effects to ecological receptors at this Site are overestimated as they are at other sites, because standard methods for the analysis of aluminum are not specific to the toxic forms of aluminum.

While cadmium, chromium, lead, selenium, vanadium, and zinc pose potential chronic risk at varying degrees of confidence in one or more areas to the robin and/or the shrew, these risks have not yet been compared to background risks (e.g., the potential risks in the soil reference area and/or the distribution and occurrence of these contaminants at the Site). This analysis will be performed as part of the forthcoming FS.

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Tables

Table 2-1. Summary of COPECs For Each Exposure Area and Media or Medium Within The Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Neponset River Surface Water[a]	Neponset River Sediment[a]	Tailrace Surface Water	Tailrace Sediment	Lewis Pond Sediment	On-Site Soil[b]	Floodplain Soil
Metals							
Aluminum		x [c]	x	x [c]	x [c]	x	x
Antimony						x	x
Arsenic						x	x
Barium	x	x [c]	x	x [c]	x [c]	x	x
Beryllium				x [c]	x [c]		
Cadmium			x		x	x	x
Chromium			x		x	x	x
Cobalt		x [c]	x	x [c]	x [c]	x	
Copper			x		x	x	x
Iron	x	x	x			x [c]	x [c]
Lead		x	x	x	x	x	x
Manganese	x	x	x	x	x	x	x
Mercury				x	x	x	x
Nickel		x	x	x	x	x	x
Selenium				x [c]	x [c]	x	x
Silver					x		
Thallium				x [c]	x [c]	x	x
Vanadium		x [c]	x	x [c]	x [c]	x	x
Zinc		x	x	x	x	x	x
PAHs							
2-Methylnaphthalene		x	x [c]	x	x	x [c]	x [c]
Acenaphthene		x		x	x	x	
Acenaphthylene		x [c]	x [c]	x [c]	x [c]	x [c]	x [c]
Anthracene		x		x	x	x [c]	x [c]
Benzo[a]anthracene		x	x	x	x	x [c]	x [c]
Benzo[a]pyrene		x	x	x	x	x	x
Benzo[b]fluoranthene	x [c]	x [c]	x [c]	x [c]	x [c]	x [c]	x [c]
Benzo[g,h,i]perylene	x [c]	x	x [c]	x	x	x [c]	x [c]
Benzo[k]fluoranthene	x [c]	x	x [c]	x	x	x [c]	x [c]
Chrysene	x [c]	x	x [c]	x	x	x [c]	x [c]
Dibenz[a,h]anthracene		x	x [c]	x	x	x [c]	x [c]
Fluoranthene		x		x	x	x [c]	x [c]
Fluorene		x		x	x	x	

Table 2-1. Summary of COPECs For Each Exposure Area and Media or Medium Within The Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Neponset River Surface Water[a]	Neponset River Sediment[a]	Tailrace Surface Water	Tailrace Sediment	Lewis Pond Sediment	On-Site Soil[b]	Floodplain Soil
Indeno[1,2,3-cd]pyrene		x	x [c]	x	x	x [c]	x [c]
Naphthalene		x		x	x	x [c]	x [c]
Phenanthrene		x		x	x	x [c]	x [c]
Pyrene	x [c]	x	x [c]	x	x	x [c]	x [c]
Other SVOCs							
1,2-Dichlorobenzene							x [c]
2,4-Dimethylphenol				x [c]	x [c]		
4-Nitroaniline	x [c]						
4-Methylphenol				x [c]	x [c]	x [c]	x [c]
Benzoic acid		x [c]		x [c]	x [c]	x [c]	x [c]
Benzyl alcohol				x	x		
bis(2-Ethylhexyl)phthalate		x		x	x		
Butylbenzylphthalate						x [c]	x [c]
Carbazole		x [c]		x [c]	x [c]	x [c]	x [c]
Di-n-octylphthalate		x [c]					
Dibenzofuran						x [c]	x [c]
Petroleum fractions							
C11-C22 Aromatic Hydrocarbons						x [c]	
C19-C36 Aliphatic Hydrocarbons						x [c]	
C9-C18 Aliphatic Hydrocarbons						x [c]	
VOCs							
Acetone					x		
2-Butanone			x [c]				
Carbon disulfide				x	x	x [c]	
Methyl tert-butyl ether (MTBE)					x [c]		
o-Xylene						x [c]	
Trichlorofluoromethane						x [c]	

Notes;
[a] Neponset River includes the Lower Former Mill Tailrace.
[b] The On-Site soil exposure area is further divided into East of South Street, West of South Street, and the Orlando Property.
[c] Compound is a COPEC because no screening level is available for that compound.

TABLE 2.2
Summary of Samples
Blackburn and Union Privileges Site
Walpole, Massachusetts

Medium	Receptor	Exposure Area	Sample ID	Sample Date	Sample Depth (ft)
Soil	Robin, Shrew	Floodplain	FP-01 & OW-404	10/10/01	0 - 1
			FP-02	10/10/01	0 - 1
			FP-03	10/10/01	0 - 1
			FP-04	10/10/01	0 - 1
			FP-05/0-1 & OW-410	8/5/03	0 - 1
			FP-05	10/10/01	0 - 1
			FP-06 / 0-1	8/5/03	0 - 1
			FP-06	10/10/01	0 - 1
			FP-08	10/10/01	0 - 1
			FP-09A / 0-1'	10/13/06	0 - 1
			FP-09B / 0-1'	10/13/06	0 - 1
			FP-09C / 0-1'	10/13/06	0 - 1
			FP-09D / 0-1'	10/13/06	0 - 1
			FP-09E / 0-1'	10/13/06	0 - 1
			FP-09F / 0-1' & OW-412	10/13/06	0 - 1
			FP-09 / 0-1	8/5/03	0 - 1
			FP-09	10/10/01	0 - 1
			FP-10	10/10/01	0 - 1
			FPW-1-1 to FPW-1-5 (composite)	8/8/03	0 - 0.5
			FPW-2-1 to FPW-2-4 (composite)	8/8/03	0 - 0.5
			FPW-3-1 to FPW-3-6 (composite)	8/8/03	0 - 0.5
	Robin, Shrew	West of South Street	OSA-1-1 to OSA-1-3 (composite)	8/7/03	0 - 0.5
			OSA-2-1 to OSA-2-3 (composite)	8/12/03	0 - 0.5
			OSA-3-1 to OSA-3-4 (composite)	8/12/03	0 - 0.5
			SB-49 / S-1-2	4/24/01	0 - 4
			SB-50 / S-1-2	4/24/01	0 - 4
			SS-28	7/23/01	0 - 1
			SS-30	3/28/01	0 - 1
			SS-31 & OW-102	2/26/01	0 - 1
			SS-32	2/22/01	0 - 1
			SS-33	2/23/01	0 - 1
			SS-34	5/2/01	0 - 1
			SS-35	5/2/01	0 - 1
			SS-36	2/21/01	0 - 1
			SS-37	4/23/01	0 - 1
			SS-38	4/23/01	0 - 1
			SS-39	2/22/01	0 - 1
			SS-40	2/26/01	0 - 1
	Robin, Shrew	East of South Street	EUA-1-1 to EUA-1-7 (composite) & OW-112	8/8/03	0 - 0.5
			EUA-2-1 to EUA-2-3 (composite)	8/8/03	0 - 0.5
			EUA-3-1 to EUA-3-5 (composite)	8/8/03	0 - 0.5
			SS-01	5/9/01	0 - 1
			SS-02	4/26/01	0 - 1
			SS-03	5/9/01	0 - 1
			SS-04	3/21/01	0 - 1
			SS-05	3/19/01	0 - 1
			SS-06	3/15/01	0 - 1
			SS-07	3/15/01	0 - 1
			SS-08	3/14/01	0 - 1
			SS-58	4/26/01	0 - 1
			SS-59	4/26/01	0 - 1
			SS-60	4/25/01	0 - 1
			SS-61	4/25/01	0 - 1
			SS-62 & OW-105-1	4/17/01	0 - 1
			SS-63	4/2/01	0 - 1
			SS-64	3/23/01	0 - 1
			SS-65	3/26/01	0 - 1
	Robin, Shrew	Orlando Property	OP-1-1 to OP-1-3 (composite)	8/8/03	0 - 0.5
			OP-2-1 to OP-2-4 (composite)	8/8/03	0 - 0.5
			OP-3-1 to OP-3-5 (composite)	8/8/03	0 - 0.5
			SS-66	7/9/01	0 -1
			SS-67	7/11/01	0 -1
			SS-68	7/11/01	0 -1
			SS-69	7/10/01	0 -1
			SS-70 & OW-108	7/10/01	0 -1
			SS-71	7/10/01	0 -1
			SS-72	7/10/01	0 -1
			SS-73	7/10/01	0 -1

TABLE 2.2
Summary of Samples
Blackburn and Union Privileges Site
Walpole, Massachusetts

Medium	Receptor	Exposure Area	Sample ID	Sample Date	Sample Depth (ft)
Soil Cont'd	Robin, Shrew	Soil Reference Area	FPR-01	10/9/01	0 - 1
			FPR-02	10/9/01	0 - 1
			FPR-03	10/9/01	0 - 1
			FPR-04	10/9/01	0 - 1
			FPR-05	10/9/01	0 - 1
			FPR-06	10/9/01	0 - 1
			FPR-07	10/9/01	0 - 1
			FPR-08	10/9/01	0 - 1
			FPR-09	10/9/01	0 - 1
			FPR-10	10/9/01	0 - 1
			OSR-1-1-S to OSR-1-5-S (composite) & OW-113	11/21/03	0 - 0.5
			OSR-2-1-S to OSR-2-3-S (composite)	11/4/03	0 - 0.5
			OSR-3-1-S to OSR 3-4-S (composite)	10/31/03	0 - 0.5
Earthworm	Robin, Shrew	Floodplain	FPW-1-1-W to FPW-1-5-W (composite)	8/8/03	
			FPW-2-1-W to FPW-2-4-W (composite)	8/8/03	
			FPW-3-1 to FPW-3-6 (composite)	8/8/03	
	Robin, Shrew	West of South Street	OSA-1-1-W to OSA-1-3-W (composite)	8/7/03	
			OSA-2-1-W to OSA-2-3-W (composite)	8/12/03	
			OSA-3-1-W to OSA-3-4-W (composite)	8/12/03	
	Robin, Shrew	East of South Street	EUA-1-1-W to EUA-1-7-W (composite) & OW-112	8/8/03	
			EUA-2-1-W to EUA-2-3-W (composite)	8/8/03	
			EUA-3-1-W to EUA-3-5-W (composite)	8/8/03	
	Robin, Shrew	Orlando Property	OP-1-1-W to OP-1-3-W (composite)	8/8/03	
			OP-2-1-W to OP-2-4-W (composite)	8/8/03	
			OP-3-1-W to OP-3-5-W (composite)	8/8/03	
	Robin, Shrew	Soil Reference Area	OSR-1-1-W to OSR-1-5-W (composite) 7& OW-904	11/21/03	
			OSR-2-1-W to OSR-2-3-W (composite)	11/4/03	
			OSR-3-1-W to OSR 3-4-W (composite)	10/31/03	
Sediment	Muskrat, Raccoon	Neponset River *	NR-1 & OW-401	7/26/01	0 - 0.3
			NR-2	7/26/01	0 - 0.2
			NR-3	7/26/01	0 - 0.2
			NR-4	7/26/01	0 - 0.5
			NR-5	7/26/01	0 - 0.2
			NR-5	12/18/02	0 - 0.5
			NR-6	7/26/01	0 - 0.3
			NR-7	7/25/01	0 - 0.1
			NR-7	12/18/02	0 - 0.5
			NR-8	7/25/01	0 - 0.2
			NR-8	12/18/02	0 - 0.5
			TR-4	7/25/01	0 - 0.4
			TR-5	7/25/01	0 - 0.6
	Muskrat, Raccoon	Lewis Pond	LP-01 & OW-402	7/31/01	0 - 0.5
			LP-01	12/18/02	0 - 0.5
			LP-02	7/31/01	0 - 0.3
			LP-03	7/31/01	0 - 0.4
			LP-04	7/31/01	0 - 0.5
			LP-05	7/30/01	0 - 0.5
			LP-06	7/30/01	0 - 0.5
			LP-06	12/18/02	0 - 0.5
			LP-07	7/30/01	0 - 0.5
			LP-08	7/30/01	0 - 0.5
			LP-09	7/30/01	0 - 0.5
			LP-09	12/18/02	0 - 0.5
			LP-10	7/30/01	0 - 0.5
	Muskrat	Upper Former Mill Tailrace	TR-1	7/25/01	0 - 0.5
			TR-2	7/25/01	0 - 0.4
			TR-3	7/25/01	0 - 0.4
			TR-3 & OW-409	12/16/02	0 - 0.5
	Muskrat, Raccoon	Neponset River Reference Area	SedRN-1&OW-407	5/24/02	0 - 0.5
			SedRN-2	5/24/02	0 - 0.5
			SedRN-3	5/24/02	0 - 0.5
			SedRN-4	5/24/02	0 - 0.5
			SedRN-4	12/18/02	0 - 0.5
			SedRN-5	5/24/02	0 - 0.5

TABLE 2.2
Summary of Samples
Blackburn and Union Privileges Site
Walpole, Massachusetts

Medium	Receptor	Exposure Area	Sample ID	Sample Date	Sample Depth (ft)
Sediment Cont'd	Raccoon	Lower Pond Reference Area	SedRNwd-01&OW-408	12/17/02	0 - 0.5
			SedRNwd-02	12/17/02	0 - 0.5
			SedRNwd-03	12/17/02	0 - 0.5
			SedRNwd-04	12/17/02	0 - 0.5
			SedRNwd-05	12/17/02	0 - 0.5
			SedRNwd-06	12/17/02	0 - 0.5
			SedRNwd-07	12/17/02	0 - 0.5
			SedRNwd-08	12/17/02	0 - 0.5
			SedRNwd-09	12/17/02	0 - 0.5
			SedRNwd-10	12/17/02	0 - 0.5
Surface Water	Robin, Shrew, Muskrat, Raccoon, Heron, Kingfisher	Neponset River *	SW-102	4/5/01	
			SW-102	8/1/01	
			SW-103	4/4/01	
			SW-103	8/1/01	
			SW-105	4/4/01	
			SW-105	8/1/01	
			SW-107	4/4/01	
			SW-107	8/1/01	
			SW-108	4/4/01	
			SW-108	8/1/01	
	Robin, Shrew Muskrat, Raccoon	Neponset River Reference Area	SWR-1	4/5/01	
			SWR-1	8/2/01	
			SWR-2	4/5/01	
			SWR-2	8/2/01	
			SWR-3	4/5/01	
			SWR-3	8/2/01	
			SWR-4	4/5/01	
			SWR-4	8/2/01	
			SWR-5	4/5/01	
			SWR-5	8/1/01	
	Muskrat	Upper Former Mill Tailrace	SW-106	4/4/01	
			OW-301	4/4/01	
			SW-106 & OW-302	8/1/01	
Invertebrates	Muskrat, Raccoon	Neponset River *	NR-5-B	1/28/03	
			NR-7-B	1/28/03	
			NR-8-B	1/28/03	
	Muskrat, Raccoon	Lewis Pond	LP-01-B	1/27/03	
			LP-06-B	1/27/03	
			LP-09-B	1/27/03	
	Muskrat	Upper Former Mill Tailrace	TR-3-B	1/27/03	
	Muskrat, Raccoon	Neponset River Reference Area	SedRN-4-B	1/28/03	
	Muskrat, Raccoon	Lower Pond Reference	SedRNwd-01-B & OW-901	1/27/03	
Fish	Raccoon, Great Blue Heron, Kingfisher	Neponset River *	NRW-1	8/18/03	
			NRW-3	8/18/03	
			NRW-4	8/18/03	
			NRW-5	8/18/03	
	Raccoon, Great Blue Heron, Kingfisher	Lewis Pond	LPW-1	8/19/03	
			LPW-2	8/19/03	
			LPW-3	8/19/03	
			LPW-4	8/19/03	
			LPW-5	8/19/03	
	Raccoon, Kingfisher	Lower Pond Reference	NWD-1-W	10/30/03	
			NWD-2-W	10/30/03	
			NWD-3-W	10/30/03	
			NWD-6-W	10/30/03	
			NWD-7-W	10/30/03	

Note:
* Neponset River includes the Lower Former Mill Tailrace
When field duplicate samples were taken at a particular location, two sample IDs are listed (e.g., FP-01 & OW-404).

Table 2-3. Assessment And Measurement Endpoints
Baseline Ecological Risk Assessment
Blackburn and Union Privileges Site
Walpole, Massachusetts

Assessment Endpoint	Indicator Species	Measurement Endpoint	Data Required (type of data)
Assessment Endpoint 1: Sustainability of local populations of benthic invertebrates and fish.	Fish Benthic invertebrates	Surface water concentrations at or below National Recommended Water Quality Criteria (NRWQC).	Surface water data (field/lab)
		Exposure concentrations in fish at or below published no observable adverse effects concentrations.	Fish data (field) Published toxicity studies (literature)
		No significant adverse effects to benthic invertebrates from exposure to sediment.	Aquatic toxicity bioassays with sediment (field/lab) Benthic invertebrate data from bioaccumulation bioassays (field/lab) Published toxicity studies (literature)
Assessment Endpoint 2: Survival, growth, and reproduction of local populations of aquatic wildlife.	Kingfisher Great blue heron Muskrat Raccoon	Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife.	Chemical analyses of exposure media (field/lab/literature) Food to receptor bioaccumulation (model) Published toxicity studies (literature)
Assessment Endpoint 3: Maintenance of terrestrial bird and small mammal populations	American robin Short-tailed shrew	Dietary doses of COPECs to wildlife as compared to Toxicity Reference Values for dietary dose to wildlife.	Chemical analyses of exposure media (field/lab/literature) Food to receptor bioaccumulation (model) Published toxicity studies (literature)

Table 3-1. Summary Statistics of Soil Data
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	15	15	100	4.85E+03	1.04E+04	7.18E+03		
Antimony	15	6	40	8.90E-01	6.70E+00	1.35E+00	9.40E-01	3.70E-01
Arsenic	21	21	100	1.40E+00	2.83E+01	6.70E+00		
Barium	15	15	100	2.41E+01	1.56E+02	7.92E+01		
Cadmium	15	15	100	1.50E-01	2.80E+00	8.02E-01		
Chromium	15	15	100	1.18E+01	9.68E+01	2.57E+01		
Copper	15	15	100	1.41E+01	1.63E+02	5.45E+01		
Iron	15	15	100	8.80E+03	4.68E+04	1.79E+04		
Lead	21	21	100	2.10E+01	7.30E+02	2.50E+02		
Manganese	15	15	100	5.30E+01	8.11E+02	2.72E+02		
Mercury	15	15	100	1.10E-01	1.40E+00	4.01E-01		
Nickel	15	15	100	4.80E+00	1.65E+02	2.24E+01		
Selenium	15	14	93	1.50E-01	1.60E+00	7.68E-01	2.20E-01	2.20E-01
Thallium	15	12	80	6.30E-02	1.50E-01	1.18E-01	4.60E-01	3.50E-01
Vanadium	15	15	100	1.60E+01	4.86E+01	3.25E+01		
Zinc	15	15	100	2.04E+01	4.60E+02	1.42E+02		
PAHs (ug/kg)								
2-Methylnaphthalene	21	19	90	9.40E+00	1.10E+03	1.13E+02	3.50E+01	3.20E+01
Acenaphthylene	21	21	100	3.40E+00	2.40E+02	8.21E+01		
Anthracene	21	21	100	5.80E+00	1.50E+03	1.61E+02		
Benz(a)anthracene	21	21	100	3.60E+01	3.60E+03	5.51E+02		
Benzo(a)pyrene	21	21	100	3.70E+01	2.70E+03	4.92E+02		
Benzo(b)fluoranthene	21	21	100	5.80E+01	3.20E+03	6.11E+02		
Benzo(g,h,i)perylene	21	21	100	2.80E+01	6.60E+02	2.10E+02		
Benzo(k)fluoranthene	21	21	100	2.70E+01	1.80E+03	4.35E+02		
Chrysene	21	21	100	4.90E+01	3.40E+03	6.64E+02		
Dibenz(a,h)anthracene	21	21	100	9.90E+00	1.60E+02	6.31E+01		
Fluoranthene	21	21	100	6.90E+01	1.00E+04	1.28E+03		
Indeno(1,2,3-cd)pyrene	21	21	100	2.60E+01	7.20E+02	2.56E+02		
Naphthalene	21	21	100	6.50E+00	1.10E+03	1.29E+02		
Phenanthrene	21	21	100	4.30E+01	1.10E+04	1.00E+03		
Pyrene	21	21	100	6.90E+01	9.20E+03	1.16E+03		
Other SVOCs (ug/kg)								
1,2-Dichlorobenzene	12	1	8	4.00E+01	4.00E+01	1.29E+02	9.70E+02	1.60E+02
4-Methylphenol	12	1	8	9.30E+01	9.30E+01	1.30E+02	9.70E+02	1.60E+02
Benzoic acid	12	12	100	5.00E+01	3.30E+03	6.24E+02		
Butylbenzylphthalate	12	2	17	3.70E+01	8.40E+01	1.29E+02	9.70E+02	1.80E+02
Carbazole	15	6	40	3.70E+01	1.20E+03	1.61E+02	2.20E+02	1.60E+02
Dibenzofuran	12	3	25	4.00E+01	6.80E+02	1.41E+02	2.20E+02	1.60E+02

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-2. Summary Statistics of Soil Data
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	17	17	100	4.85E+03	9.58E+03	6.68E+03		
Antimony	17	1	6	7.20E-01	7.20E-01	3.52E-01	1.00E+00	2.90E-01
Arsenic	17	17	100	1.40E+00	3.57E+01	5.11E+00		
Barium	17	17	100	1.10E+01	9.87E+01	4.22E+01		
Cadmium	17	15	88	8.20E-02	3.00E-01	1.77E-01	8.70E-02	7.30E-02
Chromium	17	17	100	6.60E+00	1.63E+01	9.85E+00		
Cobalt	17	17	100	2.00E+00	6.10E+00	3.72E+00		
Copper	17	17	100	4.10E+00	3.50E+01	1.61E+01		
Iron	17	17	100	6.68E+03	2.36E+04	1.14E+04		
Lead	17	17	100	9.60E+00	2.20E+02	6.81E+01		
Manganese	17	17	100	7.96E+01	3.30E+02	1.87E+02		
Mercury	17	15	88	3.30E-02	5.30E-01	9.12E-02	3.50E-02	3.00E-02
Nickel	17	15	88	5.20E+00	2.22E+01	8.84E+00	4.20E+00	3.80E+00
Selenium	17	17	100	1.50E-01	4.70E-01	3.12E-01		
Thallium	17	12	71	3.80E-02	9.80E-02	6.19E-02	1.18E-01	9.40E-02
Vanadium	17	17	100	1.29E+01	3.78E+01	2.20E+01		
Zinc	17	17	100	1.49E+01	1.40E+02	6.06E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	17	7	41	1.50E+01	1.90E+03	1.98E+02	2.20E+02	5.70E+00
Acenaphthene	17	7	41	1.10E+01	7.50E+02	8.53E+01	2.70E+01	5.70E+00
Acenaphthylene	17	13	76	6.30E+00	2.40E+03	3.27E+02	2.20E+02	5.70E+00
Anthracene	17	10	59	7.10E+00	2.30E+03	3.32E+02	2.60E+01	5.70E+00
Benz(a)anthracene	17	15	88	7.30E+00	6.40E+03	9.72E+02	6.50E+00	5.70E+00
Benzo(a)pyrene	17	15	88	7.50E+00	8.20E+03	1.16E+03	6.50E+00	5.70E+00
Benzo(b)fluoranthene	17	15	88	1.10E+01	6.70E+03	1.02E+03	6.50E+00	5.70E+00
Benzo(g,h,i)perylene	17	15	88	7.20E+00	3.20E+03	4.79E+02	6.50E+00	5.70E+00
Benzo(k)fluoranthene	17	15	88	9.30E+00	5.20E+03	7.49E+02	6.50E+00	5.70E+00
Chrysene	17	15	88	1.30E+01	7.80E+03	1.19E+03	6.50E+00	5.70E+00
Dibenz(a,h)anthracene	17	10	59	6.30E+00	8.80E+02	1.32E+02	2.60E+01	5.70E+00
Fluoranthene	17	17	100	6.10E+00	1.30E+04	1.86E+03		
Fluorene	17	7	41	1.10E+01	1.90E+03	1.91E+02	2.70E+01	5.70E+00
Indeno(1,2,3-cd)pyrene	17	15	88	8.10E+00	4.20E+03	5.77E+02	6.50E+00	5.70E+00
Naphthalene	17	15	88	9.40E+00	2.50E+03	2.91E+02	2.60E+01	6.50E+00
Phenanthrene	17	16	94	7.50E+00	1.90E+04	2.10E+03	5.70E+00	5.70E+00
Pyrene	17	17	100	6.60E+00	1.80E+04	2.58E+03		
Other SVOCs (ug/kg)								
4-Methylphenol	17					1.40E+02	8.60E+02	1.30E+02
Benzoic acid	17	13	76	9.30E+01	4.60E+03	5.15E+02	4.60E+02	3.40E+02
Butylbenzylphthalate	17	1	6	1.08E+02	1.08E+02	1.39E+02	8.60E+02	1.30E+02
Carbazole	17	6	35	8.30E+01	7.60E+02	1.70E+02	3.00E+02	1.30E+02
Dibenzofuran	17	4	24	5.20E+01	2.10E+02	1.37E+02	8.60E+02	1.30E+02

Table 3-2. Summary Statistics of Soil Data
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Petroleum fractions (ug/kg)								
C11-C22 Aromatic Hydrocarbons	2	2	100	9.80E+03	3.90E+04	2.44E+04		
C19-C36 Aliphatic Hydrocarbons	2	1	50	2.10E+04	2.10E+04	1.16E+04	4.50E+03	4.50E+03
C9-C18 Aliphatic Hydrocarbons	2	1	50	4.50E+03	4.50E+03	3.10E+03	3.40E+03	3.40E+03
VOCs (ug/kg)								
Carbon disulfide	5					1.03E+00	2.40E+00	1.80E+00
o-Xylene	5	1	20	1.00E+00	1.00E+00	1.04E+00	2.40E+00	1.80E+00
Trichlorofluoromethane	5	2	40	4.20E+00	2.00E+02	4.15E+01	2.20E+00	1.90E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-3. Summary Statistics of Soil Data
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	19	19	100	3.13E+03	1.22E+04	7.77E+03		
Antimony	19	6	32	9.50E-01	4.40E+00	7.77E-01	9.30E-01	2.80E-01
Arsenic	19	19	100	8.30E-01	1.06E+02	1.89E+01		
Barium	19	19	100	7.70E+00	1.70E+02	5.08E+01		
Cadmium	19	17	89	9.60E-02	3.50E+00	5.26E-01	9.40E-02	6.20E-02
Chromium	19	19	100	4.10E+00	4.50E+01	1.32E+01		
Cobalt	19	19	100	2.10E+00	1.01E+01	4.57E+00		
Copper	19	19	100	8.10E+00	6.70E+01	3.55E+01		
Iron	19	19	100	5.08E+03	2.33E+04	1.36E+04		
Lead	19	19	100	7.60E+00	4.20E+02	1.19E+02		
Manganese	19	19	100	6.16E+01	3.79E+02	2.18E+02		
Mercury	19	16	84	3.40E-02	1.00E+00	2.09E-01	3.00E-02	2.60E-02
Nickel	19	17	89	4.10E+00	1.91E+01	9.22E+00	4.50E+00	4.30E+00
Selenium	19	18	95	1.10E-01	1.70E+00	4.39E-01	2.00E-01	2.00E-01
Thallium	19	15	79	4.80E-02	2.40E-01	1.01E-01	1.14E-01	7.40E-02
Vanadium	19	19	100	7.10E+00	4.43E+01	2.44E+01		
Zinc	19	19	100	1.74E+01	3.90E+02	1.06E+02		
PAHs (ug/kg)								
2-Methylnaphthalene	19	13	68	6.20E+00	2.30E+03	2.70E+02	4.20E+02	5.40E+00
Acenaphthene	19	14	74	1.10E+01	4.00E+03	2.84E+02	2.30E+02	5.40E+00
Acenaphthylene	19	16	84	1.70E+01	1.20E+04	9.37E+02	5.70E+00	5.40E+00
Anthracene	19	17	89	6.20E+00	1.40E+04	1.06E+03	5.70E+00	5.60E+00
Benz(a)anthracene	19	19	100	1.40E+01	2.20E+04	2.26E+03		
Benzo(a)pyrene	19	19	100	1.60E+01	1.80E+04	2.07E+03		
Benzo(b)fluoranthene	19	19	100	1.60E+01	3.00E+04	3.32E+03		
Benzo(g,h,i)perylene	19	19	100	1.00E+01	1.10E+04	1.03E+03		
Benzo(k)fluoranthene	19	19	100	1.30E+01	1.40E+04	1.62E+03		
Chrysene	19	19	100	2.00E+01	2.40E+04	2.61E+03		
Dibenz(a,h)anthracene	19	16	84	1.10E+01	3.40E+03	3.25E+02	5.70E+00	5.40E+00
Fluoranthene	19	19	100	3.40E+01	5.60E+04	5.22E+03		
Fluorene	19	15	79	1.40E+01	4.30E+03	2.90E+02	2.30E+02	5.40E+00
Indeno(1,2,3-cd)pyrene	19	19	100	9.80E+00	1.30E+04	1.27E+03		
Naphthalene	19	14	74	9.30E+00	2.20E+03	2.89E+02	4.20E+02	5.40E+00
Phenanthrene	19	19	100	2.40E+01	2.20E+04	2.05E+03		
Pyrene	19	19	100	3.40E+01	4.50E+04	4.25E+03		
Other SVOCs (ug/kg)								
4-Methylphenol	19	3	16	1.20E+02	5.00E+02	1.35E+02	4.20E+02	1.20E+02
Benzoic acid	19	14	74	4.80E+01	2.70E+03	5.13E+02	5.70E+02	2.20E+02
Butylbenzylphthalate	19	1	5	7.90E+01	7.90E+01	1.17E+02	4.20E+02	1.20E+02
Carbazole	19	11	58	5.30E+01	2.00E+03	2.44E+02	2.40E+02	1.50E+02
Dibenzofuran	19	5	26	1.50E+02	2.80E+03	3.10E+02	4.20E+02	1.50E+02
Petroleum fractions (ug/kg)								
C11-C22 Aromatic Hydr	0							
C19-C36 Aliphatic Hydro	0							
C9-C18 Aliphatic Hydroc	0							
VOCs (ug/kg)								
Carbon disulfide	4	1	25	1.30E+00	1.30E+00	1.05E+00	2.10E+00	1.80E+00
o-Xylene	4					1.04E+00	2.50E+00	1.80E+00
Trichlorofluoromethane	4	2	50	1.10E+00	2.70E+00	1.50E+00	2.50E+00	1.90E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-4. Summary Statistics of Soil Data
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	95% UCL LogNormal	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)									
Aluminum	11	11	100	5.11E+03	1.10E+04	7.62E+03	8.90E+03		
Antimony	11					3.93E-01	4.62E-01	9.70E-01	5.00E-01
Arsenic	11	11	100	1.60E+00	4.40E+00	2.47E+00	2.91E+00		
Barium	11	11	100	1.64E+01	6.60E+01	3.33E+01	4.39E+01		
Cadmium	11	9	82	9.20E-02	4.50E-01	1.71E-01	3.09E-01	1.20E-01	8.80E-02
Chromium	11	11	100	5.70E+00	1.72E+01	1.01E+01	1.23E+01		
Cobalt	11	11	100	2.90E+00	9.60E+00	4.56E+00	5.54E+00		
Copper	11	11	100	7.20E+00	2.40E+01	1.23E+01	1.63E+01		
Iron	11	11	100	7.29E+03	2.78E+04	1.26E+04	1.55E+04		
Lead	11	11	100	1.57E+01	1.00E+02	4.27E+01	7.28E+01		
Manganese	11	11	100	1.54E+02	6.15E+02	3.28E+02	4.54E+02		
Mercury	11	9	82	3.00E-02	1.30E-01	5.06E-02	8.73E-02	3.30E-02	2.80E-02
Nickel	11	10	91	4.80E+00	9.30E+00	6.20E+00	7.96E+00	4.50E+00	4.50E+00
Selenium	11	11	100	1.60E-01	5.50E-01	2.95E-01	3.74E-01		
Thallium	11	4	36	4.80E-02	1.90E-01	6.91E-02	8.97E-02	1.14E-01	9.60E-02
Vanadium	11	11	100	1.35E+01	5.67E+01	2.47E+01	3.17E+01		
Zinc	11	11	100	2.17E+01	8.40E+01	4.35E+01	5.79E+01		
PAHs (ug/kg)									
2-Methylnaphthalene	11	5	45	6.40E+00	7.80E+02	7.80E+01	3.22E+02	2.80E+01	5.80E+00
Acenaphthene	11	4	36	5.90E+00	1.80E+03	1.70E+02	1.02E+03	2.80E+01	5.80E+00
Acenaphthylene	11	6	55	7.00E+00	2.70E+02	3.87E+01	1.94E+02	2.80E+01	5.90E+00
Anthracene	11	7	64	6.50E+00	3.30E+03	3.12E+02	2.58E+03	2.40E+01	5.80E+00
Benz(a)anthracene	11	10	91	9.90E+00	5.00E+03	5.05E+02	2.79E+03	2.40E+01	2.40E+01
Benzo(a)pyrene	11	11	100	9.10E+00	3.80E+03	3.92E+02	1.85E+03		
Benzo(b)fluoranthene	11	11	100	1.40E+01	3.50E+03	3.73E+02	1.27E+03		
Benzo(g,h,i)perylene	11	10	91	1.10E+01	1.30E+03	1.45E+02	8.41E+02	6.10E+00	6.10E+00
Benzo(k)fluoranthene	11	11	100	7.80E+00	3.10E+03	3.16E+02	1.33E+03		
Chrysene	11	11	100	1.40E+01	4.60E+03	4.76E+02	2.07E+03		
Dibenz(a,h)anthracene	11	5	45	6.40E+00	6.10E+02	6.45E+01	3.22E+02	2.80E+01	5.80E+00
Fluoranthene	11	11	100	2.10E+01	8.30E+03	8.43E+02	3.88E+03		
Fluorene	11	4	36	1.20E+01	1.80E+03	1.71E+02	1.11E+03	2.80E+01	5.80E+00
Indeno(1,2,3-cd)pyrene	11	11	100	7.40E+00	2.10E+03	2.24E+02	7.79E+02		
Naphthalene	11	5	45	6.70E+00	1.00E+03	9.87E+01	4.35E+02	2.80E+01	5.80E+00
Phenanthrene	11	10	91	1.10E+01	9.20E+03	8.88E+02	6.66E+03	2.40E+01	2.40E+01
Pyrene	11	11	100	1.60E+01	7.10E+03	7.29E+02	3.69E+03		
Other SVOCs (ug/kg)									
4-Methylphenol	11	1	9	5.60E+01	5.60E+01	1.06E+02	1.33E+02	2.70E+02	1.20E+02
Benzoic acid	11	9	82	4.80E+01	6.20E+02	1.60E+02	2.64E+02	4.00E+02	2.40E+02
Butylbenzylphthalate	11					1.08E+02	1.30E+02	2.70E+02	1.20E+02
Carbazole	11	1	9	1.20E+03	1.20E+03	2.10E+02	3.40E+02	2.70E+02	1.20E+02
Dibenzofuran	11	1	9	8.80E+02	8.80E+02	1.81E+02	2.79E+02	2.70E+02	1.20E+02
Petroleum fractions (ug/kg)									
C11-C22 Aromatic Hydr	0								
C19-C36 Aliphatic Hydr	0								
C9-C18 Aliphatic Hydro	0								
VOCs (ug/kg)									
Carbon disulfide	2					1.08E+00	N/A	2.20E+00	2.10E+00
o-Xylene	2					1.08E+00	N/A	2.20E+00	2.10E+00
Trichlorofluoromethane	2					1.08E+00	N/A	2.20E+00	2.10E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-5. Summary Statistics of Soil Data
Soil Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	95% UCL LogNormal	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg dry)									
Aluminum	13	13	100	4.21E+03	1.40E+04	8.63E+03	1.12E+04		
Antimony	13	4	31	2.70E-01	1.10E+00	5.32E-01	6.61E-01	9.70E-01	7.60E-01
Arsenic	13	13	100	1.20E+00	3.50E+01	8.26E+00	2.08E+01		
Barium	13	13	100	1.44E+01	8.70E+01	3.68E+01	5.15E+01		
Cadmium	13	13	100	1.10E-01	4.90E-01	2.50E-01	3.30E-01		
Calcium	10	10	100	3.20E+02	2.57E+03	1.26E+03	2.33E+03		
Chromium	13	13	100	7.70E+00	2.02E+01	1.24E+01	1.44E+01		
Cobalt	13	11	85	2.00E+00	5.90E+00	2.72E+00	3.93E+00	1.80E+00	1.70E+00
Copper	13	13	100	1.90E+00	7.23E+01	2.36E+01	5.68E+01		
Iron	13	13	100	4.46E+03	1.48E+04	1.01E+04	1.27E+04		
Lead	13	13	100	5.50E+00	1.35E+02	6.40E+01	1.34E+02		
Manganese	13	13	100	1.78E+01	3.50E+02	1.44E+02	2.82E+02		
Mercury	13	13	100	2.70E-02	3.30E-01	1.44E-01	2.48E-01		
Nickel	13	9	69	4.70E+00	1.40E+01	6.28E+00	1.03E+01	4.80E+00	3.80E+00
Selenium	13	13	100	1.20E-01	5.00E+00	1.00E+00	1.71E+00		
Thallium	13	10	77	5.30E-02	1.80E-01	9.56E-02	1.25E-01	1.10E-01	1.02E-01
Vanadium	13	13	100	1.51E+01	5.21E+01	3.23E+01	3.92E+01		
Zinc	13	13	100	7.10E+00	6.92E+01	3.62E+01	6.03E+01		
PAHs (ug/kg dry)									
2-Methylnaphthalene	13	8	62	1.60E+01	1.50E+02	3.99E+01	1.91E+02	1.20E+01	5.20E+00
Acenaphthene	13	2	15	4.50E+01	5.00E+01	1.11E+01	2.02E+01	1.20E+01	5.20E+00
Acenaphthylene	13	10	77	1.60E+01	6.10E+02	8.42E+01	3.74E+02	9.80E+00	9.60E+00
Anthracene	13	10	77	1.20E+01	3.60E+02	6.67E+01	3.09E+02	9.80E+00	9.60E+00
Benzo(a)anthracene	13	12	92	1.40E+01	1.30E+03	2.47E+02	1.99E+03	9.70E+00	9.70E+00
Benzo(a)pyrene	13	12	92	1.40E+01	1.20E+03	2.70E+02	2.47E+03	9.70E+00	9.70E+00
Benzo(b)fluoranthene	13	12	92	2.00E+01	1.20E+03	3.00E+02	2.78E+03	9.70E+00	9.70E+00
Benzo(g,h,i)perylene	13	12	92	1.10E+01	4.40E+02	1.21E+02	6.19E+02	9.70E+00	9.70E+00
Benzo(k)fluoranthene	13	12	92	1.80E+01	8.80E+02	2.26E+02	1.43E+03	9.70E+00	9.70E+00
Chrysene	13	12	92	2.40E+01	1.90E+03	3.84E+02	3.76E+03	9.70E+00	9.70E+00
Dibenz(a,h)anthracene	13	8	62	1.10E+01	1.50E+02	3.88E+01	1.61E+02	1.20E+01	9.60E+00
Fluoranthene	13	12	92	3.90E+01	2.70E+03	5.41E+02	5.88E+03	9.70E+00	9.70E+00
Fluorene	13	6	46	1.10E+01	2.30E+02	3.04E+01	1.00E+02	1.20E+01	5.20E+00
Indeno(1,2,3-cd)pyrene	13	12	92	1.20E+01	4.00E+02	1.20E+02	5.85E+02	9.70E+00	9.70E+00
Naphthalene	13	11	85	1.10E+01	1.50E+02	5.00E+01	2.25E+02	9.70E+00	5.20E+00
Phenanthrene	13	12	92	2.90E+01	2.40E+03	4.09E+02	3.53E+03	9.70E+00	9.70E+00
Pyrene	13	12	92	3.00E+01	3.00E+03	5.10E+02	5.29E+03	9.70E+00	9.70E+00
Other SVOCs (ug/kg dry)									
1,2-Dichlorobenzene	13	1	8	3.50E+01	3.50E+01	1.04E+02	1.37E+02	3.90E+02	1.30E+02
4-Methylphenol	13					1.09E+02	1.30E+02	3.90E+02	1.30E+02
Benzoic acid	13	11	85	7.30E+01	8.90E+03	9.88E+02	2.97E+03	3.90E+02	1.90E+02
Butylbenzylphthalate	13	3	23	5.20E+01	2.20E+02	1.24E+02	1.63E+02	3.90E+02	1.30E+02
Carbazole	13	4	31	7.90E+01	1.30E+02	9.77E+01	1.07E+02	2.50E+02	1.30E+02
Dibenzofuran	13	3	23	6.40E+01	1.00E+02	1.01E+02	1.18E+02	3.90E+02	1.30E+02
VOCs (ug/kg dry)									
Carbon disulfide	10					1.71E+00	2.15E+00	7.20E+00	2.40E+00
o-Xylene	10					1.71E+00	2.15E+00	7.20E+00	2.40E+00
Trichlorofluoromethane	10					1.71E+00	2.15E+00	7.20E+00	2.40E+00
Other									
Total Organic Carbon (%)	13	13	100	1.77E+00	2.72E+01	9.23E+00	1.67E+01		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-6. Summary Statistics of Site Earthworm Tissue
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	95th Percentile	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg wet)									
Aluminum	3	3	100	1.30E+02	6.00E+02	3.47E+02	5.71E+02		
Antimony	3	1	33	5.20E-02	5.20E-02	3.32E-02	4.92E-02	4.80E-02	4.70E-02
Arsenic	3	3	100	3.70E-01	1.20E+00	7.43E-01	1.15E+00		
Barium	3	3	100	9.30E+00	2.90E+01	1.98E+01	2.82E+01		
Cadmium	3	3	100	2.30E+00	4.00E+00	3.20E+00	3.93E+00		
Chromium	3	3	100	8.40E-01	3.00E+00	1.85E+00	2.87E+00		
Cobalt	3	3	100	3.50E-01	7.00E-01	5.33E-01	6.85E-01		
Copper	3	3	100	5.10E+00	8.50E+00	6.87E+00	8.35E+00		
Iron	3	3	100	2.60E+02	9.80E+02	5.77E+02	9.31E+02		
Lead	3	3	100	3.40E+01	5.70E+01	4.53E+01	5.58E+01		
Manganese	3	3	100	1.00E+01	1.10E+02	5.60E+01	1.04E+02		
Mercury	3	3	100	3.70E-02	9.70E-02	6.17E-02	9.24E-02		
Nickel	3	3	100	5.80E-01	1.30E+00	8.53E-01	1.24E+00		
Selenium	3	3	100	4.60E-01	1.40E+00	9.47E-01	1.36E+00		
Thallium	3	3	100	5.80E-03	2.60E-02	1.34E-02	2.43E-02		
Vanadium	3	3	100	6.80E-01	2.70E+00	1.59E+00	2.57E+00		
Zinc	3	3	100	6.90E+01	1.20E+02	8.97E+01	1.16E+02		
PAHs (ug/kg wet)									
2-Methylnaphthalene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Acenaphthene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Acenaphthylene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Anthracene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Benz[a]anthracene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Benzo[a]pyrene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Benzo[b]fluoranthene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Benzo[g,h,i]perylene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Benzo[k]fluoranthene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Chrysene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Dibenz[a,h]anthracene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Fluoranthene	3	1	33	3.30E+02	3.30E+02	2.40E+02	3.17E+02	3.90E+02	3.90E+02
Fluorene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Indeno[1,2,3-cd]pyrene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Naphthalene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Phenanthrene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Pyrene	3	1	33	2.40E+02	2.40E+02	2.10E+02	2.36E+02	3.90E+02	3.90E+02
Other SVOCs (ug/kg wet)									
1,2-Dichlorobenzene	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
4-Methylphenol	3	1	33	1.60E+02	1.60E+02	1.85E+02	2.00E+02	4.00E+02	3.90E+02
Benzoic acid	3	3	100	8.90E+02	4.10E+03	2.50E+03	3.94E+03		
Butylbenzylphthalate	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Carbazole	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Dibenzofuran	3					1.97E+02	2.00E+02	4.00E+02	3.90E+02
Other									
Lipids (%)	3	3	100	9.80E-01	1.50E+00	1.19E+00	1.46E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-7 Summary Statistics of Site Earthworm Tissue
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg wet)								
Aluminum	3	3	100	3.10E+02	8.50E+02	5.20E+02		
Antimony	3					2.20E-02	4.50E-02	4.30E-02
Arsenic	3	3	100	5.50E-01	8.90E-01	6.80E-01		
Barium	3	3	100	1.70E+01	2.80E+01	2.33E+01		
Cadmium	3	3	100	1.00E+00	1.40E+00	1.27E+00		
Chromium	3	3	100	7.60E-01	1.80E+00	1.32E+00		
Cobalt	3	3	100	4.50E-01	5.60E-01	5.07E-01		
Copper	3	3	100	3.50E+00	4.60E+00	4.23E+00		
Iron	3	3	100	4.20E+02	7.60E+02	6.10E+02		
Lead	3	3	100	6.60E+00	1.60E+01	1.22E+01		
Manganese	3	3	100	2.10E+01	3.40E+01	2.80E+01		
Mercury	3	3	100	7.30E-02	8.80E-02	8.03E-02		
Nickel	3	3	100	6.10E-01	2.30E+00	1.29E+00		
Selenium	3	3	100	6.00E-01	1.70E+00	1.23E+00		
Thallium	3	3	100	5.80E-03	1.30E-02	9.07E-03		
Vanadium	3	3	100	1.30E+00	3.00E+00	1.90E+00		
Zinc	3	3	100	6.60E+01	1.00E+02	7.87E+01		
PAHs (ug/kg wet)								
2-Methylnaphthalene	3					1.92E+02	3.90E+02	3.70E+02
Acenaphthene	3					1.92E+02	3.90E+02	3.70E+02
Acenaphthylene	3					1.92E+02	3.90E+02	3.70E+02
Anthracene	3					1.92E+02	3.90E+02	3.70E+02
Benz[a]anthracene	3	1	33	3.00E+02	3.00E+02	2.27E+02	3.90E+02	3.70E+02
Benzo[a]pyrene	3	1	33	3.90E+02	3.90E+02	2.57E+02	3.90E+02	3.70E+02
Benzo[b]fluoranthene	3	1	33	4.40E+02	4.40E+02	2.73E+02	3.90E+02	3.70E+02
Benzo[g,h,i]perylene	3	1	33	2.70E+02	2.70E+02	2.17E+02	3.90E+02	3.70E+02
Benzo[k]fluoranthene	3	1	33	1.60E+02	1.60E+02	1.80E+02	3.90E+02	3.70E+02
Chrysene	3	1	33	3.00E+02	3.00E+02	2.27E+02	3.90E+02	3.70E+02
Dibenz[a,h]anthracene	3					1.92E+02	3.90E+02	3.70E+02
Fluoranthene	3	1	33	5.20E+02	5.20E+02	3.00E+02	3.90E+02	3.70E+02
Fluorene	3					1.92E+02	3.90E+02	3.70E+02
Indeno[1,2,3-cd]pyrene	3	1	33	2.70E+02	2.70E+02	2.17E+02	3.90E+02	3.70E+02
Naphthalene	3					1.92E+02	3.90E+02	3.70E+02
Phenanthrene	3	1	33	4.20E+02	4.20E+02	2.67E+02	3.90E+02	3.70E+02
Pyrene	3	1	33	1.10E+03	1.10E+03	4.93E+02	3.90E+02	3.70E+02
Other SVOCs (ug/kg wet)								
1,2-Dichlorobenzene	3					1.92E+02	3.90E+02	3.70E+02
4-Methylphenol	3	2	67	1.50E+02	4.50E+02	2.65E+02	3.90E+02	3.90E+02
Benzoic acid	3	3	100	7.10E+02	2.30E+03	1.70E+03		
Butylbenzylphthalate	3					1.92E+02	3.90E+02	3.70E+02
Carbazole	3					1.92E+02	3.90E+02	3.70E+02
Dibenzofuran	3					1.92E+02	3.90E+02	3.70E+02
Other								
Lipids (%)	3	3	100	1.10E+00	1.80E+00	1.40E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-8. Summary Statistics for Site Earthworm Tissue
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg wet)								
Aluminum	3	3	100	2.50E+02	5.20E+02	3.57E+02		
Antimony	3	1	33	8.65E-02	8.65E-02	4.48E-02	4.90E-02	4.70E-02
Arsenic	3	3	100	1.80E+00	1.40E+01	7.53E+00		
Barium	3	3	100	1.20E+01	1.70E+01	1.45E+01		
Cadmium	3	3	100	7.10E-01	3.10E+00	2.07E+00		
Chromium	3	3	100	8.60E-01	1.30E+00	1.10E+00		
Cobalt	3	3	100	4.10E-01	6.40E-01	4.93E-01		
Copper	3	3	100	7.10E+00	1.65E+01	1.06E+01		
Iron	3	3	100	3.60E+02	1.10E+03	6.47E+02		
Lead	3	3	100	1.15E+01	4.90E+01	2.62E+01		
Manganese	3	3	100	1.40E+01	5.90E+01	3.10E+01		
Mercury	3	3	100	3.45E-02	1.80E-01	9.05E-02		
Nickel	3	3	100	7.30E-01	1.20E+00	8.90E-01		
Selenium	3	3	100	4.50E-01	2.50E+00	1.30E+00		
Thallium	3	3	100	7.30E-03	2.90E-02	1.54E-02		
Vanadium	3	3	100	1.30E+00	2.00E+00	1.63E+00		
Zinc	3	3	100	3.70E+01	2.00E+02	1.01E+02		
PAHs (ug/kg wet)								
2-Methylnaphthalene	3					1.95E+02	4.00E+02	3.80E+02
Acenaphthene	3					1.95E+02	4.00E+02	3.80E+02
Acenaphthylene	3					1.95E+02	4.00E+02	3.80E+02
Anthracene	3					1.95E+02	4.00E+02	3.80E+02
Benz[a]anthracene	3	1	33	2.30E+02	2.30E+02	2.08E+02	4.00E+02	3.90E+02
Benzo[a]pyrene	3	1	33	2.00E+02	2.00E+02	1.98E+02	4.00E+02	3.90E+02
Benzo[b]fluoranthene	3	1	33	4.50E+02	4.50E+02	2.82E+02	4.00E+02	3.90E+02
Benzo[g,h,i]perylene	3					1.95E+02	4.00E+02	3.80E+02
Benzo[k]fluoranthene	3	1	33	2.30E+02	2.30E+02	2.08E+02	4.00E+02	3.90E+02
Chrysene	3	1	33	2.20E+02	2.20E+02	2.05E+02	4.00E+02	3.90E+02
Dibenz[a,h]anthracene	3					1.95E+02	4.00E+02	3.80E+02
Fluoranthene	3	1	33	3.90E+02	3.90E+02	2.62E+02	4.00E+02	3.90E+02
Fluorene	3					1.95E+02	4.00E+02	3.80E+02
Indeno[1,2,3-cd]pyrene	3	1	33	1.90E+02	1.90E+02	1.95E+02	4.00E+02	3.90E+02
Naphthalene	3					1.95E+02	4.00E+02	3.80E+02
Phenanthrene	3					1.95E+02	4.00E+02	3.80E+02
Pyrene	3	1	33	5.00E+02	5.00E+02	2.98E+02	4.00E+02	3.90E+02
Other SVOCs (ug/kg wet)								
1,2-Dichlorobenzene	3					1.95E+02	4.00E+02	3.80E+02
4-Methylphenol	3	1	33	1.70E+02	1.70E+02	1.87E+02	4.00E+02	3.80E+02
Benzoic acid	3	3	100	2.70E+02	4.40E+03	2.29E+03		
Butylbenzylphthalate	3					1.95E+02	4.00E+02	3.80E+02
Carbazole	3					1.95E+02	4.00E+02	3.80E+02
Dibenzofuran	3					1.95E+02	4.00E+02	3.80E+02
Other								
Lipids (%)	3	3	100	1.10E+00	1.30E+00	1.23E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-9. Summary Statistics of Site Earthworm Tissue
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg wet)								
Aluminum	3	3	100	1.10E+02	2.30E+02	1.77E+02		
Antimony	3					2.30E-02	4.90E-02	4.40E-02
Arsenic	3	3	100	2.00E-01	5.60E-01	4.27E-01		
Barium	3	3	100	1.90E+00	1.30E+01	6.17E+00		
Cadmium	3	3	100	1.10E+00	4.30E+00	2.30E+00		
Chromium	3	3	100	4.20E-01	5.70E-01	5.07E-01		
Cobalt	3	3	100	3.70E-01	5.20E-01	4.47E-01		
Copper	3	3	100	2.00E+00	3.70E+00	2.93E+00		
Iron	3	3	100	1.60E+02	2.80E+02	2.23E+02		
Lead	3	3	100	1.30E+00	6.90E+01	3.01E+01		
Manganese	3	3	100	8.50E+00	4.60E+01	2.28E+01		
Mercury	3	3	100	3.10E-02	1.90E-01	1.01E-01		
Nickel	3	3	100	2.20E-01	4.50E-01	3.30E-01		
Selenium	3	3	100	6.50E-01	7.40E+00	4.45E+00		
Thallium	3	3	100	6.50E-03	9.60E-03	8.20E-03		
Vanadium	3	3	100	5.60E-01	8.70E-01	6.93E-01		
Zinc	3	3	100	4.80E+01	1.90E+02	1.04E+02		
PAHs (ug/kg wet)								
2-Methylnaphthalene	3					1.95E+02	4.00E+02	3.80E+02
Acenaphthene	3					1.95E+02	4.00E+02	3.80E+02
Acenaphthylene	3					1.95E+02	4.00E+02	3.80E+02
Anthracene	3					1.95E+02	4.00E+02	3.80E+02
Benz[a]anthracene	3					1.95E+02	4.00E+02	3.80E+02
Benzo[a]pyrene	3					1.95E+02	4.00E+02	3.80E+02
Benzo[b]fluoranthene	3					1.95E+02	4.00E+02	3.80E+02
Benzo[g,h,i]perylene	3					1.95E+02	4.00E+02	3.80E+02
Benzo[k]fluoranthene	3					1.95E+02	4.00E+02	3.80E+02
Butylbenzylphthalate	3					1.95E+02	4.00E+02	3.80E+02
Chrysene	3					1.95E+02	4.00E+02	3.80E+02
Dibenz[a,h]anthracene	3					1.95E+02	4.00E+02	3.80E+02
Fluoranthene	3					1.95E+02	4.00E+02	3.80E+02
Fluorene	3					1.95E+02	4.00E+02	3.80E+02
Indeno[1,2,3-cd]pyrene	3					1.95E+02	4.00E+02	3.80E+02
Naphthalene	3					1.95E+02	4.00E+02	3.80E+02
Phenanthrene	3					1.95E+02	4.00E+02	3.80E+02
Pyrene	3					1.95E+02	4.00E+02	3.80E+02
Other SVOCs (ug/kg wet)								
1,2-Dichlorobenzene	3					1.95E+02	4.00E+02	3.80E+02
4-Methylphenol	3	2	67	2.40E+02	6.10E+02	3.50E+02	4.00E+02	4.00E+02
Benzoic acid	3	3	100	6.00E+02	8.20E+03	3.60E+03		
Carbazole	3					1.95E+02	4.00E+02	3.80E+02
Dibenzofuran	3					1.95E+02	4.00E+02	3.80E+02
Other								
Lipids (%)	3	3	100	1.00E+00	1.30E+00	1.17E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-10. Summary Statistics of Reference Earthworm Tissue Data
Soil Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	95th Percentile	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg wet)									
Aluminum	3	3	100	1.40E+02	4.80E+02	3.27E+02	4.68E+02		
Antimony	3	2	67	4.50E-02	5.50E-02	3.82E-02	5.40E-02	2.90E-02	2.90E-02
Arsenic	3	3	100	2.30E-01	5.10E+00	2.94E+00	4.94E+00		
Barium	3	3	100	1.15E+00	2.50E+01	1.67E+01	2.49E+01		
Cadmium	3	3	100	1.00E+00	1.10E+00	1.05E+00	1.10E+00		
Chromium	3	3	100	3.20E-01	6.70E-01	5.23E-01	6.61E-01		
Cobalt	3	3	100	2.30E-01	5.70E-01	4.00E-01	5.53E-01		
Copper	3	3	100	1.25E+00	4.50E+00	3.15E+00	4.42E+00		
Iron	3	3	100	2.05E+02	6.40E+02	4.55E+02	6.28E+02		
Lead	3	3	100	1.70E+01	6.20E+01	3.37E+01	5.80E+01		
Manganese	3	3	100	2.10E+01	3.10E+01	2.57E+01	3.04E+01		
Mercury	3	3	100	8.70E-02	1.40E-01	1.05E-01	1.35E-01		
Nickel	3	3	100	3.10E-01	6.20E-01	4.87E-01	6.11E-01		
Selenium	3	3	100	5.50E-01	1.75E+00	9.73E-01	1.64E+00		
Thallium	3	3	100	6.00E-03	1.50E-02	1.13E-02	1.48E-02		
Vanadium	3	3	100	8.40E-01	2.00E+00	1.38E+00	1.93E+00		
Zinc	3	3	100	2.60E+01	4.00E+01	3.20E+01	3.90E+01		
PAHs (ug/kg wet)									
2-Methylnaphthalene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Acenaphthene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Acenaphthylene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Anthracene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Benzo(a)anthracene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Benzo(a)pyrene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Benzo(b)fluoranthene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Benzo(g,h,I)perylene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Benzo(k)fluoranthene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Butylbenzylphthalate	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Chrysene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Dibenz(a,h)anthracene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Fluoranthene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Fluorene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Indeno(1,2,3-cd)pyrene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Naphthalene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Phenanthrene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Pyrene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Other SVOCs (ug/kg wet)									
1,2-Dichlorobenzene	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
4-Methylphenol	3	2	67	1.80E+02	1.50E+03	6.20E+02	1.37E+03	3.60E+02	3.60E+02
Benzoic acid	3	3	100	5.40E+03	5.50E+03	5.43E+03	5.49E+03		
Carbazole	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Dibenzofuran	3					1.83E+02	1.85E+02	3.70E+02	3.60E+02
Other									
Percent Lipids	3	3	100	1.10E+00	2.80E+00	2.07E+00	2.75E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-11. Summary Statistics of Sediment Data
Neponset River and Lower Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Compounds								
Metals (mg/kg)								
Aluminum	13	13	100	1.70E+03	1.40E+04	4.24E+03		
Barium	13	13	100	1.13E+01	1.35E+02	3.32E+01		
Cobalt	13	13	100	2.20E+00	1.01E+01	3.81E+00		
Iron	11	11	100	4.13E+03	2.22E+04	1.01E+04		
Lead	13	13	100	8.80E+00	8.50E+02	1.25E+02		
Manganese	13	13	100	1.03E+02	2.34E+03	5.72E+02		
Nickel	13	9	69	3.00E+00	9.31E+01	1.34E+01	3.70E+00	3.20E+00
Vanadium	13	13	100	6.80E+00	4.84E+01	1.64E+01		
Zinc	13	13	100	2.28E+01	2.19E+02	7.09E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	13	12	92	7.00E+00	7.30E+02	1.21E+02	7.70E+00	7.70E+00
Acenaphthene	13	12	92	1.20E+01	6.00E+02	1.15E+02	6.50E+00	6.50E+00
Acenaphthylene	13	13	100	1.80E+01	1.30E+03	1.83E+02		
Anthracene	13	13	100	2.00E+01	1.40E+03	2.62E+02		
Benzo[a]anthracene	13	13	100	5.90E+01	4.00E+03	7.38E+02		
Benzo[a]pyrene	13	13	100	6.10E+01	3.20E+03	6.72E+02		
Benzo[b]fluoranthene	13	13	100	5.90E+01	4.60E+03	8.69E+02		
Benzo[g,h,i]perylene	13	13	100	3.00E+01	1.60E+03	2.82E+02		
Benzo[k]fluoranthene	13	13	100	3.60E+01	3.80E+03	6.10E+02		
Chrysene	13	13	100	8.00E+01	4.50E+03	8.26E+02		
Dibenz[a,h]anthracene	13	13	100	8.80E+00	2.40E+02	7.18E+01		
Fluoranthene	13	13	100	1.30E+02	9.00E+03	1.58E+03		
Fluorene	13	13	100	1.40E+01	8.70E+02	1.65E+02		
Indeno[1,2,3-cd]pyrene	13	13	100	3.40E+01	1.80E+03	3.25E+02		
Naphthalene	13	13	100	9.00E+00	9.20E+02	1.89E+02		
Phenanthrene	13	13	100	1.20E+02	6.90E+03	1.15E+03		
Pyrene	13	13	100	1.40E+02	8.50E+03	1.51E+03		
Other SVOCs (ug/kg)								
Benzoic acid	8	8	100	4.00E+01	6.20E+02	1.79E+02		
bis(2-Ethylhexyl)phthalate	13	8	62	3.90E+01	6.50E+03	7.03E+02	4.20E+02	2.30E+02
Carbazole	13	6	46	5.00E+01	6.30E+02	1.78E+02	2.60E+02	2.00E+02
Di-n-octylphthalate	11	1	9	5.30E+01	5.30E+01	1.07E+02	2.60E+02	1.90E+02

Notes:
Neponset River includes the Lower Former Mill Tailrace. COPCs in the Neponset River and Lower Former Mill Tailrace are shown on this table.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-12. Summary Statistics of Sediment Data
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	13	13	100	4.50E+03	1.10E+04	7.57E+03		
Barium	13	13	100	2.60E+01	1.27E+02	8.70E+01		
Beryllium	13	9	69	2.50E-01	8.90E-01	4.76E-01	5.40E-01	4.10E-01
Cadmium	13	13	100	6.40E-01	8.00E+00	3.70E+00		
Chromium	13	13	100	3.52E+01	4.10E+02	9.82E+01		
Cobalt	13	13	100	4.70E+00	2.50E+01	9.85E+00		
Copper	13	13	100	4.96E+01	1.80E+02	9.35E+01		
Lead	13	13	100	2.40E+02	7.60E+03	1.11E+03		
Manganese	13	13	100	2.08E+02	1.01E+03	5.00E+02		
Mercury	13	13	100	1.70E-01	9.00E-01	4.12E-01		
Nickel	13	13	100	8.60E+00	5.10E+02	6.69E+01		
Selenium	13	13	100	4.40E-01	1.30E+00	8.38E-01		
Silver	13	3	23	3.10E-01	1.90E+00	4.70E-01	8.30E-01	2.00E-01
Thallium	13	7	54	8.40E-02	1.40E-01	9.14E-02	1.70E-01	9.90E-02
Vanadium	13	13	100	1.80E+01	8.46E+01	3.82E+01		
Zinc	13	13	100	1.60E+02	4.77E+02	2.75E+02		
PAHs (ug/kg)								
2-Methylnaphthalene	13	13	100	2.70E+01	1.90E+02	1.35E+02		
Acenaphthene	13	13	100	3.10E+01	2.30E+02	1.21E+02		
Acenaphthylene	13	13	100	2.90E+02	9.00E+02	5.87E+02		
Anthracene	13	13	100	3.00E+02	1.10E+03	6.26E+02		
Benzo[a]anthracene	13	13	100	1.00E+03	3.40E+03	1.79E+03		
Benzo[a]pyrene	13	13	100	9.00E+02	3.70E+03	1.83E+03		
Benzo[b]fluoranthene	13	13	100	1.30E+03	4.00E+03	2.32E+03		
Benzo[g,h,i]perylene	13	13	100	1.90E+02	6.50E+02	3.77E+02		
Benzo[k]fluoranthene	13	13	100	9.50E+02	3.90E+03	2.13E+03		
Chrysene	13	13	100	1.10E+03	4.10E+03	2.14E+03		
Dibenz[a,h]anthracene	13	13	100	1.00E+02	2.50E+02	1.46E+02		
Fluoranthene	13	13	100	2.00E+03	6.10E+03	3.34E+03		
Fluorene	13	13	100	5.10E+01	3.60E+02	2.19E+02		
Indeno[1,2,3-cd]pyrene	13	13	100	2.40E+02	7.20E+02	4.68E+02		
Naphthalene	13	13	100	6.10E+01	7.60E+02	2.84E+02		
Phenanthrene	13	13	100	6.90E+02	2.70E+03	1.71E+03		
Pyrene	13	13	100	1.90E+03	7.30E+03	3.47E+03		
Other SVOCs (ug/kg)								
2,4-Dimethylphenol	13	10	77	5.20E+01	6.10E+02	1.27E+02	3.10E+02	2.10E+02
4-Methylphenol	13	11	85	7.40E+01	5.50E+02	1.79E+02	3.10E+02	2.10E+02
Benzoic acid	12	12	100	1.20E+02	1.60E+03	9.33E+02		
Benzyl alcohol	13	6	46	4.70E+01	1.00E+02	1.07E+02	3.70E+02	2.10E+02
bis(2-Ethylhexyl)phthalate	13	10	77	2.20E+02	3.00E+03	7.15E+02	1.90E+03	4.00E+02
Carbazole	13	12	92	1.00E+02	2.80E+02	1.62E+02	2.10E+02	2.10E+02
VOCs (ug/kg)								
Acetone	11	5	45	2.00E+01	4.40E+02	1.45E+02	1.90E+02	3.20E+01
Carbon disulfide	11	2	18	3.80E+00	8.20E+00	3.46E+00	7.90E+00	4.50E+00
Methyl tert-butyl ether (MTBE)	11	1	9	2.70E+00	2.70E+00	2.84E+00	7.90E+00	4.50E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-13. Summary Statistics of Sediment Data
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Compounds								
Metals (mg/kg)								
Aluminum	4	4	100	5.26E+03	1.31E+04	7.68E+03		
Barium	4	4	100	1.27E+01	1.43E+02	5.03E+01		
Beryllium	4	2	50	3.15E-01	5.90E-01	2.91E-01	2.90E-01	2.30E-01
Cobalt	4	4	100	2.10E+00	1.25E+01	5.18E+00		
Lead	4	4	100	1.13E+01	5.35E+02	1.75E+02		
Manganese	4	4	100	8.52E+01	2.50E+03	7.28E+02		
Mercury	4	2	50	3.60E-02	1.40E-01	5.08E-02	2.80E-02	2.60E-02
Nickel	4	4	100	3.40E+00	5.65E+01	2.01E+01		
Selenium	4	2	50	3.05E-01	6.10E-01	2.71E-01	1.90E-01	1.50E-01
Thallium	4	3	75	4.40E-02	1.90E-01	9.70E-02	8.80E-02	8.80E-02
Vanadium	4	4	100	1.20E+01	4.91E+01	2.17E+01		
Zinc	4	4	100	2.46E+01	2.64E+02	9.33E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	4	4	100	7.30E+01	4.50E+02	2.72E+02		
Acenaphthene	4	4	100	2.50E+01	2.50E+02	1.13E+02		
Acenaphthylene	4	4	100	3.00E+01	6.70E+02	2.41E+02		
Anthracene	4	4	100	3.40E+01	7.80E+02	2.52E+02		
Benz[a]anthracene	4	4	100	3.00E+01	2.70E+03	8.05E+02		
Benzo[a]pyrene	4	4	100	2.50E+01	2.40E+03	7.96E+02		
Benzo[b]fluoranthene	4	4	100	2.60E+01	4.40E+03	1.27E+03		
Benzo[g,h,i]perylene	4	4	100	1.80E+01	3.80E+02	1.46E+02		
Benzo[k]fluoranthene	4	4	100	1.80E+01	3.20E+03	9.65E+02		
Chrysene	4	4	100	3.00E+01	3.00E+03	9.36E+02		
Dibenz[a,h]anthracene	4	4	100	6.30E+00	1.80E+02	6.23E+01		
Fluoranthene	4	4	100	7.20E+01	3.90E+03	1.24E+03		
Fluorene	4	4	100	3.00E+01	3.60E+02	1.40E+02		
Indeno[1,2,3-cd]pyrene	4	4	100	1.70E+01	4.40E+02	1.68E+02		
Naphthalene	4	4	100	9.60E+01	5.20E+02	3.03E+02		
Phenanthrene	4	4	100	1.90E+02	2.00E+03	7.55E+02		
Pyrene	4	4	100	7.60E+01	4.80E+03	1.58E+03		
SVOC (ug/kg)								
2,4-Dimethylphenol	4	1	25	6.00E+01	6.00E+01	9.50E+01	2.50E+02	1.90E+02
4-Methylphenol	4	1	25	1.60E+02	1.60E+02	1.20E+02	2.50E+02	1.90E+02
Benzoic acid	4	4	100	4.20E+01	4.80E+02	1.90E+02		
Benzyl alcohol	4	1	25	6.60E+01	6.60E+01	9.65E+01	2.50E+02	1.90E+02
bis(2-Ethylhexyl)phthalate	4	2	50	4.60E+01	2.90E+02	1.44E+02	2.80E+02	2.00E+02
Carbazole	4	1	25	2.10E+02	2.10E+02	1.33E+02	2.50E+02	1.90E+02
VOCs (ug/kg)								
Carbon disulfide	4	2	50	2.10E+00	7.40E+00	2.98E+00	2.90E+00	1.90E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-14. Summary Statistics of Sediment Data
Reference Area for Neponset River (Upstream Neponset River)
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	6	6	100	2.10E+03	3.40E+03	2.65E+03		
Barium	6	6	100	1.00E+01	1.30E+02	3.58E+01		
Beryllium	6	6	100	8.90E-02	2.35E-01	1.32E-01		
Cadmium	6	6	100	1.40E-01	1.20E+00	3.62E-01		
Chromium	6	6	100	4.00E+00	9.90E+00	6.65E+00		
Cobalt	6	6	100	2.20E+00	5.85E+00	3.33E+00		
Copper	6	6	100	3.40E+00	9.90E+00	5.40E+00		
Iron	6	6	100	4.40E+03	3.40E+04	1.07E+04		
Lead	6	6	100	7.20E+00	1.75E+01	1.09E+01		
Manganese	6	6	100	1.40E+02	2.25E+03	7.62E+02		
Mercury	6	5	83	6.90E-03	9.70E-03	7.38E-03	6.10E-03	6.10E-03
Nickel	6	6	100	2.60E+00	7.25E+00	4.41E+00		
Selenium	6	2	33	1.20E-01	2.60E-01	1.25E-01	2.00E-01	1.70E-01
Silver	6	1	17	5.20E-02	5.20E-02	3.40E-02	1.60E-01	3.30E-02
Thallium	6					8.20E-02	2.00E-01	8.40E-02
Vanadium	6	6	100	7.80E+00	1.80E+01	1.12E+01		
Zinc	6	6	100	2.00E+01	1.04E+02	3.86E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	6	3	50	8.30E+00	2.20E+01	8.04E+00	7.80E+00	3.00E+00
Acenaphthene	6	1	17	3.30E+00	3.30E+00	2.20E+00	7.80E+00	2.80E+00
Acenaphthylene	6	3	50	3.60E+00	5.10E+01	1.17E+01	7.80E+00	2.80E+00
Anthracene	6	3	50	3.70E+00	3.50E+01	8.50E+00	7.80E+00	2.80E+00
Benzo(a)anthracene	6	4	67	5.20E+00	1.40E+02	3.18E+01	7.80E+00	3.00E+00
Benzo(a)pyrene	6	4	67	3.30E+00	1.20E+02	2.80E+01	7.80E+00	3.00E+00
Benzo(b)fluoranthene	6	6	100	3.50E+00	8.20E+01	2.19E+01		
Benzo(g,h,i)perylene	6	3	50	8.70E+00	7.50E+01	1.79E+01	7.80E+00	2.80E+00
Benzo(k)fluoranthene	6	4	67	3.90E+00	8.70E+01	2.07E+01	7.80E+00	3.00E+00
Chrysene	6	6	100	3.10E+00	1.30E+02	3.04E+01		
Dibenz(a,h)anthracene	6	2	33	5.00E+00	2.30E+01	6.06E+00	7.80E+00	2.80E+00
Fluoranthene	6	6	100	5.00E+00	2.20E+02	5.33E+01		
Fluorene	6	1	17	9.80E+00	9.80E+00	3.28E+00	7.80E+00	2.80E+00
Indeno(1,2,3-cd)pyrene	6	3	50	7.80E+00	6.70E+01	1.64E+01	7.80E+00	2.80E+00
Naphthalene	6	3	50	4.40E+00	1.00E+01	5.08E+00	7.80E+00	3.00E+00
Phenanthrene	6	5	83	3.00E+00	1.50E+02	3.17E+01	7.80E+00	7.80E+00
Pyrene	6	6	100	4.40E+00	2.30E+02	5.34E+01		
Other SVOCs (ug/kg)								
2,4-Dimethylphenol	6					6.58E+01	2.00E+02	1.10E+02
4-Methylphenol	6					6.58E+01	2.00E+02	1.10E+02
4-Nitroaniline	6					6.58E+01	2.00E+02	1.10E+02
Benzoic acid	5	1	20	4.70E+01	4.70E+01	5.64E+01	1.20E+02	1.10E+02
Benzyl alcohol	6					6.58E+01	2.00E+02	1.10E+02
bis(2-Ethylhexyl)phthalate	6					7.67E+01	3.30E+02	1.10E+02
Carbazole	6					6.58E+01	2.00E+02	1.10E+02
Di-n-octylphthalate	6					6.58E+01	2.00E+02	1.10E+02
VOCs (ug/kg)								
2-Butanone (MEK)	6	5	83	3.40E+00	3.30E+01	1.19E+01	2.10E+00	2.10E+00
Acetone	6	5	83	5.30E+01	6.60E+02	1.77E+02	2.40E+01	2.40E+01
Carbon disulfide	6					1.03E+00	2.10E+00	1.90E+00
Methyl tert-butyl ether (MTBE)	6					1.03E+00	2.10E+00	1.90E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-15. Summary Statistics for Sediment Data
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	10	10	100	3.50E+03	2.30E+04	1.07E+04		
Barium	10	10	100	3.50E+01	2.50E+02	1.50E+02		
Beryllium	10	10	100	1.90E-01	1.20E+00	7.36E-01		
Cadmium	10	10	100	1.90E-01	4.60E+00	2.37E+00		
Chromium	10	10	100	1.10E+01	3.90E+01	2.83E+01		
Cobalt	10	10	100	4.10E+00	2.20E+01	1.25E+01		
Copper	10	10	100	1.60E+01	1.10E+02	7.11E+01		
Iron	10	10	100	9.00E+03	3.80E+04	2.08E+04		
Lead	10	10	100	5.70E+01	8.40E+02	5.21E+02		
Manganese	10	10	100	2.10E+02	1.40E+03	8.36E+02		
Mercury	10	10	100	4.80E-02	1.90E+00	7.96E-01		
Nickel	10	10	100	7.00E+00	3.00E+01	1.95E+01		
Selenium	10	10	100	1.40E-01	2.10E+00	1.15E+00		
Silver	10	7	70	2.60E-01	4.90E-01	3.04E-01	2.30E-01	1.80E-01
Thallium	10	5	50	1.90E-01	2.70E-01	1.45E-01	1.60E-01	7.50E-02
Vanadium	10	10	100	1.50E+01	8.20E+01	5.32E+01		
Zinc	10	10	100	5.90E+01	5.50E+02	3.11E+02		
PAHS (ug/kg)								
2-Methylnaphthalene	10	10	100	2.10E+01	4.60E+02	1.37E+02		
Acenaphthene	10	10	100	8.20E+01	4.70E+02	2.27E+02		
Acenaphthylene	10	10	100	8.10E+01	9.20E+02	4.44E+02		
Anthracene	10	10	100	3.30E+02	1.60E+03	8.44E+02		
Benz(a)anthracene	10	10	100	8.30E+02	5.90E+03	2.66E+03		
Benzo(a)pyrene	10	10	100	7.50E+02	6.00E+03	3.06E+03		
Benzo(b)fluoranthene	10	10	100	6.20E+02	6.10E+03	3.39E+03		
Benzo(g,h,i)perylene	10	10	100	3.10E+02	1.70E+03	7.73E+02		
Benzo(k)fluoranthene	10	10	100	7.20E+02	5.40E+03	3.28E+03		
Chrysene	10	10	100	9.70E+02	7.20E+03	3.59E+03		
Dibenz(a,h)anthracene	10	10	100	1.10E+02	6.90E+02	2.87E+02		
Fluoranthene	10	10	100	2.00E+03	1.50E+04	6.13E+03		
Fluorene	10	10	100	1.50E+02	1.20E+03	4.21E+02		
Indeno(1,2,3-cd)pyrene	10	10	100	3.30E+02	2.20E+03	9.41E+02		
Naphthalene	10	10	100	3.00E+01	4.20E+02	1.68E+02		
Phenanthrene	10	10	100	1.90E+03	7.10E+03	3.69E+03		
Pyrene	10	10	100	1.90E+03	1.30E+04	5.93E+03		
Other SVOCs (ug/kg)								
2,4-Dimethylphenol	10					1.37E+02	4.10E+02	2.00E+02
4-Methylphenol	10					1.37E+02	4.10E+02	2.00E+02
4-Nitroaniline	10					1.37E+02	4.10E+02	2.00E+02
Benzoic acid	10	10	100	1.30E+02	1.50E+03	7.14E+02		
Benzyl alcohol	10					1.37E+02	4.10E+02	2.00E+02
bis(2-Ethylhexyl)phthalate	10	3	30	4.00E+03	5.40E+03	2.05E+03	2.90E+03	5.30E+02
Carbazole	10	10	100	2.10E+02	7.90E+02	3.67E+02		
Di-n-octylphthalate	10					1.37E+02	4.10E+02	2.00E+02
VOCs (ug/kg)								
2-Butanone (MEK)	10	10	100	9.40E+00	2.70E+02	1.10E+02		
Acetone	10	10	100	7.50E+01	1.20E+03	4.88E+02		
Carbon disulfide	10	9	90	3.40E+00	2.90E+01	1.14E+01	2.90E+00	2.90E+00
Methyl tert-butyl ether (MTBE)	10					2.99E+00	1.30E+01	2.90E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-16. Summary Statistics for Surface Water
Neponset River *
Blackburn and Union Site
Walpole, Massachusetts

	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Dissolved Metals (ug/L)								
Aluminum - Dissolved	10	1	10	5.35E+02	5.35E+02	7.85E+01	5.56E+01	5.56E+01
Barium - Dissolved	10	10	100	1.39E+01	1.96E+01	1.77E+01		
Cadmium - Dissolved	10					5.50E-01	1.10E+00	1.10E+00
Chromium - Dissolved	10	6	60	1.20E+00	9.30E+00	2.08E+00	1.10E+00	1.10E+00
Copper - Dissolved	10	10	100	1.80E+00	1.78E+01	3.75E+00		
Iron - Dissolved	10	10	100	1.17E+02	1.28E+03	3.26E+02		
Lead - Dissolved	10	2	20	3.80E+00	6.74E+01	7.56E+00	1.10E+00	1.10E+00
Manganese - Dissolved	10	10	100	2.41E+01	1.25E+02	5.05E+01		
Nickel - Dissolved	10	7	70	1.20E+00	1.05E+01	2.34E+00	1.10E+00	1.10E+00
Vanadium - Dissolved	10	1	10	4.36E+01	4.36E+01	9.36E+00	1.11E+01	1.11E+01
Zinc - Dissolved	10	1	10	2.69E+01	2.69E+01	7.69E+00	1.11E+01	1.11E+01
Total Metals (ug/L)								
Aluminum - Total	10	7	70	5.59E+01	1.80E+04	2.38E+03	5.56E+01	5.56E+01
Barium - Total	10	10	100	1.47E+01	2.19E+02	4.87E+01		
Cadmium - Total	10	1	10	1.50E+00	1.50E+00	6.45E-01	1.10E+00	1.10E+00
Chromium - Total	10	2	20	1.49E+01	3.83E+01	5.76E+00	1.10E+00	1.10E+00
Copper - Total	10	10	100	1.90E+00	9.05E+01	1.44E+01		
Iron - Total	10	10	100	1.75E+02	1.38E+04	2.15E+03		
Lead - Total	10	2	20	1.85E+02	5.76E+02	7.65E+01	1.10E+00	1.10E+00
Manganese - Total	10	10	100	2.63E+01	9.50E+02	2.24E+02		
Nickel - Total	10	6	60	1.10E+00	6.13E+01	8.04E+00	1.10E+00	1.10E+00
Vanadium - Total	10	2	20	2.21E+01	1.22E+02	1.89E+01	1.11E+01	1.11E+01
Zinc - Total	10	4	40	1.12E+01	3.40E+02	6.13E+01	1.11E+01	1.11E+01
PAHs (ng/L)								
Benzo(a)anthracene	10	2	20	8.50E+01	4.10E+02	5.65E+01	2.50E+01	1.00E+01
Benzo(a)pyrene	10	6	60	2.80E+00	5.10E+02	6.60E+01	1.50E+01	1.00E+01
Benzo(b)fluoranthene	10	5	50	6.00E+00	5.70E+02	7.51E+01	2.50E+01	4.90E+00
Benzo(g,h,I)perylene	10	6	60	6.20E+00	3.10E+02	4.76E+01	2.50E+01	2.50E+01
Benzo(k)fluoranthene	10	3	30	5.20E+00	3.00E+02	4.40E+01	2.50E+01	4.80E+00
Chrysene	10	3	30	5.40E+00	6.20E+02	7.93E+01	2.50E+01	4.80E+00
Pyrene	10	5	50	6.10E+00	1.10E+03	1.41E+02	2.50E+01	1.00E+01
SVOCs (ug/L)								
4-Nitroaniline	10	1	10	7.10E-01	7.10E-01	9.71E-01	2.00E+00	2.00E+00

Notes:
* Neponset River includes the Lower Former Mill Tailrace. COPECs in the Neponset River and Lower Former Mill Tailrace are shown on this table.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-17. Summary Statistics for Surface Water
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Dissolved Metals (ug/L)								
Aluminum	3	3	100	1.35E+02	3.61E+02	2.34E+02		
Barium	3	3	100	7.10E+00	2.83E+01	1.56E+01		
Cadmium	3					5.50E-01	1.10E+00	1.10E+00
Chromium	3	3	100	2.50E+00	3.70E+00	2.93E+00		
Cobalt	3					5.50E-01	1.10E+00	1.10E+00
Copper	3	3	100	5.90E+00	1.70E+01	1.00E+01		
Iron	3	3	100	1.83E+02	6.23E+02	3.69E+02		
Lead	3	3	100	7.20E+00	2.84E+01	1.57E+01		
Manganese	3	3	100	2.02E+01	4.57E+01	3.06E+01		
Nickel	3	3	100	4.40E+00	1.10E+01	8.50E+00		
Vanadium	3	3	100	1.29E+01	3.06E+01	2.02E+01		
Zinc	3	3	100	2.36E+01	4.07E+01	3.21E+01		
Total Metals (ug/L)								
Aluminum	3	3	100	1.34E+03	7.33E+03	4.11E+03		
Barium	3	3	100	2.54E+01	6.69E+01	4.50E+01		
Cadmium	3					5.50E-01	1.10E+00	1.10E+00
Chromium	3	2	67	3.20E+00	9.30E+00	5.42E+00	7.50E+00	7.50E+00
Cobalt	3	2	67	2.20E+00	2.40E+00	1.72E+00	1.10E+00	1.10E+00
Copper	3	3	100	8.50E+00	2.35E+01	1.62E+01		
Iron	3	3	100	1.05E+03	5.37E+03	3.14E+03		
Lead	3	3	100	2.00E+01	7.44E+01	5.58E+01		
Manganese	3	3	100	4.68E+01	1.49E+02	1.06E+02		
Nickel	3	3	100	4.50E+00	1.56E+01	1.04E+01		
Vanadium	3	2	67	2.22E+01	3.66E+01	2.15E+01	1.11E+01	1.11E+01
Zinc	3	3	100	4.23E+01	9.33E+01	7.12E+01		
PAHs (ng/L)								
2-Methylnaphthalene	3	2	67	4.80E+01	2.90E+02	1.17E+02	2.50E+01	2.50E+01
Acenaphthylene	3	3	100	4.40E+01	2.70E+02	1.38E+02		
Benzo(a)anthracene	3	2	67	1.10E+02	6.00E+02	2.41E+02	2.70E+01	2.70E+01
Benzo(a)pyrene	3	3	100	4.10E+01	8.90E+02	3.67E+02		
Benzo(b)fluoranthene	3	3	100	3.30E+01	9.00E+02	3.54E+02		
Benzo(g,h,I)perylene	3	3	100	3.00E+01	5.00E+02	2.13E+02		
Benzo(k)fluoranthene	3	2	67	1.10E+02	4.70E+02	1.98E+02	2.70E+01	2.70E+01
Chrysene	3	3	100	3.60E+01	9.80E+02	3.85E+02		
Dibenz(a,h)anthracene	3	1	33	1.20E+02	1.20E+02	4.85E+01	2.60E+01	2.50E+01
Indeno(1,2,3-cd)pyrene	3	2	67	9.10E+01	4.30E+02	1.78E+02	2.50E+01	2.50E+01
Pyrene	3	3	100	1.10E+02	1.60E+03	6.87E+02		
VOCs (ug/L)								
2-Butanone (MEK)	3					1.00E+00	2.00E+00	2.00E+00

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-18. Summary Statistics for Reference Surface Water
Neponset River *
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Dissolved Metals (ug/L)								
Aluminum	10					2.78E+01	5.56E+01	5.56E+01
Barium	10	10	100	1.70E+01	1.84E+01	1.77E+01		
Cadmium	10					5.50E-01	1.10E+00	1.10E+00
Chromium	10	3	30	1.10E+00	2.90E+00	9.85E-01	1.10E+00	1.10E+00
Cobalt	10					5.50E-01	1.10E+00	1.10E+00
Copper	10	10	100	1.80E+00	2.30E+00	2.05E+00		
Iron	10	10	100	1.05E+02	3.94E+02	1.74E+02		
Lead	10					5.50E-01	1.10E+00	1.10E+00
Manganese	10	10	100	2.40E+01	5.83E+01	3.34E+01		
Nickel	10	5	50	1.50E+00	2.40E+00	1.17E+00	1.10E+00	1.10E+00
Vanadium	10					5.55E+00	1.11E+01	1.11E+01
Zinc	10	1	10	5.05E+01	5.05E+01	1.00E+01	1.11E+01	1.11E+01
Total Metals (ug/L)								
Aluminum	10	3	30	5.59E+01	6.03E+01	3.68E+01	5.56E+01	5.56E+01
Barium	10	10	100	1.60E+01	2.13E+01	1.80E+01		
Cadmium	10					5.50E-01	1.10E+00	1.10E+00
Chromium	10					5.50E-01	1.10E+00	1.10E+00
Cobalt	10					5.50E-01	1.10E+00	1.10E+00
Copper	10	10	100	1.80E+00	2.20E+00	2.05E+00		
Iron	10	10	100	1.71E+02	5.03E+02	2.90E+02		
Lead	10					5.50E-01	1.10E+00	1.10E+00
Manganese	10	10	100	2.70E+01	2.86E+02	9.41E+01		
Nickel	10	3	30	1.10E+00	1.20E+00	7.25E-01	1.10E+00	1.10E+00
Vanadium	10					5.55E+00	1.11E+01	1.11E+01
Zinc	10					5.55E+00	1.11E+01	1.11E+01
PAHs (ng/L)								
2-Methylnaphthalene	10					9.10E+00	2.90E+01	1.00E+01
Acenaphthylene	10					9.10E+00	2.90E+01	1.00E+01
Benzo(a)anthracene	10					9.10E+00	2.90E+01	1.00E+01
Benzo(a)pyrene	10					3.32E+00	1.20E+01	2.80E+00
Benzo(b)fluoranthene	10					7.85E+00	2.90E+01	4.90E+00
Benzo(g,h,i)perylene	10					9.10E+00	2.90E+01	1.00E+01
Benzo(k)fluoranthene	10					7.82E+00	2.90E+01	4.80E+00
Chrysene	10					7.82E+00	2.90E+01	4.80E+00
Dibenz(a,h)anthracene	10					7.69E+00	2.90E+01	4.30E+00
Indeno(1,2,3-cd) pyrene	10					7.69E+00	2.90E+01	2.90E+00
Pyrene	10	1	10	5.70E+00	5.70E+00	9.17E+00	2.90E+01	1.00E+01
SVOCs (ug/L)								
4-Nitroaniline	10					1.03E+00	2.30E+00	2.00E+00
VOCs (ug/L)								
2-Butanone (MEK)	10					1.00E+00	2.00E+00	2.00E+00

Notes:
* Neponset River includes the Lower Former Mill Tailrace
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-19 Summary Statistics for Site Invertebrates (*Lumbriculus variegatus*)
Neponset River *
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	95th Percentile	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)									
Aluminum	3	3	100	6.30E+01	1.20E+02	9.77E+01	1.19E+02		
Barium	3	3	100	5.50E+01	6.20E+01	5.83E+01	6.16E+01		
Beryllium	3					1.38E-02	1.49E-02	3.00E-02	2.50E-02
Cadmium	3	3	100	2.10E-01	6.10E-01	4.63E-01	6.06E-01		
Chromium	3	3	100	3.80E-01	5.50E-01	4.87E-01	5.48E-01		
Cobalt	3	3	100	1.80E-01	3.50E-01	2.73E-01	3.44E-01		
Copper	3	3	100	4.00E+00	1.00E+01	7.53E+00	9.86E+00		
Iron	3	3	100	4.80E+02	7.20E+02	6.23E+02	7.15E+02		
Lead	3	3	100	4.10E+00	9.60E+00	7.53E+00	9.53E+00		
Manganese	3	3	100	6.80E+00	7.50E+01	4.66E+01	7.33E+01		
Mercury	3	3	100	9.60E-03	1.30E-02	1.12E-02	1.28E-02		
Nickel	3	3	100	6.30E-01	9.50E-01	7.43E-01	9.20E-01		
Selenium	3	3	100	5.80E-01	6.40E-01	6.17E-01	6.39E-01		
Silver	3					1.38E-02	1.49E-02	3.00E-02	2.50E-02
Thallium	3	3	100	4.20E-03	5.70E-03	5.00E-03	5.64E-03		
Vanadium	3	3	100	5.40E-01	8.60E-01	7.33E-01	8.54E-01		
Zinc	3	3	100	3.50E+01	4.20E+01	3.77E+01	4.14E+01		
PAHs (ug/kg)									
2-Methylnaphthalene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Acenaphthene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Acenaphthylene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Anthracene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Benz[a]anthracene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Benzo[a]pyrene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Benzo[b]fluoranthene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Benzo[g,h,i]perylene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Benzo[k]fluoranthene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Chrysene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Dibenz[a,h]anthracene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Fluoranthene	3	1	33	1.20E+02	1.20E+02	1.25E+02	1.38E+02	2.80E+02	2.30E+02
Fluorene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Indeno[1,2,3-cd]pyrene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Naphthalene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Phenanthrene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Pyrene	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Other SVOCs (ug/kg)									
Benzoic acid	3	3	100	9.10E+02	2.80E+03	1.64E+03	2.64E+03		
bis(2-Ethylhexyl)phthalate	3					3.22E+02	3.53E+02	7.10E+02	5.60E+02
Carbazole	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02
Di-n-octylphthalate	3					1.28E+02	1.39E+02	2.80E+02	2.30E+02

Notes:
* Neponset River includes the Lower Former Mill Tailrace.
Concentration according to wet weight.
Chemical concentrations are from *Lumbriculus variegatus* tissue analyzed after bioaccumulation testing.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-20 Summary Statistics of Site Invertebrates (*Lumbriculus variegatus*)
Lewis Pond
Blackburn Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	3	3	100	9.30E+01	1.30E+02	1.18E+02		
Barium	3	3	100	5.70E+01	6.50E+01	6.13E+01		
Beryllium	3					1.32E-02	3.00E-02	2.40E-02
Cadmium	3	3	100	9.50E-02	9.90E-02	9.77E-02		
Chromium	3	3	100	1.00E+00	8.70E+00	5.57E+00		
Cobalt	3	3	100	2.50E-01	3.40E-01	2.93E-01		
Copper	3	3	100	2.60E+00	6.00E+00	4.67E+00		
Iron	3	3	100	4.50E+02	5.00E+02	4.80E+02		
Lead	3	3	100	5.90E+00	3.40E+01	2.06E+01		
Manganese	3	3	100	4.20E+00	1.70E+01	1.01E+01		
Mercury	3	3	100	1.00E-02	1.40E-02	1.17E-02		
Nickel	3	3	100	8.60E-01	3.50E+00	2.19E+00		
Selenium	3	3	100	4.40E-01	5.90E-01	5.17E-01		
Silver	3					1.32E-02	3.00E-02	2.40E-02
Thallium	3	2	67	2.70E-03	4.40E-03	2.55E-03	1.10E-03	1.10E-03
Vanadium	3	3	100	5.10E-01	8.30E-01	6.40E-01		
Zinc	3	3	100	3.00E+01	3.80E+01	3.30E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	3					1.37E+02	2.80E+02	2.70E+02
Acenaphthene	3					1.37E+02	2.80E+02	2.70E+02
Acenaphthylene	3					1.37E+02	2.80E+02	2.70E+02
Anthracene	3					1.37E+02	2.80E+02	2.70E+02
Benz[a]anthracene	3	1	33	1.40E+02	1.40E+02	1.38E+02	2.80E+02	2.70E+02
Benzo[a]pyrene	3					1.37E+02	2.80E+02	2.70E+02
Benzo[b]fluoranthene	3					1.37E+02	2.80E+02	2.70E+02
Benzo[g,h,i]perylene	3					1.37E+02	2.80E+02	2.70E+02
Benzo[k]fluoranthene	3					1.37E+02	2.80E+02	2.70E+02
Chrysene	3	2	67	1.30E+02	1.30E+02	1.32E+02	2.70E+02	2.70E+02
Dibenz[a,h]anthracene	3					1.37E+02	2.80E+02	2.70E+02
Fluoranthene	3	3	100	1.20E+02	3.20E+02	1.87E+02		
Fluorene	3					1.37E+02	2.80E+02	2.70E+02
Indeno[1,2,3-cd]pyrene	3					1.37E+02	2.80E+02	2.70E+02
Naphthalene	3					1.37E+02	2.80E+02	2.70E+02
Phenanthrene	3					1.37E+02	2.80E+02	2.70E+02
Pyrene	3	3	100	1.30E+02	3.90E+02	2.17E+02		
Other SVOCs (ug/kg)								
4-Methylphenol	3	2	67	1.60E+02	2.00E+02	1.67E+02	2.80E+02	2.80E+02
Benzoic acid	3	3	100	7.80E+02	9.70E+02	8.73E+02		
Benzyl alcohol	3	3	100	1.10E+03	2.40E+03	1.73E+03		
bis(2-Ethylhexyl)phthalate	3					2.10E+02	4.50E+02	3.70E+02
Carbazole	3					1.37E+02	2.80E+02	2.70E+02

Notes:
Concentration according to wet weight.
Chemical concentrations are from Lumbriculus variegatus tissue analyzed after bioaccumulation testing.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-21 Summary Statistics for Site Invertebrates (*Lumbriculus variegatus*)
Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	1	1	100	3.20E+02	3.20E+02	3.20E+02		
Barium	1	1	100	2.50E+01	2.50E+01	2.50E+01		
Beryllium	1					1.35E-02	2.70E-02	2.70E-02
Cadmium	1	1	100	3.30E-02	3.30E-02	3.30E-02		
Chromium	1	1	100	5.70E-01	5.70E-01	5.70E-01		
Cobalt	1	1	100	3.90E-01	3.90E-01	3.90E-01		
Copper	1	1	100	1.50E+00	1.50E+00	1.50E+00		
Iron	1	1	100	4.90E+02	4.90E+02	4.90E+02		
Lead	1	1	100	7.10E+00	7.10E+00	7.10E+00		
Manganese	1	1	100	8.50E+00	8.50E+00	8.50E+00		
Mercury	1					3.55E-03	7.10E-03	7.10E-03
Nickel	1	1	100	9.70E-01	9.70E-01	9.70E-01		
Selenium	1	1	100	4.60E-01	4.60E-01	4.60E-01		
Silver	1					1.35E-02	2.70E-02	2.70E-02
Thallium	1	1	100	2.40E-03	2.40E-03	2.40E-03		
Vanadium	1	1	100	9.20E-01	9.20E-01	9.20E-01		
Zinc	1	1	100	2.40E+01	2.40E+01	2.40E+01		
PAHS (ug/kg)								
2-Methylnaphthalene	1					1.35E+02	2.70E+02	2.70E+02
Acenaphthene	1					1.35E+02	2.70E+02	2.70E+02
Acenaphthylene	1					1.35E+02	2.70E+02	2.70E+02
Anthracene	1					1.35E+02	2.70E+02	2.70E+02
Benz[a]anthracene	1					1.35E+02	2.70E+02	2.70E+02
Benzo[a]pyrene	1					1.35E+02	2.70E+02	2.70E+02
Benzo[b]fluoranthene	1	1	100	1.20E+02	1.20E+02	1.20E+02		
Benzo[g,h,i]perylene	1					1.35E+02	2.70E+02	2.70E+02
Benzo[k]fluoranthene	1					1.35E+02	2.70E+02	2.70E+02
Chrysene	1	1	100	1.20E+02	1.20E+02	1.20E+02		
Dibenz[a,h]anthracene	1					1.35E+02	2.70E+02	2.70E+02
Fluoranthene	1	1	100	1.50E+02	1.50E+02	1.50E+02		
Fluorene	1					1.35E+02	2.70E+02	2.70E+02
Indeno[1,2,3-cd]pyrene	1					1.35E+02	2.70E+02	2.70E+02
Naphthalene	1					1.35E+02	2.70E+02	2.70E+02
Phenanthrene	1					1.35E+02	2.70E+02	2.70E+02
Pyrene	1	1	100	2.50E+02	2.50E+02	2.50E+02		
Other SVOCs (ug/kg)								
4-Methylphenol	1					1.35E+02	2.70E+02	2.70E+02
Benzoic acid	1	1	100	3.60E+02	3.60E+02	3.60E+02		
Benzyl alcohol	1	1	100	5.20E+03	5.20E+03	5.20E+03		
bis(2-Ethylhexyl)phthalate	1					2.75E+02	5.50E+02	5.50E+02
Carbazole	1					1.35E+02	2.70E+02	2.70E+02

Notes:
Concentration according to wet weight.
Chemical concentrations are from Lumbriculus variegatus tissue analyzed after bioaccumulation testing.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-22 Summary Statistics of Invertebrate Data
Neponset River Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	1	1	100	1.50E+02	1.50E+02	1.50E+02		
Barium	1	1	100	6.80E+01	6.80E+01	6.80E+01		
Beryllium	1					1.25E-02	2.50E-02	2.50E-02
Cadmium	1	1	100	4.90E-01	4.90E-01	4.90E-01		
Chromium	1	1	100	6.20E-01	6.20E-01	6.20E-01		
Cobalt	1	1	100	3.60E-01	3.60E-01	3.60E-01		
Copper	1	1	100	3.50E+00	3.50E+00	3.50E+00		
Iron	1	1	100	5.60E+02	5.60E+02	5.60E+02		
Lead	1	1	100	1.20E+00	1.20E+00	1.20E+00		
Manganese	1	1	100	9.90E+01	9.90E+01	9.90E+01		
Mercury	1	1	100	1.10E-02	1.10E-02	1.10E-02		
Nickel	1	1	100	8.00E-01	8.00E-01	8.00E-01		
Selenium	1	1	100	7.20E-01	7.20E-01	7.20E-01		
Silver	1	1	100	2.60E-02	2.60E-02	2.60E-02		
Thallium	1	1	100	4.00E-03	4.00E-03	4.00E-03		
Vanadium	1	1	100	8.60E-01	8.60E-01	8.60E-01		
Zinc	1	1	100	3.90E+01	3.90E+01	3.90E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	1					1.40E+02	2.80E+02	2.80E+02
Acenaphthene	1					1.40E+02	2.80E+02	2.80E+02
Acenaphthylene	1					1.40E+02	2.80E+02	2.80E+02
Anthracene	1					1.40E+02	2.80E+02	2.80E+02
Benz(a)anthracene	1					1.40E+02	2.80E+02	2.80E+02
Benzo(a)pyrene	1					1.40E+02	2.80E+02	2.80E+02
Benzo(b)fluoranthene	1					1.40E+02	2.80E+02	2.80E+02
Benzo(g,h,I)perylene	1					1.40E+02	2.80E+02	2.80E+02
Benzo(k)fluoranthene	1					1.40E+02	2.80E+02	2.80E+02
Chrysene	1					1.40E+02	2.80E+02	2.80E+02
Dibenz(a,h)anthracene	1					1.40E+02	2.80E+02	2.80E+02
Fluoranthene	1					1.40E+02	2.80E+02	2.80E+02
Fluorene	1					1.40E+02	2.80E+02	2.80E+02
Indeno(1,2,3-cd)pyrene	1					1.40E+02	2.80E+02	2.80E+02
Naphthalene	1					1.40E+02	2.80E+02	2.80E+02
Phenanthrene	1					1.40E+02	2.80E+02	2.80E+02
Pyrene	1					1.40E+02	2.80E+02	2.80E+02
Other SVOCs (ug/kg)								
2,4-Dimethylphenol	1					1.40E+02	2.80E+02	2.80E+02
4-Methylphenol	1	1	100	2.50E+02	2.50E+02	2.50E+02		
Benzoic acid	1	1	100	7.00E+02	7.00E+02	7.00E+02		
Benzyl alcohol	1	1	100	1.90E+03	1.90E+03	1.90E+03		
bis(2-Ethylhexyl)phthalate	1					5.00E+02	1.00E+03	1.00E+03
Carbazole	1					1.40E+02	2.80E+02	2.80E+02
Di-n-octylphthalate	1					1.40E+02	2.80E+02	2.80E+02

Notes:
Concentration according to wet weight.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-23 Summary Statistics of Invertebrate Tissue
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	1	1	100	9.85E+01	9.85E+01	9.85E+01		
Barium	1	1	100	7.45E+01	7.45E+01	7.45E+01		
Beryllium	1					1.30E-02	2.60E-02	2.60E-02
Cadmium	1	1	100	8.75E-02	8.75E-02	8.75E-02		
Chromium	1	1	100	5.20E-01	5.20E-01	5.20E-01		
Cobalt	1	1	100	3.10E-01	3.10E-01	3.10E-01		
Copper	1	1	100	3.20E+00	3.20E+00	3.20E+00		
Iron	1	1	100	5.60E+02	5.60E+02	5.60E+02		
Lead	1	1	100	1.12E+01	1.12E+01	1.12E+01		
Manganese	1	1	100	1.95E+01	1.95E+01	1.95E+01		
Mercury	1	1	100	4.60E-02	4.60E-02	4.60E-02		
Nickel	1	1	100	9.20E-01	9.20E-01	9.20E-01		
Selenium	1	1	100	5.70E-01	5.70E-01	5.70E-01		
Silver	1					1.30E-02	2.60E-02	2.60E-02
Thallium	1	1	100	1.70E-03	1.70E-03	1.70E-03		
Vanadium	1	1	100	1.20E+00	1.20E+00	1.20E+00		
Zinc	1	1	100	3.20E+01	3.20E+01	3.20E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	1					1.25E+02	2.50E+02	2.50E+02
Acenaphthene	1					1.25E+02	2.50E+02	2.50E+02
Acenaphthylene	1					1.25E+02	2.50E+02	2.50E+02
Anthracene	1	1	100	1.35E+02	1.35E+02	1.35E+02		
Benz(a)anthracene	1	1	100	2.35E+02	2.35E+02	2.35E+02		
Benzo(a)pyrene	1	1	100	1.40E+02	1.40E+02	1.40E+02		
Benzo(b)fluoranthene	1	1	100	2.10E+02	2.10E+02	2.10E+02		
Benzo(g,h,I)perylene	1					1.25E+02	2.50E+02	2.50E+02
Benzo(k)fluoranthene	1	1	100	1.55E+02	1.55E+02	1.55E+02		
Chrysene	1	1	100	3.40E+02	3.40E+02	3.40E+02		
Dibenz(a,h)anthracene	1					1.25E+02	2.50E+02	2.50E+02
Fluoranthene	1	1	100	1.02E+03	1.02E+03	1.02E+03		
Fluorene	1					1.25E+02	2.50E+02	2.50E+02
Indeno(1,2,3-cd)pyrene	1					1.25E+02	2.50E+02	2.50E+02
Naphthalene	1					1.25E+02	2.50E+02	2.50E+02
Phenanthrene	1	1	100	7.45E+02	7.45E+02	7.45E+02		
Pyrene	1	1	100	8.15E+02	8.15E+02	8.15E+02		
Other SVOCs (ug/kg)								
4-Methylphenol	1	1	100	1.95E+02	1.95E+02	1.95E+02		
Benzoic acid	1	1	100	1.20E+03	1.20E+03	1.20E+03		
Benzyl alcohol	1	1	100	2.50E+03	2.50E+03	2.50E+03		
bis(2-Ethylhexyl)phthalate	1					2.10E+02	4.20E+02	4.20E+02
Carbazole	1					1.25E+02	2.50E+02	2.50E+02

Notes:
Concentration according to wet weight.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).

Table 3-24
Summary Statistics for Site Fish
Neponset River*
Blackburn and Union Privileges Site
Walpole, Massachusetts

Compounds	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Total Metals (mg/kg-ww)								
Aluminum	4	4	100	7.20E-01	6.60E+00	2.53E+00		
Barium	4	4	100	2.20E-01	1.90E+00	1.07E+00		
Cobalt	4	1	25	6.10E-02	6.10E-02	2.83E-02	4.60E-02	2.90E-02
Iron	4	4	100	2.50E+01	8.00E+01	5.33E+01		
Lead	4	4	100	5.20E-02	5.70E-01	2.14E-01		
Manganese	4	4	100	7.30E+00	6.00E+01	3.38E+01		
Nickel	4	4	100	1.50E-01	3.70E-01	2.58E-01		
Vanadium	4	2	50	4.20E-02	9.90E-02	4.25E-02	2.90E-02	2.90E-02
Zinc	4	4	100	1.30E+01	1.80E+01	1.60E+01		
PAHs (ug/kg-ww)								
2-Methylnaphthalene	4					1.03E+00	2.10E+00	2.00E+00
Acenaphthene	4	2	50	2.00E+00	2.30E+00	1.60E+00	2.10E+00	2.10E+00
Acenaphthylene	4					1.03E+00	2.10E+00	2.00E+00
Anthracene	4					1.03E+00	2.10E+00	2.00E+00
Benz[a]anthracene	4	2	50	2.40E+00	2.90E+00	1.84E+00	2.10E+00	2.00E+00
Benzo[a]pyrene	4	1	25	2.20E+00	2.20E+00	1.33E+00	2.10E+00	2.00E+00
Benzo[b]fluoranthene	4	3	75	3.50E+00	3.90E+00	3.05E+00	2.00E+00	2.00E+00
Benzo[g,h,i]perylene	4					1.03E+00	2.10E+00	2.00E+00
Benzo[k]fluoranthene	4	3	75	2.30E+00	3.10E+00	2.20E+00	2.00E+00	2.00E+00
Chrysene	4	3	75	2.10E+00	2.60E+00	1.98E+00	2.00E+00	2.00E+00
Dibenz[a,h]anthracene	4					1.03E+00	2.10E+00	2.00E+00
Fluoranthene	4					1.03E+00	2.10E+00	2.00E+00
Fluorene	4	1	25	2.30E+00	2.30E+00	1.35E+00	2.10E+00	2.00E+00
Indeno[1,2,3-cd]pyrene	4					1.03E+00	2.10E+00	2.00E+00
Naphthalene	4					1.05E+00	2.20E+00	2.00E+00
Phenanthrene	4	3	75	2.90E+00	4.30E+00	2.86E+00	2.10E+00	2.10E+00
Pyrene	4	1	25	2.30E+00	2.30E+00	1.35E+00	2.10E+00	2.00E+00
Total PAH[a]					4.30E+00	1.52E+00		
Other SVOCs (ug/kg-ww)								
4-Nitroaniline	4					2.54E+02	5.20E+02	4.90E+02
Benzoic acid	4	2	50	9.20E+02	2.00E+03	3.23E+03	1.00E+04	1.00E+04
bis(2-Ethylhexyl)phthalate	4	2	50	4.40E+03	7.60E+03	3.29E+03	1.40E+03	9.30E+02
Carbazole	4					1.03E+00	2.10E+00	2.00E+00
Di-n-octylphthalate	4					2.54E+02	5.20E+02	4.90E+02
Other								
Percent lipids	4	4	100	1.30E+00	4.20E+00	2.68E+00		

Notes:
Concentration according to wet weight.
* Neponset River includes the Lower Former Mill Tailrace.
[a]Total PAH concentrations are calculated based on measurements for the 17 PAHs listed.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).
Tissue concentrations have not been lipid normalized.

Table 3-25 Summary Statistics for Site Fish
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Total Metals (mg/kg)								
Aluminum	5	5	100	1.10E+00	2.60E+01	8.22E+00		
Barium	5	5	100	6.40E-01	1.60E+00	1.11E+00		
Beryllium	5					1.49E-02	3.20E-02	2.60E-02
Cadmium	5	5	100	1.80E-02	6.40E-02	4.46E-02		
Chromium	5	5	100	3.10E-01	9.80E-01	6.10E-01		
Cobalt	5	5	100	3.50E-02	5.30E-02	4.42E-02		
Copper	5	5	100	7.20E-01	2.50E+00	1.67E+00		
Lead	5	5	100	4.30E-01	1.10E+00	6.30E-01		
Manganese	5	5	100	6.30E+00	3.50E+01	1.62E+01		
Mercury	5	5	100	3.60E-02	1.20E-01	7.02E-02		
Nickel	5	5	100	2.60E-01	6.20E-01	3.60E-01		
Selenium	5	5	100	3.90E-01	7.90E-01	5.34E-01		
Silver	5					1.49E-02	3.20E-02	2.60E-02
Thallium	5	4	80	9.10E-04	4.40E-03	2.68E-03	1.40E-03	1.40E-03
Vanadium	5	4	80	5.50E-02	1.40E-01	8.22E-02	6.40E-02	6.40E-02
Zinc	5	5	100	1.60E+01	5.20E+01	2.84E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	5					1.04E+00	2.10E+00	2.00E+00
Acenaphthylene	5					1.04E+00	2.10E+00	2.00E+00
Acenaphthene	5	2	40	2.30E+00	4.90E+00	2.07E+00	2.10E+00	2.10E+00
Anthracene	5					1.04E+00	2.10E+00	2.00E+00
Benz[a]anthracene	5	2	40	6.50E+00	6.70E+00	3.27E+00	2.10E+00	2.10E+00
Benzo[a]pyrene	5	2	40	6.20E+00	8.40E+00	3.55E+00	2.10E+00	2.10E+00
Benzo[b]fluoranthene	5	3	60	2.30E+00	1.50E+01	5.88E+00	2.10E+00	2.10E+00
Benzo[g,h,i]perylene	5	1	20	2.90E+00	2.90E+00	1.42E+00	2.10E+00	2.10E+00
Benzo[k]fluoranthene	5	3	60	2.50E+00	1.10E+01	4.66E+00	2.10E+00	2.10E+00
Chrysene	5	2	40	5.50E+00	6.00E+00	2.93E+00	2.10E+00	2.10E+00
Dibenz[a,h]anthracene	5					1.04E+00	2.10E+00	2.00E+00
Fluoranthene	5	3	60	2.20E+00	4.80E+00	2.46E+00	2.10E+00	2.10E+00
Fluorene	5	3	60	2.20E+00	4.70E+00	2.66E+00	2.10E+00	2.10E+00
Indeno[1,2,3-cd]pyrene	5	2	40	2.50E+00	3.20E+00	1.77E+00	2.10E+00	2.10E+00
Naphthalene	5	2	40	2.90E+00	3.30E+00	1.92E+00	2.60E+00	2.10E+00
Phenanthrene	5	4	80	2.40E+00	9.20E+00	4.55E+00	2.10E+00	2.10E+00
Pyrene	5	4	80	2.20E+00	1.70E+01	7.17E+00	2.10E+00	2.10E+00
Total PAH[a]						4.85E+01		
Other SVOCs (ug/kg)								
2,4-Dimethylphenol	5					1.73E+03	4.20E+03	5.10E+02
4-Nitroaniline	5					2.60E+02	5.30E+02	5.10E+02
4-Methylphenol	5					2.60E+02	5.30E+02	5.10E+02
Benzoic acid	3	2	67	6.00E+02	7.50E+02	2.12E+03	1.00E+04	1.00E+04
Benzyl alcohol	5					2.60E+02	5.30E+02	5.10E+02
bis(2-Ethylhexyl)phthalate	5	3	60	4.00E+03	1.20E+04	4.32E+03	1.20E+03	2.30E+02
Carbazole	5					1.04E+00	2.10E+00	2.00E+00
Di-n-octylphthalate	5					2.60E+02	5.30E+02	5.10E+02
Other								
Percent lipids	5	5	100	1.60E+00	7.50E+00	4.04E+00		

Notes:
Concentration according to wet weight.
[a]Total PAH concentrations are calculated based on measurements for the 17 PAHs listed.
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).
Tissue concentrations have not been lipid normalized.

Table 3-26 Summary Statistics of Fish
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Metals (mg/kg)								
Aluminum	5	5	100	1.73E+00	1.52E+01	7.13E+00		
Arsenic	5	5	100	2.49E-02	6.50E-02	4.00E-02		
Barium	5	5	100	1.28E+00	3.50E+00	2.28E+00		
Beryllium	5					2.04E-02	4.75E-02	3.80E-02
Cadmium	5	4	80	7.74E-03	1.29E-02	8.80E-03	9.43E-03	9.43E-03
Chromium	5	5	100	1.70E-01	4.28E-01	2.56E-01		
Cobalt	5	2	40	4.30E-02	4.65E-02	3.03E-02	4.75E-02	3.80E-02
Copper	5	5	100	4.54E-01	1.81E+00	8.46E-01		
Iron	5	5	100	6.59E+01	1.60E+02	1.10E+02		
Lead	5	5	100	1.40E-01	3.40E-01	2.25E-01		
Manganese	5	5	100	3.10E+00	5.80E+01	2.41E+01		
Mercury	5	5	100	5.23E-02	2.26E-01	9.14E-02		
Nickel	5	5	100	1.77E-01	4.36E-01	2.66E-01		
Selenium	5	5	100	2.50E-01	3.66E-01	3.10E-01		
Silver	5					2.04E-02	4.75E-02	3.80E-02
Thallium	5	5	100	1.40E-03	9.53E-03	3.52E-03		
Vanadium	5	5	100	8.78E-02	2.10E-01	1.46E-01		
Zinc	5	5	100	1.41E+01	2.20E+01	1.78E+01		
PAHs (ug/kg)								
2-Methylnaphthalene	5	5	100	2.70E+00	5.82E+00	4.71E+00		
Acenaphthene	5	1	20	2.55E+00	2.55E+00	1.41E+00	2.30E+00	2.12E+00
Acenaphthylene	5					1.11E+00	2.30E+00	2.12E+00
Anthracene	5	1	20	2.33E+00	2.33E+00	1.36E+00	2.30E+00	2.12E+00
Benz(a)anthracene	5					1.37E+00	3.91E+00	2.24E+00
Benzo(a)pyrene	5					1.55E+00	3.94E+00	2.24E+00
Benzo(b)fluoranthene	5					1.99E+00	5.55E+00	2.24E+00
Benzo(g,h,I)perylene	5					1.23E+00	2.90E+00	2.24E+00
Benzo(k)fluoranthene	5					1.92E+00	4.92E+00	2.24E+00
Chrysene	5					1.54E+00	4.47E+00	2.24E+00
Dibenz(a,h)anthracene	5					1.26E+00	3.69E+00	2.12E+00
Fluoranthene	5					2.09E+00	7.12E+00	2.40E+00
Fluorene	5	5	100	2.60E+00	4.32E+00	3.52E+00		
Indeno(1,2,3-cd)pyrene	5					1.21E+00	3.08E+00	2.20E+00
Naphthalene	5	5	100	2.60E+00	4.13E+00	3.40E+00		
Phenanthrene	5					3.39E+00	9.22E+00	4.30E+00
Pyrene	5					1.96E+00	7.04E+00	2.30E+00

Table 3-26 Summary Statistics of Fish
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals	Number Analyzed	Number Detected	Detection Frequency (%)	Minimum Detected	Maximum Detected	Average	Maximum of Detection Limits	Minimum of Detection Limits
Other SVOCs (ug/kg)								
4-Nitroaniline	5					2.22E+02	4.60E+02	4.25E+02
4-Methylphenol	5					2.22E+02	4.60E+02	4.25E+02
Benzoic acid	3	3	100	2.00E+02	1.10E+03	6.10E+02		
Benzyl alcohol	5	1	20	3.50E+02	3.50E+02	2.46E+02	4.50E+02	4.25E+02
bis(2-Ethylhexyl)phthalate	5					1.27E+02	5.50E+02	1.20E+02
Carbazole	5	2	40	2.31E+00	3.23E+00	1.78E+00	2.30E+00	2.12E+00
Di-n-octylphthalate	5					2.22E+02	4.60E+02	4.25E+02
Other								
Percent Lipids (%)	5	5	100	1.90E+00	3.10E+00	2.64E+00		

Notes:
Samples without detected COPECs were included in calculation of the average and 95% UCL concentrations using 1/2 the detection limit or the whole detection limit (See Section 3.1).
Tissue concentrations have not been lipid normalized.

TABLE 3-27
Available Total Organic Carbon Data for Soil, Sediment, and Surface Water
Blackburn and Union Privileges Site
Walpole, Massachusetts

Medium	Exposure Area	Sample ID	Sample Date	TOC	TOC Units
Soil	Floodplain	FP-01 & OW-404	10/10/01	2.6	%
		FP-02	10/10/01	4.2	%
		FP-03	10/10/01	3.9	%
		FP-04	10/10/01	3.7	%
		FP-05/0-1 & OW-410	8/5/03	5.7	%
		FP-05	10/10/01	5.6	%
		FP-06 / 0-1	8/5/03	3.2	%
		FP-06	10/10/01	2.1	%
		FP-08	10/10/01	8.0	%
		FP-09 / 0-1	8/5/03	15.0	%
		FP-09	10/10/01	13.3	%
		FP-10	10/10/01	9.0	%
		FPW-1	8/8/03	8.5	%
		FPW-2	8/8/03	7.8	%
		FPW-3	8/8/03	8.5	%
	West of South Street	OSA-1	8/7/03	3.1	%
		OSA-2	8/12/03	2.8	%
		OSA-3	8/12/03	3.7	%
		SS-28	7/23/01	3.1	%
		SS-31 & OW-102	2/26/01	4.0	%
		SS-38	4/23/01	1.8	%
	East of South Street	EUA-1 & OW-112	8/8/03	6.8	%
		EUA-2	8/8/03	10.0	%
		EUA-3	8/8/03	5.8	%
		SS-04	3/21/01	13.0	%
		SS-07	3/15/01	1.4	%
	Orlando Property	OP-1	8/8/03	4.6	%
		OP-2	8/8/03	1.2	%
		OP-3	8/8/03	2.9	%
	Soil Reference Area	FPR-01	10/9/01	27.2	%
		FPR-02	10/9/01	3.8	%
		FPR-03	10/9/01	2.6	%
		FPR-04	10/9/01	5.6	%
		FPR-05	10/9/01	3.5	%
		FPR-06	10/9/01	17.5	%
		FPR-07	10/9/01	9.3	%
		FPR-08	10/9/01	1.8	%
		FPR-09	10/9/01	6.4	%
		FPR-10	10/9/01	7.7	%
		OSR-1-S AVERAGE	11/21/03	9.3	%
		OSR-2-S	11/4/03	16.0	%
		OSR-3-S	10/31/03	9.3	%
Sediment	Neponset River	NR-1	7/26/01	0.2	%
		NR-2	7/26/01	0.3	%
		NR-3	7/26/01	0.4	%
		NR-4	7/26/01	0.7	%
		NR-5	7/26/01	11.2	%
		NR-5	12/18/02	1.1	%
		NR-6	7/26/01	13.6	%
		NR-7	7/25/01	0.4	%
		NR-7	12/18/02	0.4	%
		NR-8	7/25/01	0.2	%
		NR-8	12/18/02	0.6	%
		TR-4	7/25/01	7.0	%
		TR-5	7/25/01	7.1	%
	Lewis Pond	LP-01	7/31/01	6.2	%
		LP-01	12/18/02	5.8	%
		LP-02	7/31/01	12.5	%
		LP-03	7/31/01	12.7	%
		LP-04	7/31/01	8.3	%
		LP-05	7/30/01	15.0	%
		LP-06	7/30/01	11.8	%
		LP-06	12/18/02	9.5	%
		LP-07	7/30/01	6.5	%
		LP-08	7/30/01	7.8	%
		LP-09	7/30/01	4.8	%
		LP-09	12/18/02	6.9	%
		LP-10	7/30/01	9.1	%
	Upper Former Mill Tailrace	TR-1	7/25/01	13.0	%
		TR-2	7/25/01	2.1	%
		TR-3	7/25/01	1.7	%
		TR-3 AVERAGE	12/16/02	1.0	%

TABLE 3-27
Available Total Organic Carbon Data for Soil, Sediment, and Surface Water
Blackburn and Union Privileges Site
Walpole, Massachusetts

Medium	Exposure Area	Sample ID	Sample Date	TOC	TOC Units
Sediment Cont'd	Neponset River Reference Area	SedRN-1	5/24/02	0.3	%
		SedRN-2	5/24/02	0.1	%
		SedRN-3	5/24/02	0.2	%
		SedRN-4	5/24/02	0.3	%
		SedRN-4	12/18/02	0.2	%
		SedRN-5	5/24/02	0.3	%
	Lower Pond Reference Area	SedRNwd-01	12/17/02	3.9	%
		SedRNwd-02	12/17/02	1.0	%
		SedRNwd-03	12/17/02	4.8	%
		SedRNwd-04	12/17/02	7.6	%
		SedRNwd-05	12/17/02	2.7	%
		SedRNwd-06	12/17/02	6.0	%
		SedRNwd-07	12/17/02	6.4	%
		SedRNwd-08	12/17/02	13.0	%
		SedRNwd-09	12/17/02	13.0	%
		SedRNwd-10	12/17/02	5.7	%
Surface Water	Neponset River	SW-102	4/5/01	3.9	mg/L
		SW-102	8/1/01	5.7	mg/L
		SW-103	4/4/01	4.4	mg/L
		SW-103	8/1/01	5.2	mg/L
		SW-105	4/4/01	4.5	mg/L
		SW-105	8/1/01	5.3	mg/L
		SW-107	4/4/01	7.3	mg/L
		SW-107	8/1/01	28.0	mg/L
		SW-108	4/4/01	4.2	mg/L
		SW-108	8/1/01	5.3	mg/L
	Neponset River Reference Area	SWR-1	4/5/01	4.4	mg/L
		SWR-1	8/2/01	6.1	mg/L
		SWR-2	4/5/01	4.2	mg/L
		SWR-2	8/2/01	6.0	mg/L
		SWR-3	4/5/01	4.3	mg/L
		SWR-3	8/2/01	5.9	mg/L
		SWR-4	4/5/01	4.3	mg/L
		SWR-4	8/2/01	5.3	mg/L
		SWR-5	4/5/01	4.5	mg/L
		SWR-5	8/1/01	5.4	mg/L
	Former Mill Tailrace	SW-106	4/4/01	50.0	mg/L
		OW-301	4/4/01	47.0	mg/L
		SW-106 & OW-302	8/1/01	13.5	mg/L

Table 3-28
pH Measurements
Blackburn and Union Privileges Site
Walpole, Masachusetts

Medium	Sample ID	pH
Sediment (Toxicity Test) (1)	NR-7	7.3 - 7.6
	NR-8	7.4 - 7.6
	LP-01	7.3 - 7.7
	TR-3	7.5 - 8.2
	OW-801	7.0 - 7.6
	Sed RN-4	7.5 - 7.7
	Sed Nwd-1	7.1 - 7.6
Sediment (2)	TR-1	10
	TR-2	8.5
	TR-3	9.4
	TR-4	9.4
	TR-5	8.5
Surface Water (2)	SW-105	8.4
	SW-106	9.6
	SW-106	10
	SW-106	9.3
	SW-107	8.2
	SW-107	8.2
	SW-107	9.0

Notes:
(1) pH expressed as a range since the pH was measured on Days 0 and 27 of test and three times weekly.
(2) Only pH measurements above 8 are shown.

Table 3-29
Sediment Ammonia Measurements
Blackburn and Union Privileges Site
Walpole, Massachusetts

Exposure Point	Sample ID	Analyte	Concentration (mg/kg dry)	Qualifier
Neponset River	NR-7 / 12-18-02	Nitrogen-Ammonia as N	20	
Neponset River	NR-8 / 12-18-02	Nitrogen-Ammonia as N	10	
Lewis Pond	LP-01 / 12-18-02	Nitrogen-Ammonia as N	31	
Upper Tailrace	TR-3 / 12-16-02	Nitrogen-Ammonia as N	91	
Upper Tailrace	TR-3 / 12-16-02 (duplicate)	Nitrogen-Ammonia as N	110	
Neponset River Reference Area	SedRN-4 / 12-18-02	Nitrogen-Ammonia as N	10	
Lower Pond	SedRNwd-01 / 12-17-02	Nitrogen-Ammonia as N	38	J
Reference Area	SedRNwd-01 / 12-17-02 (duplicate)	Nitrogen-Ammonia as N	72	J

Table 3-30
Invertebrate Lipid Data
Blackburn Union Privileges Site
Walpole, Massachusetts

	Nepooset River			Lewis Pond			Former Mill Tailrace	Lower Pond Reference Area	Neposet River Reference Area
	NR-5-B 0302001-01 1/28/03	NR-7-B 0302001-02 01-28-03	NR-8-B 0302001-03 01-28-03	LP-01-B 0302001-04 01-27-03	LP-06-B 0302001-05 1/27/03	LP-09-B 0302001-06 1/27/03	TR-3-B 0302001-07 01-27-03	SedRNwd-1-B AVG --- 1/27/03	SedRN-4-B --- 01-28-03
% Lipid	1.1	1.3	1.3	1.2	1.7	1.3	1.1	1.35	1.3

Table 3-31
Fish Length, Weight, and Lipid Data
Blackburn Union Privileges Site
Walpole, Massachusetts

Neponset River				
Sample ID	NRW-1	NRW-3	NRW-4	NRW-5
Fish Species	Bluegill	Bluegill	American eel	White sucker
Lab ID	0308049-01	0308049-08	0308049-09	0308049-10
Sample Date	8/18/2003	8/18/2003	8/18/2003	8/18/2003
Total Length (mm)	130	110	355	251
Total Weight (g)	38	28	54	174
% Lipid	4.2	2.6	1.3	2.6

Lewis Pond					
Sample ID	LPW-1	LPW-2	LPW-3	LPW-4	LPW-5
Fish Species	White sucker	White sucker	Bluegill	Redfin pickerel	American eel
Lab ID	0308049-12	0308049-13	0308049-19	0308049-20	0308049-21
Sample Date	8/19/2003	8/19/2003	8/19/2003	8/19/2003	8/19/2003
Total Length (mm)	412	433	118	145	345
Total Weight (g)	983	878	30	20	63
% Lipid	6	7.5	3.5	1.6	1.6

Lower Pond Reference					
Sample ID	NWD-1-W [b]	NWD-2-W [b]	NWD-3-W [b]	NWD-6-W	NWD-7-W
Fish Species	Large Mouth Bass	Large Mouth Bass	Large Mouth Bass	Bluegill	Bluegill
Lab ID	---	---	---	---	---
Sample Date	10/30/2003	10/30/2003	10/30/2003	10/30/2003	10/30/2003
Total Length (mm)	369	288	192	123	120
Total Weight (g)	849	314	119	25	25
% Lipid	2.8	2.7	2.6	3.1	1.9

Notes:
a Weight data was unavailable therefore whole body concentrations were not reconstructed. Carcass data was used in the BERA.
b Samples have been reconstucted to whole body using data from the fillet and carcass

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
East of South Street	Aluminum	mg/kg	7.77E+03	1.22E+04	8.83E+03	(N)	95% UCL	W-Test (3)
	Antimony	mg/kg	7.77E-01	4.40E+00	1.34E+00	(T)	95% UCL	W-Test (4)
	Arsenic	mg/kg	1.89E+01	1.06E+02	3.30E+01	(G)	95% UCL	K-S Test (5)
	Barium	mg/kg	5.08E+01	1.70E+02	6.65E+01	(G)	95% UCL	K-S Test (5)
	Cadmium	mg/kg	5.26E-01	3.50E+00	1.06E+00	(T)	95% UCL	W-Test (9)
	Chromium	mg/kg	1.32E+01	4.50E+01	1.67E+01	(G)	95% UCL	K-S Test (5)
	Cobalt	mg/kg	4.57E+00	1.01E+01	5.33E+00	(G)	95% UCL	K-S Test (5)
	Copper	mg/kg	3.55E+01	6.70E+01	4.28E+01	(N)	95% UCL	W-Test (3)
	Iron	mg/kg	1.36E+04	2.33E+04	1.55E+04	(N)	95% UCL	W-Test (3)
	Lead	mg/kg	1.19E+02	4.20E+02	1.84E+02	(G)	95% UCL	K-S Test (5)
	Manganese	mg/kg	2.18E+02	3.79E+02	2.52E+02	(N)	95% UCL	W-Test (3)
	Mercury	mg/kg	2.09E-01	1.00E+00	3.54E-01	(G)	95% UCL	K-S Test (5)
	Nickel	mg/kg	9.22E+00	1.91E+01	1.09E+01	(N)	95% UCL	W-Test (3)
	Selenium	mg/kg	4.39E-01	1.70E+00	6.14E-01	(G)	95% UCL	K-S Test (5)
	Thallium	mg/kg	1.01E-01	2.40E-01	1.28E-01	(G)	95% UCL	K-S Test (5)
	Vanadium	mg/kg	2.44E+01	4.43E+01	2.81E+01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	1.06E+02	3.90E+02	1.56E+02	(G)	95% UCL	K-S Test (5)
	2-Methylnaphthalene	ug/kg	2.70E+02	2.30E+03	6.37E+02	(G)	95% UCL	K-S Test (12)
	Acenaphthene	ug/kg	2.84E+02	4.00E+03	1.05E+03	(T)	95% UCL	W-Test (7)
	Acenaphthylene	ug/kg	9.37E+02	1.20E+04	5.77E+03	(T)	95% UCL	W-Test (7)
	Anthracene	ug/kg	1.06E+03	1.40E+04	6.04E+03	(T)	95% UCL	W-Test (7)
	Benz(a)anthracene	ug/kg	2.26E+03	2.20E+04	1.36E+04	(T)	95% UCL	W-Test (7)
	Benzo(a)pyrene	ug/kg	2.07E+03	1.80E+04	1.35E+04	(T)	95% UCL	W-Test (7)
	Benzo(b)fluoranthene	ug/kg	3.32E+03	3.00E+04	2.24E+04	(T)	95% UCL	W-Test (7)
	Benzo(g,h,i)perylene	ug/kg	1.03E+03	1.10E+04	5.50E+03	(T)	95% UCL	W-Test (7)
	Benzo(k)fluoranthene	ug/kg	1.62E+03	1.40E+04	1.07E+04	(T)	95% UCL	W-Test (7)
	Chrysene	ug/kg	2.61E+03	2.40E+04	1.65E+04	(T)	95% UCL	W-Test (7)
	Dibenz(a,h)anthracene	ug/kg	3.25E+02	3.40E+03	1.85E+03	(T)	95% UCL	W-Test (7)
	Fluoranthene	ug/kg	5.22E+03	5.60E+04	2.89E+04	(T)	95% UCL	W-Test (7)
	Fluorene	ug/kg	2.90E+02	4.30E+03	9.74E+02	(T)	95% UCL	W-Test (7)

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
East of South Street Cont'd	Indeno(1,2,3-cd)pyrene	ug/kg	1.27E+03	1.30E+04	7.57E+03	(T)	95% UCL	W-Test (7)
	Naphthalene	ug/kg	2.89E+02	2.20E+03	6.50E+02	(G)	95% UCL	K-S Test (12)
	Phenanthrene	ug/kg	2.05E+03	2.20E+04	1.08E+04	(T)	95% UCL	W-Test (7)
	Pyrene	ug/kg	4.25E+03	4.50E+04	2.39E+04	(T)	95% UCL	W-Test (7)
	Total PAH	ug/kg	2.92E+04	2.97E+05	1.72E+05	(T)	99% UCL	W-Test (7)
	4-Methylphenol	ug/kg	1.35E+02	5.00E+02	1.72E+02	(NP)	95% UCL	W-Test (10)
	Benzoic acid	ug/kg	5.13E+02	2.70E+03	1.03E+03	(T)	95% UCL	W-Test (9)
	Butylbenzylphthalate	ug/kg	1.17E+02	7.90E+01	1.29E+02	(NP)	95% UCL	(11)
	Carbazole	ug/kg	2.44E+02	2.00E+03	6.97E+02	(NP)	95% UCL	W-Test (6)
	Dibenzofuran	ug/kg	3.10E+02	2.80E+03	9.35E+02	(NP)	95% UCL	W-Test (6)
	Carbon disulfide	ug/kg	1.05E+00	1.30E+00	1.26E+00	(N)	95% UCL	W-Test (3)
	o-Xylene	ug/kg	ND	ND	ND		NA	NA
	Trichlorofluoromethane	ug/kg	1.50E+00	2.70E+00	2.45E+00	(N)	95% UCL	W-Test (3)
West of South Street	Aluminum	mg/kg	6.68E+03	9.58E+03	7.23E+03	(N)	95% UCL	W-Test (3)
	Antimony	mg/kg	3.52E-01	7.20E-01	4.34E-01	(G)	95% UCL	K-S Test (5)
	Arsenic	mg/kg	5.11E+00	3.57E+01	1.36E+01	(NP)	95% UCL	W-Test (6)
	Barium	mg/kg	4.22E+01	9.87E+01	5.28E+01	(N)	95% UCL	W-Test (3)
	Cadmium	mg/kg	1.77E-01	3.00E-01	2.14E-01	(N)	95% UCL	W-Test (3)
	Chromium	mg/kg	9.85E+00	1.63E+01	1.08E+01	(N)	95% UCL	W-Test (3)
	Cobalt	mg/kg	3.72E+00	6.10E+00	4.24E+00	(N)	95% UCL	W-Test (3)
	Copper	mg/kg	1.61E+01	3.50E+01	1.93E+01	(N)	95% UCL	W-Test (3)
	Iron	mg/kg	1.14E+04	2.36E+04	1.32E+04	(NP)	95% UCL	W-Test (10)
	Lead	mg/kg	6.81E+01	2.20E+02	9.64E+01	(G)	95% UCL	K-S Test (5)
	Manganese	mg/kg	1.87E+02	3.30E+02	2.17E+02	(N)	95% UCL	W-Test (3)
	Mercury	mg/kg	9.12E-02	5.30E-01	1.39E-01	(G)	95% UCL	K-S Test (5)
	Nickel	mg/kg	8.84E+00	2.22E+01	1.15E+01	(G)	95% UCL	K-S Test (5)
	Selenium	mg/kg	3.12E-01	4.70E-01	3.53E-01	(N)	95% UCL	W-Test (3)
	Thallium	mg/kg	6.19E-02	9.80E-02	6.85E-02	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	2.20E+01	3.78E+01	2.49E+01	(G)	95% UCL	K-S Test (5)
	Zinc	mg/kg	6.06E+01	1.40E+02	7.60E+01	(N)	95% UCL	W-Test (3)

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
West of South Street Cont'd	2-Methylnaphthalene	ug/kg	1.98E+02	1.90E+03	1.41E+03	(NP)	99% UCL	W-Test (13)
	Acenaphthene	ug/kg	8.53E+01	7.50E+02	5.45E+02	(NP)	99% UCL	W-Test (13)
	Acenaphthylene	ug/kg	3.27E+02	2.40E+03	9.22E+02	(G)	95% UCL	K-S Test (12)
	Anthracene	ug/kg	3.32E+02	2.30E+03	2.11E+03	(NP)	99% UCL	W-Test (12)
	Benz(a)anthracene	ug/kg	9.72E+02	6.40E+03	2.71E+03	(G)	95% UCL	K-S Test (12)
	Benzo(a)pyrene	ug/kg	1.16E+03	8.20E+03	9.99E+03	(T)	99% UCL	W-Test (7)
	Benzo(b)fluoranthene	ug/kg	1.02E+03	6.70E+03	2.79E+03	(G)	95% UCL	K-S Test (13)
	Benzo(g,h,i)perylene	ug/kg	4.79E+02	3.20E+03	3.30E+03	(T)	99% UCL	W-Test (7)
	Benzo(k)fluoranthene	ug/kg	7.49E+02	5.20E+03	6.19E+03	(T)	99% UCL	W-Test (7)
	Chrysene	ug/kg	1.19E+03	7.80E+03	3.28E+03	(G)	95% UCL	K-S Test (12)
	Dibenz(a,h)anthracene	ug/kg	1.32E+02	8.80E+02	8.14E+02	(NP)	99% UCL	W-Test (13)
	Fluoranthene	ug/kg	1.86E+03	1.30E+04	5.00E+03	(G)	95% UCL	K-S Test (12)
	Fluorene	ug/kg	1.91E+02	1.90E+03	1.38E+03	(NP)	99% UCL	W-Test (13)
	Indeno(1,2,3-cd)pyrene	ug/kg	5.77E+02	4.20E+03	4.22E+03	(T)	99% UCL	W-Test (7)
	Naphthalene	ug/kg	2.91E+02	2.50E+03	1.19E+03	(T)	99% UCL	W-Test (7)
	Phenanthrene	ug/kg	2.10E+03	1.90E+04	1.67E+04	(T)	99% UCL	W-Test (7)
	Pyrene	ug/kg	2.58E+03	1.80E+04	1.97E+04	(T)	99% UCL	W-Test (7)
	Total PAH	ug/kg	1.43E+04	1.01E+05	3.92E+04	(G)	95% UCL	K-S Test (12)
	4-Methylphenol	ug/kg	ND	ND	ND		NA	NA
	Benzoic acid	ug/kg	5.15E+02	4.60E+03	1.64E+03	(NP)	95% UCL	W-Test (6)
	Butylbenzylphthalate	ug/kg	1.39E+02	1.08E+02	1.74E+02	(NP)	95% UCL	(11)
	Carbazole	ug/kg	1.70E+02	7.60E+02	3.48E+02	(NP)	95% UCL	W-Test (6)
	Dibenzofuran	ug/kg	1.37E+02	2.10E+02	1.79E+02	(T)	95% UCL	W-Test (4)
	C11-C22 Aromatic Hydrocarbons	ug/kg	2.44E+04	3.90E+04	NC		NC	(8)
	C19-C36 Aliphatic Hydrocarbons	ug/kg	1.16E+04	2.10E+04	NC		NC	(8)
	C9-C10 Aromatic Hydrocarbons	ug/kg	ND	ND	ND		NA	NA
	C9-C12 Aliphatic Hydrocarbons	ug/kg	ND	ND	ND		NA	NA
	C9-C18 Aliphatic Hydrocarbons	ug/kg	3.10E+03	4.50E+03	NC		NC	(8)
	Carbon disulfide	ug/kg	ND	ND	ND		NA	NA

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
West of South Street Cont'd	o-Xylene	ug/kg	1.04E+00	1.00E+00	1.15E+00	(N)	95% UCL	(11)
	Trichlorofluoromethane	ug/kg	4.15E+01	2.00E+02	2.75E+04	(NP)	95% UCL	(14)
Orlando Property	Aluminum	mg/kg	7.62E+03	1.10E+04	8.63E+03	(N)	95% UCL	W-Test (3)
	Antimony	mg/kg	ND	ND	ND		NA	NA
	Arsenic	mg/kg	2.47E+00	4.40E+00	2.89E+00	(G)	95% UCL	K-S Test (5)
	Barium	mg/kg	3.33E+01	6.60E+01	4.12E+01	(N)	95% UCL	W-Test (3)
	Cadmium	mg/kg	1.71E-01	4.50E-01	2.60E-01	(G)	95% UCL	K-S Test (5)
	Chromium	mg/kg	1.01E+01	1.72E+01	1.19E+01	(N)	95% UCL	W-Test (3)
	Cobalt	mg/kg	4.56E+00	9.60E+00	5.53E+00	(NP)	95% UCL	W-Test (10)
	Copper	mg/kg	1.23E+01	2.40E+01	1.58E+01	(G)	95% UCL	K-S Test (5)
	Iron	mg/kg	1.26E+04	2.78E+04	1.55E+04	(NP)	95% UCL	W-Test (10)
	Lead	mg/kg	4.27E+01	1.00E+02	6.51E+01	(G)	95% UCL	K-S Test (5)
	Manganese	mg/kg	3.28E+02	6.15E+02	4.11E+02	(N)	95% UCL	W-Test (3)
	Mercury	mg/kg	5.06E-02	1.30E-01	6.96E-02	(N)	95% UCL	W-Test (3)
	Nickel	mg/kg	6.20E+00	9.30E+00	7.16E+00	(N)	95% UCL	W-Test (3)
	Selenium	mg/kg	2.95E-01	5.50E-01	3.57E-01	(N)	95% UCL	W-Test (3)
	Thallium	mg/kg	6.91E-02	1.90E-01	9.20E-02	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	2.47E+01	5.67E+01	3.14E+01	(G)	95% UCL	K-S Test (5)
	Zinc	mg/kg	4.35E+01	8.40E+01	5.43E+01	(N)	95% UCL	W-Test (3)
	2-Methylnaphthalene	ug/kg	7.80E+01	7.80E+02	7.77E+02	(NP)	99% UCL	W-Test (13)
	Acenaphthene	ug/kg	1.70E+02	1.80E+03	1.79E+03	(NP)	99% UCL	W-Test (13)
	Acenaphthylene	ug/kg	3.87E+01	2.70E+02	9.41E+01	(G)	95% UCL	K-S Test (5)
	Anthracene	ug/kg	3.12E+02	3.30E+03	3.29E+03	(NP)	99% UCL	W-Test (13)
	Benz(a)anthracene	ug/kg	5.05E+02	5.00E+03	4.98E+03	(NP)	99% UCL	W-Test (13)
	Benzo(a)pyrene	ug/kg	3.92E+02	3.80E+03	3.78E+03	(NP)	99% UCL	W-Test (13)
	Benzo(b)fluoranthene	ug/kg	3.73E+02	3.50E+03	3.49E+03	(NP)	99% UCL	W-Test (13)
	Benzo(g,h,i)perylene	ug/kg	1.45E+02	1.30E+03	4.92E+02	(T)	99% UCL	W-Test (7)
	Benzo(k)fluoranthene	ug/kg	3.16E+02	3.10E+03	3.09E+03	(NP)	99% UCL	W-Test (13)
	Chrysene	ug/kg	4.76E+02	4.60E+03	4.58E+03	(NP)	99% UCL	W-Test (13)

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Orlando Property Cont'd	Dibenz(a,h)anthracene	ug/kg	6.45E+01	6.10E+02	6.08E+02	(NP)	99% UCL	W-Test (13)
	Fluoranthene	ug/kg	8.43E+02	8.30E+03	8.27E+03	(NP)	99% UCL	W-Test (13)
	Fluorene	ug/kg	1.71E+02	1.80E+03	1.79E+03	(NP)	99% UCL	W-Test (13)
	Indeno(1,2,3-cd)pyrene	ug/kg	2.24E+02	2.10E+03	2.09E+03	(NP)	99% UCL	W-Test (13)
	Naphthalene	ug/kg	9.87E+01	1.00E+03	9.96E+02	(NP)	99% UCL	W-Test (13)
	Phenanthrene	ug/kg	8.88E+02	9.20E+03	9.16E+03	(NP)	99% UCL	W-Test (13)
	Pyrene	ug/kg	7.29E+02	7.10E+03	7.07E+03	(NP)	99% UCL	W-Test (13)
	Total PAH	ug/kg	5.82E+03	5.76E+04	5.73E+04	(NP)	99% UCL	W-Test (13)
	4-Methylphenol	ug/kg	1.06E+02	5.60E+01	1.22E+02	(NP)	95% UCL	(11)
	Benzoic acid	ug/kg	1.60E+02	6.20E+02	2.51E+02	(G)	95% UCL	K-S Test (5)
	Butylbenzylphthalate	ug/kg	ND	ND	ND		NA	NA
	Carbazole	ug/kg	2.10E+02	1.20E+03	6.43E+02	(NP)	95% UCL	W-Test (6)
	Dibenzofuran	ug/kg	1.81E+02	8.80E+02	4.88E+02	(NP)	95% UCL	W-Test (6)
	o-Xylene	ug/kg	ND	ND	ND		NA	NA
	Trichlorofluoromethane	ug/kg	ND	ND	ND		NA	NA
Floodplain	Aluminum	mg/kg	7.18E+03	1.04E+04	7.92E+03	(N)	95% UCL	W-Test (3)
	Antimony	mg/kg	1.35E+00	6.70E+00	2.77E+00	(T)	95% UCL	W-Test (9)
	Arsenic	mg/kg	6.70E+00	2.83E+01	8.84E+00	(G)	95% UCL	K-S Test (5)
	Barium	mg/kg	7.92E+01	1.56E+02	9.63E+01	(N)	95% UCL	W-Test (3)
	Cadmium	mg/kg	8.02E-01	2.80E+00	1.23E+00	(G)	95% UCL	K-S Test (5)
	Chromium	mg/kg	2.57E+01	9.68E+01	4.90E+01	(NP)	95% UCL	W-Test (6)
	Copper	mg/kg	5.45E+01	1.63E+02	7.82E+01	(G)	95% UCL	K-S Test (5)
	Iron	mg/kg	1.79E+04	4.68E+04	3.29E+04	(NP)	95% UCL	W-Test (6)
	Lead	mg/kg	2.50E+02	7.30E+02	3.62E+02	(G)	95% UCL	K-S Test (5)
	Manganese	mg/kg	2.72E+02	8.11E+02	3.85E+02	(G)	95% UCL	K-S Test (5)
	Mercury	mg/kg	4.01E-01	1.40E+00	5.65E-01	(G)	95% UCL	K-S Test (5)
	Nickel	mg/kg	2.24E+01	1.65E+02	6.76E+01	(NP)	95% UCL	W-Test (6)
	Selenium	mg/kg	7.68E-01	1.60E+00	9.95E-01	(N)	95% UCL	W-Test (3)
	Thallium	mg/kg	1.18E-01	1.50E-01	1.40E-01	(N)	95% UCL	W-Test (3)

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Floodplain Cont'd	Vanadium	mg/kg	3.25E+01	4.86E+01	3.70E+01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	1.42E+02	4.60E+02	2.08E+02	(G)	95% UCL	K-S Test (5)
	2-Methylnaphthalene	ug/kg	1.13E+02	1.10E+03	6.32E+02	(NP)	99% UCL	W-Test (13)
	Acenaphthylene	ug/kg	8.21E+01	2.40E+02	1.21E+02	(G)	95% UCL	K-S Test (5)
	Anthracene	ug/kg	1.61E+02	1.50E+03	3.33E+02	(T)	95% UCL	W-Test (9)
	Benz(a)anthracene	ug/kg	5.51E+02	3.60E+03	8.14E+02	(G)	95% UCL	K-S Test (5)
	Benzo(a)pyrene	ug/kg	4.92E+02	2.70E+03	7.13E+02	(G)	95% UCL	K-S Test (5)
	Benzo(b)fluoranthene	ug/kg	6.11E+02	3.20E+03	8.67E+02	(G)	95% UCL	K-S Test (5)
	Benzo(g,h,i)perylene	ug/kg	2.10E+02	6.60E+02	2.87E+02	(G)	95% UCL	K-S Test (5)
	Benzo(k)fluoranthene	ug/kg	4.35E+02	1.80E+03	6.03E+02	(G)	95% UCL	K-S Test (5)
	Chrysene	ug/kg	6.64E+02	3.40E+03	9.36E+02	(G)	95% UCL	K-S Test (5)
	Dibenz(a,h)anthracene	ug/kg	6.31E+01	1.60E+02	8.36E+01	(G)	95% UCL	K-S Test (5)
	Fluoranthene	ug/kg	1.28E+03	1.00E+04	2.51E+03	(T)	95% UCL	W-Test (9)
	Indeno(1,2,3-cd)pyrene	ug/kg	2.56E+02	7.20E+02	3.56E+02	(G)	95% UCL	K-S Test (5)
	Naphthalene	ug/kg	1.29E+02	1.10E+03	6.81E+02	(NP)	99% UCL	W-Test (13)
	Phenanthrene	ug/kg	1.00E+03	1.10E+04	1.75E+03	(T)	95% UCL	W-Test (9)
	Pyrene	ug/kg	1.16E+03	9.20E+03	2.28E+03	(T)	95% UCL	W-Test (9)
	Total PAH	ug/kg	7.20E+03	4.89E+04	1.25E+04	(T)	95% UCL	W-Test (4)
	1,2-Dichlorobenzene	ug/kg	1.29E+02	4.00E+01	2.73E+02	(NP)	95% UCL	(11)
	4-Methylphenol	ug/kg	1.30E+02	9.30E+01	1.88E+02	(NP)	95% UCL	(11)
	Benzoic acid	ug/kg	6.24E+02	3.30E+03	1.27E+03	(G)	95% UCL	K-S Test (5)
	Butylbenzylphthalate	ug/kg	1.29E+02	8.40E+01	2.73E+02	(NP)	95% UCL	(11)
	Carbazole	ug/kg	1.61E+02	1.20E+03	4.85E+02	(NP)	95% UCL	W-Test (6)
	Dibenzofuran	ug/kg	1.41E+02	6.80E+02	3.56E+02	(NP)	95% UCL	W-Test (6)
Soil Reference Area	Aluminum	mg/kg	8.63E+03	1.40E+04	1.03E+04	(N)	95% UCL	W-Test (3)
	Arsenic	mg/kg	8.26E+00	3.50E+01	2.26E+01	(NP)	95% UCL	W-Test (6)
	Cadmium	mg/kg	2.50E-01	4.90E-01	3.09E-01	(N)	95% UCL	W-Test (3)
	Chromium	mg/kg	1.24E+01	2.02E+01	1.42E+01	(N)	95% UCL	W-Test (3)
	Lead	mg/kg	6.40E+01	1.35E+02	8.19E+01	(N)	95% UCL	W-Test (3)
	Selenium	mg/kg	1.00E+00	5.00E+00	2.48E+00	(NP)	95% UCL	W-Test (6)

TABLE 3-32

Upper Concentration Limit Summary for Soil

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (2)	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) (1,2)		Statistic	Rationale
Soil Reference Area Cont'd	Vanadium	mg/kg	3.23E+01	5.21E+01	3.72E+01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	3.62E+01	6.92E+01	4.62E+01	(N)	95% UCL	W-Test (3)

Notes:

NA = Not applicable.

NC = Not calculated.

ND = Not detected.

(G) = gamma

(N) = normal

(NP) = non-parametric

(T) = log-normal (value based on log-transformed data)

(1) UCL and distribution form were established using USEPA ProUCL software (ProUCL Version 3.0, USEPA, 2004).

(2) Individual samples where the COPEC was not detected in at least one sample in soil were included in estimation of the EPC using 1/2 the detection limit

(3) Shapiro-Wilk W test indicates the data are normally distributed. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(4) Shapiro-Wilk W test indicates the data are log-normally distributed, $0.5<\sigma<1.0$. Therefore, a 95% UCL was calculated based on the H-UCL statistic (USEPA, 2004).

(5) Kolmogorov-Smirnov test indicates the data are gamma distributed and k^>0.5. Therefore, an approximate gamma 95% UCL was calculated (USEPA, 2004).

(6) Shapiro-Wilk W test indicates the data are non-parametric and $0.5<\sigma<1.0$. Therefore, a 95% UCL was calculated based on the Chebyshev Theorem using the sample arithmetic mean and standard deviation of the data (USEPA, 2004).

(7) Shapiro-Wilk W test indicates the data are log-normally distributed, $1.5<\sigma<2.0$, and $n<20$. Therefore, a 99% UCL was calculated based on the Chebyshev Theorem using the Minimum Variance Unbiased Estimate of the log-transformed data (USEPA, 2004).

(8) The arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models because 3 samples or fewer were available for UCL calculation.

(9) Shapiro-Wilk W test indicates the data are log-normally distributed, $1<\sigma<1.5$, and $n<25$. Therefore, a 95% UCL was calculated based on the Chebyshev Theorem using the Minimum Variance Unbiased Estimate of the log-transformed data (USEPA, 2004).

(10) Shapiro-Wilk W test indicates the data are non-parametric and $0<\sigma<0.5$. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(11) Recommended UCL and the arithmetic mean concentration exceed the maximum detected concentration. Therefore, the maximum concentration will be used in RME and CTE food chain models.

(12) Kolmogorov-Smirnov test indicates the data are gamma distributed and 0.1< k^< 0.5. Therefore, an adjusted gamma 95% UCL was calculated (USEPA, 2004).

(13) Shapiro-Wilk W test indicates the data are non-parametric and $1<\sigma<2$. Therefore, a 99% UCL was calculated based on the Chebyshev Theorem using the sample arithmetic mean and standard deviation of the data (USEPA, 2004).

(14) Recommended UCL exceeds the maximum detected concentration. Therefore, the arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models.

TABLE 3-33

Upper Concentration Limit Summary for Sediment

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Neponset River *	Aluminum	mg/kg	4.24E+03	1.40E+04	8.70E+03	(NP)	95% UCL	W-Test (6)
	Barium	mg/kg	3.32E+01	1.35E+02	5.01E+01	(N)	95% UCL	W-Test (4)
	Cobalt	mg/kg	3.81E+00	1.01E+01	5.10E+00	(N)	95% UCL	W-Test (10)
	Iron	mg/kg	1.01E+04	2.22E+04	1.40E+04	(G)	95% UCL	K-S Test (5)
	Lead	mg/kg	1.25E+02	8.50E+02	2.78E+02	(T)	95% UCL	W-Test (7)
	Manganese	mg/kg	5.72E+02	2.34E+03	8.91E+02	(G)	95% UCL	K-S Test (5)
	Nickel	mg/kg	1.34E+01	9.31E+01	8.67E+01	(NP)	99% UCL	W-Test (8)
	Vanadium	mg/kg	1.64E+01	4.84E+01	2.25E+01	(G)	95% UCL	K-S Test (5)
	Zinc	mg/kg	7.09E+01	2.19E+02	1.03E+02	(G)	95% UCL	K-S Test (5)
	2-Methylnaphthalene	ug/kg	1.21E+02	7.30E+02	5.96E+02	(T)	95% UCL	W-Test (7)
	Acenaphthene	ug/kg	1.15E+02	6.00E+02	2.44E+02	(G)	95% UCL	K-S Test (5)
	Acenaphthylene	ug/kg	1.83E+02	1.30E+03	1.16E+03	(NP)	99% UCL	W-Test (8)
	Anthracene	ug/kg	2.62E+02	1.40E+03	6.80E+02	(T)	95% UCL	W-Test (7)
	Benzo[a]anthracene	ug/kg	7.38E+02	4.00E+03	1.47E+03	(G)	95% UCL	K-S Test (5)
	Benzo[a]pyrene	ug/kg	6.72E+02	3.20E+03	1.68E+03	(T)	95% UCL	W-Test (7)
	Benzo[b]fluoranthene	ug/kg	8.69E+02	4.60E+03	2.26E+03	(T)	95% UCL	W-Test (7)
	Benzo[g,h,i]perylene	ug/kg	2.82E+02	1.60E+03	5.45E+02	(G)	95% UCL	K-S Test (5)
	Benzo[k]fluoranthene	ug/kg	6.10E+02	3.80E+03	1.52E+03	(T)	95% UCL	W-Test (7)
	Chrysene	ug/kg	8.26E+02	4.50E+03	2.03E+03	(T)	95% UCL	W-Test (7)
	Dibenz[a,h]anthracene	ug/kg	7.18E+01	2.40E+02	1.32E+02	(G)	95% UCL	K-S Test (5)
	Fluoranthene	ug/kg	1.58E+03	9.00E+03	3.16E+03	(G)	95% UCL	K-S Test (5)
	Fluorene	ug/kg	1.65E+02	8.70E+02	3.32E+02	(G)	95% UCL	K-S Test (5)
	Indeno[1,2,3-cd]pyrene	ug/kg	3.25E+02	1.80E+03	6.48E+02	(G)	95% UCL	K-S Test (5)
	Naphthalene	ug/kg	1.89E+02	9.20E+02	5.69E+02	(NP)	95% UCL	W-Test (6)
	Phenanthrene	ug/kg	1.15E+03	6.90E+03	2.23E+03	(G)	95% UCL	K-S Test (5)
	Pyrene	ug/kg	1.51E+03	8.50E+03	3.58E+03	(T)	95% UCL	W-Test (7)
	Benzoic acid	ug/kg	1.79E+02	6.20E+02	5.45E+02	(NP)	95% UCL	W-Test (6)
	bis(2-Ethylhexyl)phthalate	ug/kg	7.03E+02	6.50E+03	1.25E+03	(T)	95% UCL	W-Test (7)
	Carbazole	ug/kg	1.78E+02	6.30E+02	2.66E+02	(T)	95% UCL	W-Test (4)
	Di-n-octylphthalate	ug/kg	1.07E+02	5.30E+01	1.22E+02	(G)	95% UCL	(9)

TABLE 3-33

Upper Concentration Limit Summary for Sediment

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Lewis Pond	Aluminum	mg/kg	7.57E+03	1.10E+04	8.60E+03	(N)	95% UCL	W-Test (3)
	Barium	mg/kg	8.70E+01	1.27E+02	1.02E+02	(N)	95% UCL	W-Test (3)
	Beryllium	mg/kg	4.76E-01	8.90E-01	5.92E-01	(N)	95% UCL	W-Test (3)
	Cadmium	mg/kg	3.70E+00	8.00E+00	4.76E+00	(N)	95% UCL	W-Test (3)
	Chromium	mg/kg	9.82E+01	4.10E+02	2.25E+02	(NP)	95% UCL	W-Test (6)
	Cobalt	mg/kg	9.85E+00	2.50E+01	1.24E+01	(G)	95% UCL	K-S Test (5)
	Copper	mg/kg	9.35E+01	1.80E+02	1.11E+02	(N)	95% UCL	W-Test (3)
	Lead	mg/kg	1.11E+03	7.60E+03	3.49E+03	(NP)	95% UCL	W-Test (6)
	Manganese	mg/kg	5.00E+02	1.01E+03	6.75E+02	(G)	95% UCL	K-S Test (5)
	Mercury	mg/kg	4.12E-01	9.00E-01	5.14E-01	(N)	95% UCL	W-Test (3)
	Nickel	mg/kg	6.69E+01	5.10E+02	2.29E+02	(NP)	95% UCL	W-Test (6)
	Selenium	mg/kg	8.38E-01	1.30E+00	9.81E-01	(N)	95% UCL	W-Test (3)
	Silver	mg/kg	4.70E-01	1.90E+00	1.02E+00	(NP)	95% UCL	W-Test (5)
	Thallium	mg/kg	9.14E-02	1.40E-01	1.06E-01	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	3.82E+01	8.46E+01	4.70E+01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	2.75E+02	4.77E+02	3.22E+02	(N)	95% UCL	W-Test (3)
	2-Methylnaphthalene	ug/kg	1.35E+02	1.90E+02	1.58E+02	(N)	95% UCL	W-Test (3)
	Acenaphthene	ug/kg	1.21E+02	2.30E+02	1.49E+02	(N)	95% UCL	W-Test (3)
	Acenaphthylene	ug/kg	5.87E+02	9.00E+02	6.81E+02	(N)	95% UCL	W-Test (3)
	Anthracene	ug/kg	6.26E+02	1.10E+03	7.53E+02	(N)	95% UCL	W-Test (3)
	Benzo[a]anthracene	ug/kg	1.79E+03	3.40E+03	2.13E+03	(N)	95% UCL	W-Test (3)
	Benzo[a]pyrene	ug/kg	1.83E+03	3.70E+03	2.18E+03	(N)	95% UCL	W-Test (3)
	Benzo[b]fluoranthene	ug/kg	2.32E+03	4.00E+03	2.77E+03	(N)	95% UCL	W-Test (3)
	Benzo[g,h,i]perylene	ug/kg	3.77E+02	6.50E+02	4.38E+02	(N)	95% UCL	W-Test (3)
	Benzo[k]fluoranthene	ug/kg	2.13E+03	3.90E+03	2.59E+03	(N)	95% UCL	W-Test (3)
	Chrysene	ug/kg	2.14E+03	4.10E+03	2.51E+03	(N)	95% UCL	W-Test (3)
	Dibenz[a,h]anthracene	ug/kg	1.46E+02	2.50E+02	1.69E+02	(G)	95% UCL	K-S Test (5)

TABLE 3-33

Upper Concentration Limit Summary for Sediment

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Lewis Pond Cont'd	Fluoranthene	ug/kg	3.34E+03	6.10E+03	3.97E+03	(N)	95% UCL	W-Test (3)
	Fluorene	ug/kg	2.19E+02	3.60E+02	2.66E+02	(N)	95% UCL	W-Test (3)
	Indeno[1,2,3-cd]pyrene	ug/kg	4.68E+02	7.20E+02	5.33E+02	(N)	95% UCL	W-Test (3)
	Naphthalene	ug/kg	2.84E+02	7.60E+02	3.66E+02	(N)	95% UCL	W-Test (3)
	Phenanthrene	ug/kg	1.71E+03	2.70E+03	2.00E+03	(N)	95% UCL	W-Test (3)
	Pyrene	ug/kg	3.47E+03	7.30E+03	4.24E+03	(N)	95% UCL	W-Test (3)
	2,4-Dimethylphenol	ug/kg	1.27E+02	6.10E+02	3.06E+02	(NP)	95% UCL	W-Test (6)
	4-Methylphenol	ug/kg	1.79E+02	5.50E+02	2.46E+02	(G)	95% UCL	K-S Test (5)
	Benzoic acid	ug/kg	9.33E+02	1.60E+03	1.12E+03	(N)	95% UCL	W-Test (3)
	Benzyl alcohol	ug/kg	1.07E+02	1.00E+02	1.29E+02	(N)	95% UCL	(9)
	bis(2-Ethylhexyl)phthalate	ug/kg	7.15E+02	3.00E+03	1.12E+03	(G)	95% UCL	K-S Test (5)
	Carbazole	ug/kg	1.62E+02	2.80E+02	1.84E+02	(N)	95% UCL	W-Test (3)
	Acetone	ug/kg	1.45E+02	4.40E+02	2.71E+02	(G)	95% UCL	K-S Test (5)
	Carbon disulfide	ug/kg	3.46E+00	8.20E+00	4.37E+00	(G)	95% UCL	K-S Test (5)
	Methyl tert-butyl ether (MTBE)	ug/kg	2.84E+00	2.70E+00	3.14E+00	(N)	95% UCL	(9)
Upper Former Mill Tailrace	Aluminum	mg/kg	7.68E+03	1.31E+04	1.20E+04	(N)	95% UCL	W-Test (3)
	Barium	mg/kg	5.03E+01	1.43E+02	3.15E+02	(G)	95% UCL	(9)
	Beryllium	mg/kg	2.91E-01	5.90E-01	5.47E-01	(N)	95% UCL	W-Test (3)
	Cobalt	mg/kg	5.18E+00	1.25E+01	2.16E+01	(G)	95% UCL	(9)
	Lead	mg/kg	1.75E+02	5.35E+02	4.62E+02	(N)	95% UCL	W-Test (3)
	Manganese	mg/kg	7.28E+02	2.50E+03	7.20E+03	(G)	95% UCL	(9)
	Mercury	mg/kg	5.08E-02	1.40E-01	1.22E-01	(N)	95% UCL	W-Test (3)
	Nickel	mg/kg	2.01E+01	5.65E+01	4.91E+01	(N)	95% UCL	W-Test (3)
	Selenium	mg/kg	2.71E-01	6.10E-01	5.64E-01	(N)	95% UCL	W-Test (3)
	Thallium	mg/kg	9.70E-02	1.90E-01	1.79E-01	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	2.17E+01	4.91E+01	6.15E+01	(NP)	95% UCL	W-Test (3)
	Zinc	mg/kg	9.33E+01	2.64E+02	5.80E+02	(G)	95% UCL	(9)

TABLE 3-33

Upper Concentration Limit Summary for Sediment

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Upper Former Mill Tailrace Cont'd	2-Methylnaphthalene	ug/kg	2.72E+02	4.50E+02	4.97E+02	(N)	95% UCL	(9)
	Acenaphthene	ug/kg	1.13E+02	2.50E+02	2.33E+02	(N)	95% UCL	W-Test (3)
	Acenaphthylene	ug/kg	2.41E+02	6.70E+02	5.93E+02	(N)	95% UCL	W-Test (3)
	Anthracene	ug/kg	2.52E+02	7.80E+02	2.17E+03	(G)	95% UCL	(9)
	Benz[a]anthracene	ug/kg	8.05E+02	2.70E+03	8.90E+03	(G)	95% UCL	(9)
	Benzo[a]pyrene	ug/kg	7.96E+02	2.40E+03	2.09E+03	(N)	95% UCL	W-Test (3)
	Benzo[b]fluoranthene	ug/kg	1.27E+03	4.40E+03	1.52E+04	(G)	95% UCL	(9)
	Benzo[g,h,i]perylene	ug/kg	1.46E+02	3.80E+02	3.35E+02	(N)	95% UCL	W-Test (3)
	Benzo[k]fluoranthene	ug/kg	9.65E+02	3.20E+03	2.74E+03	(N)	95% UCL	W-Test (3)
	Chrysene	ug/kg	9.36E+02	3.00E+03	2.58E+03	(N)	95% UCL	W-Test (3)
	Dibenz[a,h]anthracene	ug/kg	6.23E+01	1.80E+02	1.56E+02	(N)	95% UCL	W-Test (3)
	Fluoranthene	ug/kg	1.24E+03	3.90E+03	3.35E+03	(N)	95% UCL	W-Test (3)
	Fluorene	ug/kg	1.40E+02	3.60E+02	3.17E+02	(N)	95% UCL	W-Test (3)
	Indeno[1,2,3-cd]pyrene	ug/kg	1.68E+02	4.40E+02	3.88E+02	(N)	95% UCL	W-Test (3)
	Naphthalene	ug/kg	3.03E+02	5.20E+02	5.21E+02	(N)	95% UCL	(9)
	Phenanthrene	ug/kg	7.55E+02	2.00E+03	1.74E+03	(N)	95% UCL	W-Test (3)
	Pyrene	ug/kg	1.58E+03	4.80E+03	4.16E+03	(N)	95% UCL	W-Test (3)
	2,4-Dimethylphenol	ug/kg	9.50E+01	6.00E+01	1.27E+02	(N)	95% UCL	(9)
	4-Methylphenol	ug/kg	1.20E+02	1.60E+02	1.55E+02	(N)	95% UCL	W-Test (3)
	Benzoic acid	ug/kg	1.90E+02	4.80E+02	4.27E+02	(N)	95% UCL	W-Test (3)
	Benzyl alcohol	ug/kg	9.65E+01	6.60E+01	1.25E+02	(N)	95% UCL	(9)
	bis(2-Ethylhexyl)phthalate	ug/kg	1.44E+02	2.90E+02	2.67E+02	(N)	95% UCL	W-Test (3)
	Carbazole	ug/kg	1.33E+02	2.10E+02	1.95E+02	(N)	95% UCL	W-Test (3)
	Carbon disulfide	ug/kg	2.98E+00	7.40E+00	6.49E+00	(N)	95% UCL	W-Test (3)
Neponset River Reference Area	Aluminum	mg/kg	2.65E+03	3.40E+03	3.03E+03	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	1.12E+01	1.80E+01	1.46E+01	(N)	95% UCL	W-Test (3)

TABLE 3-33

Upper Concentration Limit Summary for Sediment

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (2)	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) (1,2)		Statistic	Rationale
Lower Pond Reference Area	Aluminum	mg/kg	1.07E+04	2.30E+04	1.43E+04	(N)	95% UCL	W-Test (3)
	Lead	mg/kg	5.21E+02	8.40E+02	6.90E+02	(N)	95% UCL	W-Test (3)
	Nickel	mg/kg	1.95E+01	3.00E+01	2.41E+01	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	5.32E+01	8.20E+01	6.83E+01	(N)	95% UCL	W-Test (3)

Notes:

* Neponset River includes the Lower Former Mill Tailrace

NA = Not applicable.

NC = Not calculated.

(G) = gamma

(N) = normal

(NP) = non-parametric

(T) = log-normal (value based on log-transformed data)

(1) UCL and distribution form were established using USEPA ProUCL software (ProUCL Version 3.0, USEPA, 2004).

(2) Individual samples where the COPEC was not detected were included in estimation of the arithmetic mean and UCL calculation using 1/2 the detection limit.

(3) Shapiro-Wilk W test indicates the data are normally distributed. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(4) Shapiro-Wilk W test indicates the data are log-normally distributed and $0.5<s<1.0$. Therefore, a 95% UCL was calculated based on the H-UCL (USEPA, 2004).

(5) Kolmogorov-Smirnov test indicates the data are gamma distributed and $k>0.5$. Therefore, an approximate gamma 95% UCL was calculated (USEPA, 2004).

(6) Shapiro-Wilk W test indicates the data are non-parametric and $0.5<\sigma<1.0$. Therefore, a 95% UCL was calculated based on the Chebyshev Theorem using the arithmetic mean and standard deviation of the data (USEPA, 2004).

(7) Shapiro-Wilk W test indicates the data are log-normally distributed, $1<\sigma<1.5$, and $n<25$. Therefore, a 95% UCL was calculated based on the Chebyshev Theorem using the Minimum Variance Unbiased Estimate of the log-transformed data (USEPA, 2004).

(8) Shapiro-Wilk W test indicates the data are non-parametric and $1.0<s<2.0$ and $n<50$. Therefore, a 99% UCL was calculated based on the Chebyshev Theorem using the arithmetic mean and standard deviation of the data (USEPA, 2004).

(9) Recommended UCL exceeds the maximum detected concentration. Therefore, the arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models.

(10) Shapiro-Wilk W test indicates the data are non-parametric and $s\leq 0.5$. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

TABLE 3-34

Upper Concentration Limit Summary for Surface Water

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit Value (Distribution) [1,2]		Statistic	Rationale
Neponset River*	Barium - Total	ug/L	4.87E+01	2.19E+02	1.43E+02	(NP)	95% UCL	W-Test (3)
	Iron - Total	ug/L	2.15E+03	1.38E+04	8.22E+03	(NP)	95% UCL	W-Test (3)
	Manganese - Total	ug/L	2.24E+02	9.50E+02	5.35E+02	(G)	95% UCL	W-Test (4)
	Benzo(b)fluoranthene	ng/L	7.51E+01	5.70E+02	3.19E+02	(NP)	95% UCL	W-Test (3)
	Benzo(g,h,I)perylene	ng/L	4.76E+01	3.10E+02	1.78E+02	(NP)	95% UCL	W-Test (3)
	Benzo(k)fluoranthene	ng/L	4.40E+01	3.00E+02	1.99E+02	(NP)	99% UCL	W-Test (5)
	Chrysene	ng/L	7.93E+01	6.20E+02	3.45E+02	(NP)	95% UCL	W-Test (3)
	Pyrene	ng/L	1.41E+02	1.10E+03	6.15E+02	(NP)	95% UCL	W-Test (3)
	Total PAHs	ng/L	3.87E+02	2.90E+03	1.63E+03	(NP)	95% UCL	W-Test (3)
Upper Former Mill Tailrace	Aluminum	ug/L	4.11E+03	7.33E+03	NA		NA	(7)
	Barium	ug/L	4.50E+01	6.69E+01	NA		NA	(7)
	Cadmium	ug/L	ND	ND	NA		NA	(7)
	Chromium	ug/L	5.42E+00	9.30E+00	NA		NA	(7)
	Cobalt	ug/L	1.72E+00	2.40E+00	NA		NA	(7)
	Copper	ug/L	1.62E+01	2.35E+01	NA		NA	(7)
	Iron	ug/L	3.14E+03	5.37E+03	NA		NA	(7)
	Lead	ug/L	5.58E+01	7.44E+01	NA		NA	(7)
	Manganese	ug/L	1.06E+02	1.49E+02	NA		NA	(7)
	Nickel	ug/L	1.04E+01	1.56E+01	NA		NA	(7)
	Vanadium	ug/L	2.15E+01	3.66E+01	NA		NA	(7)
	Zinc	ug/L	7.12E+01	9.33E+01	NA		NA	(7)
	2-Methylnaphthalene	ng/L	1.17E+02	2.90E+02	NA		NA	(7)
	Acenaphthylene	ng/L	1.38E+02	2.70E+02	NA		NA	(7)
	Benzo(a)anthracene	ng/L	2.41E+02	6.00E+02	NA		NA	(7)
	Benzo(a)pyrene	ng/L	3.67E+02	8.90E+02	NA		NA	(7)
	Benzo(b)fluoranthene	ng/L	3.54E+02	9.00E+02	NA		NA	(7)
	Benzo(g,h,I)perylene	ng/L	2.13E+02	5.00E+02	NA		NA	(7)
	Benzo(k)fluoranthene	ng/L	1.98E+02	4.70E+02	NA		NA	(7)
	Chrysene	ng/L	3.85E+02	9.80E+02	NA		NA	(7)
	Dibenz(a,h)anthracene	ng/L	4.85E+01	1.20E+02	NA		NA	(7)
	Indeno(1,2,3-cd)pyrene	ng/L	1.78E+02	4.30E+02	NA		NA	(7)
	Pyrene	ng/L	6.87E+02	1.60E+03	NA		NA	(7)
	2-Butanone (MEK)	ng/L	ND	ND	NA		NA	(7)

TABLE 3-34

Upper Concentration Limit Summary for Surface Water

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit			
					Value (Distribution) [1,2]		Statistic	Rationale
Neponset River Reference Area	Aluminum	ug/L	3.68E+01	6.03E+01	4.52E+01	(NP)	95% UCL	W-Test (8)
	Barium	ug/L	1.80E+01	2.13E+01	1.91E+01	(N)	95% UCL	W-Test (9)
	Cadmium	ug/L	ND	ND	NA		NA	NA
	Copper	ug/L	2.05E+00	2.20E+00	2.13E+00	(N)	95% UCL	W-Test (9)
	Chromium	ug/L	ND	ND	NA		NA	NA
	Iron	ug/L	2.90E+02	5.03E+02	3.81E+02	(G)	95% UCL	K-S Test (10)
	Lead	ug/L	ND	ND	NA		NA	NA
	Manganese	ug/L	9.41E+01	2.86E+02	2.14E+02	(NP)	95% UCL	W-Test (3)
	Nickel	ug/L	7.25E-01	1.20E+00	8.89E-01	(NP)	95% UCL	W-Test (8)
	Vanadium	ug/L	ND	ND	NA		NA	NA
	Zinc	ug/L	ND	ND	NA		NA	NA
	Pyrene	ng/L	9.17E+00	5.70E+00	1.51E+01	(NP)	95% UCL	(6)

Notes:

* Neponset River includes the Lower Former Mill Tailrace

NA = Not applicable.

NC = Not calculated.

ND = Not detected.

(G) = gamma

(N) = normal

(NP) = non-parametric

(T) = log-normal (value based on log-transformed data)

(1) UCL and distribution form were established using USEPA ProUCL software (ProUCL Version 3.0, USEPA, 2004).

(2) Individual samples where the COPEC was not detected were included in estimation of the mean and UCL calculations using 1/2 the detection limit.

(3) Shapiro-Wilk W test indicates the data are non-parametric and $0.5<\sigma<1.0$. Therefore, a 95% UCL was calculated based on the Chebyshev Theorem using the sample arithmetic mean and standard deviation of the data (USEPA, 2004).

(4) Kolmogorov-Smirnov test indicates the data are gamma distributed and $k>0.5$. Therefore, an approximate gamma 95% UCL was calculated (USEPA, 2004).

(5) Shapiro-Wilk W test indicates the data are log-normally distributed, $1.5<\sigma<2.0$, and $n<20$. Therefore, a 99% UCL was calculated based on the Chebyshev Theorem using the Minimum Variance Unbiased Estimate of the log-transformed data (USEPA, 2004).

(6) Recommended UCL exceeds the maximum detected concentration. Therefore, the arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models.

(7) The arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models because 3 samples or fewer were available for UCL calculation.

(8) Shapiro-Wilk W test indicates the data are non-parametric and $0<\sigma<0.5$. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

TABLE 3-35

Upper Concentration Limit Summary for Fish Tissue

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit			
					Value (Distribution) [1,2]		Statistic	Rationale
Neponset River *	Aluminum	mg/kg	2.53E+00	6.60E+00	5.75E+00	(N)	95% UCL	W-Test (3)
	Barium	mg/kg	1.07E+00	1.90E+00	1.93E+00	(N)	95% UCL	(4)
	Cobalt	mg/kg	2.83E-02	6.10E-02	5.44E-02	(N)	95% UCL	W-Test (3)
	Iron	mg/kg	5.33E+01	8.00E+01	8.59E+01	(N)	95% UCL	(4)
	Lead	mg/kg	2.14E-01	5.70E-01	4.99E-01	(N)	95% UCL	W-Test (3)
	Manganese	mg/kg	3.38E+01	6.00E+01	6.87E+01	(N)	95% UCL	(4)
	Nickel	mg/kg	2.58E-01	3.70E-01	3.97E-01	(N)	95% UCL	(4)
	Vanadium	mg/kg	4.25E-02	9.90E-02	8.94E-02	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	1.60E+01	1.80E+01	1.89E+01	(N)	95% UCL	(4)
	Benzoic acid	ug/kg	3.23E+03	2.00E+03	5.69E+03	(N)	95% UCL	(4)
	bis(2-Ethylhexyl)phthalate	ug/kg	3.29E+03	7.60E+03	7.28E+03	(N)	95% UCL	W-Test (3)
	Acenaphthene	ug/kg	1.60E+00	2.30E+00	2.36E+00	(N)	95% UCL	(4)
	Acenaphthylene	ug/kg	ND	ND	NA		NA	NA
	Anthracene	ug/kg	ND	ND	NA		NA	NA
	Benz[a]anthracene	ug/kg	1.84E+00	2.90E+00	2.97E+00	(N)	95% UCL	(4)
	Benzo[a]pyrene	ug/kg	1.33E+00	2.20E+00	2.01E+00	(NP)	95% UCL	W-Test (5)
	Benzo[b]fluoranthene	ug/kg	3.05E+00	3.90E+00	6.05E+00	(NP)	95% UCL	(4)
	Benzo[g,h,i]perylene	ug/kg	ND	ND	NA		NA	NA
	Benzo[k]fluoranthene	ug/kg	2.20E+00	3.10E+00	3.23E+00	(N)	95% UCL	(4)
	Chrysene	ug/kg	1.98E+00	2.60E+00	2.78E+00	(N)	95% UCL	(4)
	Fluorene	ug/kg	1.35E+00	2.30E+00	2.10E+00	(NP)	95% UCL	W-Test (5)
	Indeno[1,2,3-cd]pyrene	ug/kg	ND	ND	NA		NA	NA
	2-Methylnaphthalene	ug/kg	ND	ND	NA		NA	NA
	Phenanthrene	ug/kg	2.86E+00	4.30E+00	4.45E+00	(N)	95% UCL	(4)
	Pyrene	ug/kg	1.35E+00	2.30E+00	2.10E+00	(NP)	95% UCL	W-Test (5)
	Total PAHs	ug/kg	2.58E+01	3.08E+01	2.98E+01	(N)	95% UCL	W-Test (3)
Lewis Pond	Aluminum	mg/kg	8.22E+00	2.60E+01	1.82E+01	(N)	95% UCL	W-Test (3)
	Barium	mg/kg	1.11E+00	1.60E+00	1.51E+00	(N)	95% UCL	W-Test (3)
	Beryllium	mg/kg	ND	ND	ND		NA	NA
	Cadmium	mg/kg	4.46E-02	6.40E-02	6.56E-02	(N)	95% UCL	(4)
	Chromium	mg/kg	6.10E-01	9.80E-01	9.28E-01	(N)	95% UCL	W-Test (3)
	Cobalt	mg/kg	4.42E-02	5.30E-02	5.05E-02	(N)	95% UCL	W-Test (3)
	Copper	mg/kg	1.67E+00	2.50E+00	2.51E+00	(N)	95% UCL	(4)
	Lead	mg/kg	6.30E-01	1.10E+00	8.90E-01	(N)	95% UCL	W-Test (3)
	Manganese	mg/kg	1.62E+01	3.50E+01	2.70E+01	(N)	95% UCL	W-Test (3)

TABLE 3-35

Upper Concentration Limit Summary for Fish Tissue

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit			
					Value (Distribution) [1,2]		Statistic	Rationale
Lewis Pond Cont'd	Mercury	mg/kg	7.02E-02	1.20E-01	1.00E-01	(N)	95% UCL	W-Test (3)
	Nickel	mg/kg	3.60E-01	6.20E-01	5.00E-01	(T)	95% UCL	W-Test (6)
	Selenium	mg/kg	5.34E-01	7.90E-01	6.81E-01	(N)	95% UCL	W-Test (3)
	Silver	mg/kg	ND	ND	ND		NA	NA
	Thallium	mg/kg	2.68E-03	4.40E-03	4.35E-03	(N)	95% UCL	W-Test (3)
	Vanadium	mg/kg	8.22E-02	1.40E-01	1.22E-01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	2.84E+01	5.20E+01	4.25E+01	(N)	95% UCL	W-Test (3)
	bis(2-Ethylhexyl)phthalate	ug/kg	4.32E+03	1.20E+04	8.87E+03	(N)	95% UCL	W-Test (3)
	Benzoic acid	ug/kg	2.12E+03	7.50E+02	NC		NC	(7)
	Acenaphthene	ug/kg	2.07E+00	4.90E+00	7.42E+00	(T)	95% UCL	(4)
	Benz[a]anthracene	ug/kg	3.27E+00	6.70E+00	1.68E+01	(NP)	95% UCL	(4)
	Benzo[a]pyrene	ug/kg	3.55E+00	8.40E+00	1.92E+01	(NP)	95%UCL	(4)
	Benzo[b]fluoranthene	ug/kg	5.88E+00	1.50E+01	1.19E+01	(N)	95% UCL	W-Test (3)
	Benzo[g,h,i]perylene	ug/kg	1.42E+00	2.90E+00	2.21E+00	(NP)	95% UCL	W-Test (5)
	Benzo[k]fluoranthene	ug/kg	4.66E+00	1.10E+01	8.93E+00	(N)	95% UCL	W-Test (3)
	Chrysene	ug/kg	2.93E+00	6.00E+00	7.96E+00	(NP)	95% UCL	(4)
	Fluoranthene	ug/kg	2.46E+00	4.80E+00	3.97E+00	(N)	95% UCL	W-Test (3)
	Fluorene	ug/kg	2.66E+00	4.70E+00	4.33E+00	(N)	95% UCL	W-Test (3)
	Indeno[1,2,3-cd]pyrene	ug/kg	1.77E+00	3.20E+00	2.74E+00	(N)	95% UCL	W-Test (3)
	Naphthalene	ug/kg	1.92E+00	3.30E+00	2.96E+00	(N)	95% UCL	W-Test (3)
	Phenanthrene	ug/kg	4.55E+00	9.20E+00	7.89E+00	(N)	95% UCL	W-Test (3)
	Pyrene	ug/kg	7.17E+00	1.70E+01	1.38E+01	(N)	95% UCL	W-Test (3)
	Total PAHs	ug/kg	4.85E+01	8.77E+01	1.14E+02	(G)	95% UCL	(4)

TABLE 3-35

Upper Concentration Limit Summary for Fish Tissue

Blackburn and Union Privileges Site

Walpole, Massachusetts

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean [2]	Maximum Concentration	95% Upper Confidence Limit			
					Value (Distribution) [1,2]		Statistic	Rationale
Lower Pond Reference Area	Aluminum	mg/kg	7.13E+00	1.52E+01	1.24E+01	(N)	95% UCL	W-Test (3)
	Barium	mg/kg	2.28E+00	3.50E+00	3.12E+00	(N)	95% UCL	W-Test (3)
	Beryllium	mg/kg	ND	ND	ND		NA	NA
	Cadmium	mg/kg	8.80E-03	1.29E-02	1.16E-02	(N)	95% UCL	W-Test (3)
	Chromium	mg/kg	2.56E-01	4.28E-01	3.54E-01	(N)	95% UCL	W-Test (3)
	Cobalt	mg/kg	3.03E-02	4.65E-02	4.31E-02	(N)	95% UCL	W-Test (3)
	Copper	mg/kg	8.46E-01	1.81E+00	1.63E+00	(G)	95% UCL	K-S Test (8)
	Lead	mg/kg	2.25E-01	3.40E-01	3.06E-01	(N)	95% UCL	W-Test (3)
	Manganese	mg/kg	2.41E+01	5.80E+01	4.43E+01	(N)	95% UCL	W-Test (3)
	Mercury	mg/kg	9.14E-02	2.26E-01	2.39E-01	(NP)	95% UCL	(4)
	Nickel	mg/kg	2.66E-01	4.36E-01	3.63E-01	(N)	95% UCL	W-Test (3)
	Selenium	mg/kg	3.10E-01	3.66E-01	3.51E-01	(N)	95% UCL	W-Test (3)
	Silver	mg/kg	ND	ND	ND		NA	NA
	Thallium	mg/kg	3.52E-03	9.53E-03	9.24E-03	(G)	95% UCL	K-S Test (8)
	Vanadium	mg/kg	1.46E-01	2.10E-01	1.96E-01	(N)	95% UCL	W-Test (3)
	Zinc	mg/kg	1.78E+01	2.20E+01	2.15E+01	(N)	95% UCL	W-Test (3)
	bis(2-Ethylhexyl)phthalate	mg/kg	ND	ND	ND		NA	NA

Notes:

* Neponset River includes the Lower Former Mill Tailrace

NA = Not applicable.

NC = Not calculated.

ND = Not detected.

(G) = gamma

(N) = normal

(NP) = non-parametric

(T) = log-normal (value based on log-transformed data)

(1) UCL and distribution form were established using USEPA ProUCL software (ProUCL Version 3.0, USEPA, 2004).

(2) Individual samples where the COPEC was not detected were included in estimation of the mean and UCL calculations using 1/2 the detection limit.

(3) Shapiro-Wilk W test indicates the data are normally distributed. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(4) Recommended UCL exceeds the maximum detected concentration. Therefore, the arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models.

(5) Shapiro-Wilk W test indicates the data are non-parametric and $0<\sigma<0.5$. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(6) Shapiro-Wilk W test indicates the data are log-normally distributed and $0<\sigma<0.5$. Therefore, a 95% UCL was calculated based on the Student's t statistic (USEPA, 2004).

(7) The arithmetic mean concentration will be used in CTE food chain models and the maximum concentration will be used in RME food chain models because 3 samples or fewer were available for UCL calculation.

(8) Kolmogorov-Smirnov test indicates the data are gamma distributed and $k>0.5$. Therefore, an approximate gamma 95% UCL was calculated (USEPA, 2004).

Table 3-36. Food Chain Model Parameters for Semi-aquatic Mammals and Piscivorous Birds
Blackburn and Union Privileges Site
Walpole, Massachusetts

Species	Body Weight (kg)[a]	Food Ingestion Rate (kg/kg day ww)[a]	Proportion fish in diet[a]	Proportion invertebrates in diet[a]	Proportion plants in diet[a]	Percent sediment/soil in diet	Sediment/Soil Ingestion Rate kg/kg day dw[f]	Water ingestion rate L/kg day ww[a]	Foraging area[a,g]
Muskrat, *Ondatra zibethicus*	1.35	0.34	0	0.05	0.95	2[c]	0.0014	0.980	0.42 acres
Raccoon, *Procyon lotor*	5.74	0.3[b]	0.3	0.3	0.4	9.4[d]	0.0056	0.083	267 acres
Heron, *Ardea herodias*	2.204	0.18	1	0	0	0[e]	0	0.045	3.1 km distance from colony
Kingfisher, *Ceryle alcyon*	0.148	0.5	1	0	0	0[e]	0	0.11	0.39 km shoreline

[a] EPA. 1993. Wildlife Exposure Factors Handbook: Volume I of II. United States Environmental Protection Agency. EPA/600/R-93/187a.

[b] Allometrically determined using the metabolic rate and following EPA, 1993 equation: FIR (kg/day) = 0.687 Wt (kg) $^{0.822}$

[c] Based on reported values for other herbivorous rodents (Beyer et al., 1994).

[d] Beyer, W.N., E.E. Connor, and Gerould, S. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manage. 58(2): 375-382.

[e] Sample, B. E. and G. W. Suter II. 1994. Estimating Exposure of Terresterial Wildlife to Contaminants. Oak Ridge National Laboratory. DE-AC05-84OR21400.

[f] **Calculation of Sediment/Soil Ingestion Rate (SIR):**

SIR is calculated from the percent sediment/soil in diet and the food ingestion rate (FIR) converted to dry weight.
FIRdry=FIRwet*wet to dry factor* proportion of food type in diet; SIRdry=FIRdry*percentage of sediment/soil in diet
A wet to dry factor of 0.20 (Sample, B.E. and G.W., Sutter, II. 1994) is used in the above equation.

[g] For receptors other than the Heron, species-specific foraging areas were not used to calculate exposures in the food chain model (see section 3.2.2). For these receptors the foraging area (fa) was assumed to be equal to the area of the Site (A) (i.e A/fa = 1).

Table 3-37. Food Chain Model Parameters for Terrestrial Wildlife
Blackburn and Union Privileges Site
Walpole, Massachusetts

Species	Body Weight (kg)	Food Ingestion Rate (kg/kg day ww)[c]	Proportion soil invertebrates in diet[c]	Percent soil in diet	Soil Ingestion Rate kg/kg day dw[e]	Water ingestion rate L/kg day ww[c]	Foraging area[c,f]
American Robin, *Turdus migratorius*	0.082[a]	0.9	1	10[d*]	0.018	0.14	1.04 acres
Short-tailed Shrew, *Blarina brevicauda*	0.015[b]	0.6	1	13[b]	0.016	0.22	0.96 acres

[a] Skorupa and Hothem. 1985. Consumption of commercially-grown grapes by American robins:a field evaluation of laboratory estimates. Journal of Field Ornithology 56:369-378.

[b] Sample, B. E. and G. W. Suter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory. DE-AC05-84OR21400.

[c] EPA. 1993. Wildlife Exposure Factors Handbook: Volume I of II. United States Environmental Protection Agency. EPA/600/R-93/187a.

[d] Beyer, W.N., E.E. Connor, and Gerould, S. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manage. 58(2): 375-382.
Because the robin is assumed to have a diet of 100% soil invertebrates, a soil ingestion rate of 10% is used

[e] **Calculation of Soil Ingestion Rate (SIR):**
SIR is calculated from the percent soil in diet and the food ingestion rate (FIR) converted to dry weight
$FIR_{dry}=FIR_{wet}$*wet to dry factor* proportion of food type in diet; $SIR_{dry}=FIR_{dry}$*percentage of soil in diet
Since the robin and shrew diets consist of soil invertebrates, a wet to dry factor of 0.20 (Sample, B.E. and G.W., Sutter, II. 1994) is used in the above equation.

[f] Species-specific foraging areas were not used to calculate exposures in the food chain model. The foraging area (fa) was assumed to be equal to the area of the Site (A) (i.e A/fa = 1).

*For this assessment, it was assumed that the diet of the robin and shrew consists entirely of earthworms.

Table 3-38. Calculation of CTE and RME (95% UCL) Aquatic Plant Exposure Point Concentrations - Site
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	$BSAF_{Plant}$	Source [1]	95% UCL Bulk Sediment Concentration Neponset River [3]	95% UCL Plant Concentration Neponset River[2]	95% UCL Bulk Sediment Concentration Lewis Pond	95% UCL Plant Concentration Lewis Pond[2]	95% UCL Bulk Sediment Concentration Upper Tailrace[3]	95% UCL Plant Concentration Upper Tailrace[2]
	Kg- soil/Kg-plant		mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww
Metals								
Aluminum	0.004	Baes et al. (1984)	8.70E+03	6.96E+00	8.60E+03	6.88E+00	1.20E+04	9.58E+00
Barium	0.15	Baes et al. (1984)	5.01E+01	1.50E+00	1.02E+02	3.06E+00	50.3 / 143	1.51E+00 / 4.29E+00
Beryllium	0.01	Baes et al. (1984)			5.92E-01	1.18E-03	5.47E-01	1.09E-03
Cadmium	0.43	MADEP (1995)			4.76E+00	4.09E-01		
Chromium	0.81	MADEP (1995)			2.25E+02	3.64E+01		
Cobalt	0.02	Baes et al. (1984)	5.10E+00	2.04E-02	1.24E+01	4.96E-02	5.18 / 12.5	2.07E-02 / 5.00E-02
Copper	0.4	Baes et al. (1984)			1.11E+02	8.86E+00		
Iron	0.004	Baes et al. (1984)	1.40E+04	1.12E+01				
Lead	0.01	MADEP (1995)	2.78E+02	5.56E-01	3.49E+03	6.98E+00	4.62E+02	9.24E-01
Manganese	0.25	Baes et al. (1984)	8.91E+02	4.45E+01	6.75E+02	3.37E+01	728 / 2500 [3]	3.64E+01 / 1.25E+02
Mercury	0.017	MADEP (1995)			5.14E-01	1.75E-03	1.22E-01	4.14E-04
Nickel	0.52	MADEP (1995)	8.67E+01	9.01E+00	2.29E+02	2.38E+01	4.91E+01	5.11E+00
Selenium	0.07	MADEP (1995)			9.81E-01	1.37E-02	5.64E-01	7.89E-03
Silver	0.8	MADEP (1995)			1.02E+00	1.63E-01		
Thallium	0.0004	MADEP (1995)			1.06E-01	8.45E-06	1.79E-01	1.43E-05
Vanadium	0.0055	Baes et al. (1984)	2.25E+01	2.47E-02	4.70E+01	5.17E-02	6.15E+01	6.77E-02
Zinc	0.8	MADEP (1995)	1.03E+02	1.65E+01	3.22E+02	5.16E+01	5.80E+02	9.29E+01
PAHs								
2-Methylnaphthalene	0.42	MADEP (1995)	5.96E-01	5.01E-02	1.58E-01	1.33E-02	.272 / .450	2.28E-02 / 3.78E-02
Acenaphthene	0.42	MADEP (1995)	2.44E-01	2.05E-02	1.49E-01	1.25E-02	2.33E-01	1.96E-02
Acenaphthylene	0.42	MADEP (1995)	1.16E+00	9.76E-02	6.81E-01	5.72E-02	5.93E-01	4.98E-02
Anthracene	0.42	MADEP (1995)	6.80E-01	5.71E-02	7.53E-01	6.32E-02	.252 / .780	2.12E-02 / 6.55E-02
Benzo(a)anthracene	0.42	MADEP (1995)	1.47E+00	1.23E-01	2.13E+00	1.79E-01	.805 / 2.7	6.76E-02 / 2.27E-01
Benzo(a)pyrene	0.42	MADEP (1995)	1.68E+00	1.41E-01	2.18E+00	1.83E-01	2.09E+00	1.75E-01
Benzo(b)fluoranthene	0.42	MADEP (1995)	2.26E+00	1.90E-01	2.77E+00	2.32E-01	1.27 / 4.4	1.07E-01 / 3.70E-01
Benzo[g,h,i]perylene	0.42	MADEP (1995)	5.45E-01	4.58E-02	4.38E-01	3.68E-02	3.35E-01	2.81E-02
Benzo(k)fluoranthene	0.42	MADEP (1995)	1.52E+00	1.28E-01	2.59E+00	2.18E-01	2.74E+00	2.30E-01
Chrysene	0.42	MADEP (1995)	2.03E+00	1.70E-01	2.51E+00	2.11E-01	2.58E+00	2.17E-01
Dibenz[a,h]anthracene	0.42	MADEP (1995)	1.32E-01	1.11E-02	1.69E-01	1.42E-02	1.56E-01	1.31E-02
Fluoranthene	0.42	MADEP (1995)	3.16E+00	2.66E-01	3.97E+00	3.34E-01	3.35E+00	2.82E-01
Fluorene	0.42	MADEP (1995)	3.32E-01	2.79E-02	2.66E-01	2.23E-02	3.17E-01	2.66E-02
Indeno[1,2,3-cd]pyrene	0.42	MADEP (1995)	6.48E-01	5.45E-02	5.33E-01	4.48E-02	3.88E-01	3.26E-02
Naphthalene	0.42	MADEP (1995)	5.69E-01	4.78E-02	3.66E-01	3.08E-02	.303 / .520	2.55E-02 / 4.37E-02
Phenanthrene	0.42	MADEP (1995)	2.23E+00	1.87E-01	2.00E+00	1.68E-01	1.74E+00	1.46E-01
Pyrene	0.42	MADEP (1995)	3.58E+00	3.01E-01	4.24E+00	3.56E-01	4.16E+00	3.50E-01
Other SVOCs								
2,4-Dimethylphenol		NA			3.06E-01		9.50E-02 / 6.00E-02	
4-Methylphenol		NA			2.46E-01		1.55E-01	
Benzoic acid		NA	5.45E-01		1.12E+00		4.27E-01	
Benzyl alcohol		NA			1.07E-01 / 1.00E-01		9.65E-02 / 6.60E-02	
bis(2-Ethylhexyl)phthalate		NA	1.25E+00		1.12E+00		2.67E-01	
Carbazole		NA	2.66E-01		1.84E-01		1.95E-01	
Di-n-octylphthalate		NA	1.07E-01 / 5.30E-02					
VOCs								
Acetone		NA			2.71E-01			
Carbon disulfide		NA			4.37E-03		6.49E-03	
Methyl tert-butyl ether		NA			2.84E-03 / 2.70E-03			

Notes:
(1) Baes, C.F. III, Sharp, R.D., Sjoreen, A.L., and R.W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by the Oak Ridge National Laboratory, Oak Ridge, Tennessee for the U.S. Department of Energy. September.
MADEP. 1995. Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan. Bureau of Waste Site Cleanup and Office of Research and Standards. July 1995. Table B-8.
(2) Assumes 80% moisture content in plants (Sample, B. E. and G. W. Suter II. 1994. Estimating Exposure of Terresterial Wildlife to Contaminants. Oak Ridge National Laboratory. DE-AC05-84OR21400).
(3) Concentrations for barium, cobalt, manganese, 2-methylnaphthalene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, indeno[1,2,3-cd]pyrene, and 2,4-dimethylphenol are based on average / maximum sediment concentrations since the recommended UCL exceeds the maximum detected concentration.

Table 3-39. Calculation of Maximum Aquatic Plant Exposure Point Concentrations - Site
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	$BSAF_{Plant}$	Source [1]	Maximum Bulk Sediment Concentration Neponset River*	Maximum Plant Concentration Neponset River[2]	Maximum Bulk Sediment Concentration Lewis Pond	Maximum Plant Concentration Lewis Pond[2]	Maximum Bulk Sediment Concentration Tailrace	Maximum Plant Concentraton Tailrace[2]
	Kg- soil/Kg-plant		mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww
Metals								
Aluminum	0.004	Baes et al. (1984)	1.40E+04	1.12E+01	1.10E+04	8.80E+00	1.31E+04	1.05E+01
Barium	0.15	Baes et al. (1984)	1.35E+02	4.05E+00	1.27E+02	3.81E+00	1.43E+02	4.29E+00
Beryllium	0.01	Baes et al. (1984)			8.90E-01	1.78E-03	5.90E-01	1.18E-03
Cadmium	0.43	MADEP (1995)			8.00E+00	6.88E-01		
Chromium	0.81	MADEP (1995)			4.10E+02	6.64E+01		
Cobalt	0.02	Baes et al. (1984)	1.01E+01	4.04E-02	2.50E+01	1.00E-01	1.25E+01	5.00E-02
Copper	0.4	Baes et al. (1984)			1.80E+02	1.44E+01		
Iron	0.004	Baes et al. (1984)	2.22E+04	1.78E+01				
Lead	0.01	MADEP (1995)	8.50E+02	1.70E+00	7.60E+03	1.52E+01	5.35E+02	1.07E+00
Manganese	0.25	Baes et al. (1984)	2.34E+03	1.17E+02	1.01E+03	5.05E+01	2.50E+03	1.25E+02
Mercury	0.017	MADEP (1995)			9.00E-01	3.06E-03	1.40E-01	4.76E-04
Nickel	0.52	MADEP (1995)	9.31E+01	9.68E+00	5.10E+02	5.30E+01	5.65E+01	5.88E+00
Selenium	0.07	MADEP (1995)			1.30E+00	1.82E-02	6.10E-01	8.54E-03
Silver	0.8	MADEP (1995)			1.90E+00	3.04E-01		
Thallium	0.0004	MADEP (1995)			1.40E-01	1.12E-05	1.90E-01	1.52E-05
Vanadium	0.0055	Baes et al. (1984)	4.84E+01	5.32E-02	8.46E+01	9.31E-02	4.91E+01	5.40E-02
Zinc	0.8	MADEP (1995)	2.19E+02	3.50E+01	4.77E+02	7.63E+01	2.64E+02	4.22E+01
PAHs								
2-Methylnaphthalene	0.42	MADEP	7.30E-01	6.13E-02	1.90E-01	1.60E-02	4.50E-01	3.78E-02
Acenaphthene	0.42	MADEP	6.00E-01	5.04E-02	2.30E-01	1.93E-02	2.50E-01	2.10E-02
Acenaphthylene	0.42	MADEP	1.30E+00	1.09E-01	9.00E-01	7.56E-02	6.70E-01	5.63E-02
Anthracene	0.42	MADEP	1.40E+00	1.18E-01	1.10E+00	9.24E-02	7.80E-01	6.55E-02
Benzo(a)anthracene	0.42	MADEP	4.00E+00	3.36E-01	3.40E+00	2.86E-01	2.70E+00	2.27E-01
Benzo(a)pyrene	0.42	MADEP	3.20E+00	2.69E-01	3.70E+00	3.11E-01	2.40E+00	2.02E-01
Benzo(b)fluoranthene	0.42	MADEP	4.60E+00	3.86E-01	4.00E+00	3.36E-01	4.40E+00	3.70E-01
Benzo[g,h,i]perylene	0.42	MADEP	1.60E+00	1.34E-01	6.50E-01	5.46E-02	3.80E-01	3.19E-02
Benzo(k)fluoranthene	0.42	MADEP	3.80E+00	3.19E-01	3.90E+00	3.28E-01	3.20E+00	2.69E-01
Chrysene	0.42	MADEP	4.50E+00	3.78E-01	4.10E+00	3.44E-01	3.00E+00	2.52E-01
Dibenz[a,h]anthracene	0.42	MADEP	2.40E-01	2.02E-02	2.50E-01	2.10E-02	1.80E-01	1.51E-02
Fluoranthene	0.42	MADEP	9.00E+00	7.56E-01	6.10E+00	5.12E-01	3.90E+00	3.28E-01
Fluorene	0.42	MADEP	8.70E-01	7.31E-02	3.60E-01	3.02E-02	3.60E-01	3.02E-02
Indeno[1,2,3-cd]pyrene	0.42	MADEP	1.80E+00	1.51E-01	7.20E-01	6.05E-02	4.40E-01	3.70E-02
Naphthalene	0.42	MADEP	9.20E-01	7.73E-02	7.60E-01	6.38E-02	5.20E-01	4.37E-02
Phenanthrene	0.42	MADEP	6.90E+00	5.80E-01	2.70E+00	2.27E-01	2.00E+00	1.68E-01
Pyrene	0.42	MADEP	8.50E+00	7.14E-01	7.30E+00	6.13E-01	4.80E+00	4.03E-01
Other SVOCs								
2,4-Dimethylphenol		NA			6.10E-01		6.00E-02	
4-Methylphenol		NA			5.50E-01		1.60E-01	
Benzoic acid		NA	6.20E-01		1.60E+00		4.80E-01	
Benzyl alcohol		NA			1.00E-01		6.60E-02	
bis(2-Ethylhexyl)phthalate		NA	6.50E+00		3.00E+00		2.90E-01	
Carbazole		NA	6.30E-01		2.80E-01		2.10E-01	
Di-n-octylphthalate		NA	5.30E-02					
VOCs								
Acetone		NA			4.40E-01			
Carbon disulfide		NA			8.20E-03		7.40E-03	
Methyl tert-butyl ether		NA			2.70E-03			

* Neponset River includes the Lower Former Mill Tailrace
(1) Baes, C. F., R. D. Sharp, A. L. Sjoreen, and R. W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. ORNL-5786. Oak Ridge National Laboratory, Oak Ridge, TN
MADEP, Office of Research and Standards. 1995. Guidance for Disposal Site Risk Characterization and related Phase II activities in support of the Massachusetts Contingency Plan. Commonwealth of Massachusetts: Office of the Secretary of State. Table B-8.
(2) assumes 80% moisture content in plants

Table 3-40. Calculation of CTE and RME (95%UCL) Exposure Point Concentrations - Reference Areas
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	$BSAF_{Plant}$	Source [1]	95%UCL Bulk Sediment Concentration Neponset River Reference Area	95%UCL Plant Concentration Neponset River Reference Area [2]	95%UCL Bulk Sediment Concentration Lower Pond Reference Area	95% UCL Plant Concentration Lower Pond Reference Area [2]	95% UCL Bulk Sediment Concentration Former Mill Tailrace Reference Area [3]	95% UCL Plant Concentraton Former Mill Tailrace Reference Area [2]
	Kg- soil/Kg-plant		mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww	mg/Kg-soil dw	mg/Kg plant ww
Metals								
Aluminum	0.004	Baes et al. (1984)	3.03E+03	2.42E+00	1.43E+04	1.14E+01	3.03E+03	2.42E+00
Lead	0.01	MADEP (1995)			6.90E+02	1.38E+00		
Nickel	0.52	MADEP (1995)			2.41E+01	2.51E+00		
Vanadium	0.0055	Baes et al. (1984)	1.46E+01	1.61E-02	6.83E+01	7.51E-02	1.46E+01	1.61E-02

Notes:
(1) Baes, C.F. III, Sharp, R.D., Sjoreen, A.L., and R.W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by the Oak Ridge National Laboratory, Oak Ridge, Tennessee for the U.S. Department of Energy. September.
MADEP. 1995. Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan. Bureau of Waste Site Cleanup and Office of Research and Standards. July 1995. Table B-8.
(2) Assumes 80% moisture content in plants (Sample, B. E. and G. W. Suter II. 1994. Estimating Exposure of Terresterial Wildlife to Contaminants. Oak Ridge National Laboratory. DE-AC05-84OR21400).
(3) Reference area is the upstream Neponset River reference area.

Table 3-41. Calculation of Maximum Aquatic Plant Exposure Point Concentration - Reference Areas
Blackburn and Union Privileges Site
Walpole, Massachusetts

Compound	$BSAF_{Plant}$ Kg- soil/Kg-plant	Source [1]	Maximum Bulk Sediment Concentration Neponset River Reference Area mg/Kg-soil dw	Maximum Plant Concentration Neponset River Reference Area [2] mg/Kg plant ww	Maximum Bulk Sediment Concentration Lower Pond Reference Area mg/Kg-soil dw	Maximum Plant Concentration Lower Pond Reference Area [2] mg/Kg plant ww	Maximum Bulk Sediment Concentration Former Mill Tailrace Reference Area [3] mg/Kg-soil dw	Maximum Plant Concentration Former Mill Tailrace Reference Area [2] mg/Kg plant ww
Metals								
Aluminum	0.004	Baes et al. (1984)	3.40E+03	2.72E+00	2.30E+04	1.84E+01	3.40E+03	2.72E+00
Lead	0.01	MADEP (1995)	1.75E+01	3.50E-02	8.40E+02	1.68E+00	1.75E+01	3.50E-02

(1) Baes, C.F. III, Sharp, R.D., Sjoreen, A.L., and R.W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by the Oak Ridge National Laboratory, Oak Ridge, Tennessee for the U.S. Department of Energy. September.
MADEP 1995. Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan. Bureau of Waste Site Cleanup and Office of Research and Standards. July 1995. Table B-8.
(2) assumes 80% moisture content in plants
(3) Reference area is the upstream Neponset River reference area.

Table 4-1. National Recommended Water Quality Criteria and Tier II Secondary Chronic Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Neponset River			Tailrace		
	NRWQC [1] 44 (mg equivalent CaCO3/L)		Tier II SCV [2]	NRWQC [1] 40 (mg equivalent CaCO3/L)		Tier II SCV [2]
Chemicals	CMC	CCC		CMC	CCC	
Dissolved Metals (ug/L)						
Aluminum	NA	NA	NA	NA	NA	NA
Barium	NA	NA	4	NA	NA	4
Cadmium	0.9	0.14		0.8	0.13	
Chromium VI	16	11		16	11	
Cobalt	NA	NA	23	NA	NA	23
Copper	6	4.4		6	4.1	
Iron	NA	NA	NA	NA	NA	NA
Lead	26	1		24	0.9	
Manganese	NA	NA	120	NA	NA	120
Nickel	234	26		216	24	
Vanadium	NA	NA	20	NA	NA	20
Zinc	58	59		54	54	
Total Metals (ug/L)						
Aluminum	750	87		750	87	
Barium	NA	NA	4	NA	NA	4
Cadmium	0.9	0.15		0.8	0.14	
Chromium VI	16	11		16	11	
Cobalt	NA	NA	23	NA	NA	23
Copper	6	4.6		6	4.3	
Iron	NA	1000		NA	1000	
Lead	29	1.1		25	1	
Manganese	NA	NA	120	NA	NA	120
Nickel	234	26		216	24	
Vanadium	NA	NA	20	NA	NA	20
Zinc	60	60		55	55	
PAHs (ug/L)						
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	0.027	NA	NA	0.027
Benzo(a)pyrene	NA	NA	0.014	NA	NA	0.014
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA
Benzo(g,h,I)perylene	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA
Other SVOCs (ug/L)						
4-Nitroaniline	NA	NA	NA	NA	NA	NA
VOC (ug/L)						
2-Butanone (MEK)	NA	NA	14000	NA	NA	14000

Notes:

1: Values are from: National Recommended Water Quality Criteria: 2004a. EPA, Office of Water, 2004. National Recommended Water qulaity Criteria that are hardness dependent were derived using the site-specific hardness

2: Values are calculated using Great Lakes Water Quality Initiative Tier II methodology (40 CFR 9 et al.) as presented in Suter and Tsao (1996). Tier II SCVs are used when a NRWQC is not available.

CMC = Criterion Maximum Concentration (acute criterion)

CCC = Criterion Continuous Concentration (chronic criterion)

NA: Criteria not available

SCV = Secondary Chronic Value

Table 4-2. Whole Body Toxicity Reference Values for Fish
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemicals[1]	Test Species Scientific Name	Test Species Common Name	Effect Concentration (mg/kg ww)	Type of Effect Level	Reported NOED (mg/kg ww)	Estimated NOED (mg/kg ww)	Endpoint	Body Part	Reference
Aluminum	*Oncorhynchus mykiss*	Trout - Rainbow			8.53		Mortality	Whole Body	Handy, R.D, 1993
Barium			NA						
Beryllium	*Lepomis macrochirus*	Bluegill			5.13		Mortality	Whole Body	Barrows et al., 1980
Cadmium	*Poecilia reticulata*	Guppy	1	LOED	0.5		Growth	Whole Body	Hatakeyama and Yasuno
Chromium	*Oncorhynchus mykiss*	Trout - Rainbow			2.3		Mortality	Whole Body	Van De Putteet al., 1981
Cobalt			NA						
Copper	*Oncorhynchus mykiss*	Trout - Rainbow	4.48	LOED	3.92		Mortality	Whole Body	Mount al., 1994
Iron			NA						
Lead	*Pimephales promelas*	Fathead minnow	26.2	LOED		2.62	Behavior	Whole Body	Weber et al., 1991
Manganese			NA						
Mercury	*Stizostedion vitreum*	Walleye	2.37	LOED	0.25		Growth	Whole Body	Friedmann et al., 1996
Nickel			NA						
Selenium	*Pimephales promelas*	Fathead minnow	1.4	LOED	1.14		Growth	Whole Body	Ogle and Knight, 1989
Silver			NA						
Thallium	*Lepomis macrochirus*	Bluegill			2.72		Mortality	Whole Body	Barrows et al., 1980
Vanadium	*Jordanella floridae*	American flagfish	2.7	LOED	0.68		Growth	Whole Body	Holdway et al., 1983
Zinc	*Jordanella floridae*	American flagfish	50	LOED		5	Mortality	Whole Body	Spehar et al., 1978

Note:
NA = not available
[1]The narcosis model was used to evaluate semi-volatile organic compounds. See Section 4.2 and Table 5-5.

Table 4-3. Whole Body Toxicity Reference Values for Benthic Invertebrates
Blackburn and Union Privileges
Walpole, Massachusetts

Chemicals	Test Species Scientific Name	Test Species Common Name	Effect Concentration (mg/kg ww)	Type of Effect Level	Estimated NOED (mg/kg ww)	Reported NOED (mg/kg ww)	Exposure Route	Endpoint	Reference
Metals									
Aluminum			NA			NA			
Barium			NA			NA			
Beryllium			NA			NA			
Cadmium	*Hyalella azteca*	Amphipod - Freshwater	6	LOED		4.6	Water	Mortality	Borgmann U. et al., 1991. Can J Fish Aquat Sci 48:1055-1060
Chromium			NA			NA			
Cobalt			NA			NA			
Copper	*Chironomus decorus*	Midge	18	LOED		13	Ingestion	Development	Kosalwat and Knight, 1987. Arch. Environ. Contam. Toxicol. 16:283-290.
Iron			NA			NA			
Lead	*Hyalella azteca*	Amphipod - Freshwater	82.67	LOED		48.277	Combined	Survival	MacLean RS et al., 1996. Can J Fish Aquat Sci 53:2212-2220
Manganese			NA			NA			
Mercury	*Daphnia magna*	Water flea	2.33	LOED		0.859	Absorption	Reproduction	Biesinger K.E et al., 1982. Arch. Environ. Contam. Toxicol. 11:769-774.
Nickel	*Hyalella azteca*	Amphipod - Freshwater	1.15	ED50	0.115	NA	Combined	Growth	Borgmann U, R Neron, WP Norwood, 2001. Environ Pollut 111:189-198
Selenium	*Daphnia magna*	Water flea	6.34	LOED		2.94	Absorption	Reproduction	Ingersoll, C.G., F.J. Dwyer and T.W., 1990. Environ. Toxicol. Chem. 9:1171-1181.
Silver	*Daphnia magna*	Water flea	0.175	LD50	0.0175		Water	Mortality	Bianchini and Wood, 2003. Environ Tox & Chem 22 (6), 1361-1367
Thallium	*Hyalella azteca*	Amphipod - Freshwater	12.06	LOED	1.206	NA	Water	Reproduction	Borgmann et al., 2001. Environ Pollut 99:105-114
Vanadium			NA			NA			
Zinc	*Hyalella azteca*	Amphipod - Freshwater	60.8	LOED		53.6	Absorption	Mortality	Borgmann and Norwood, 1997. Can. J. Fish. Aquat. Sci. 54: 1046-1054
VOCs									
Acetone			NA			NA			
2-Butanone			NA			NA			
Carbon disulfide			NA			NA			
Methyl tert-butyl ether			NA			NA			
SVOCs									
2,4-Dimethylphenol			NA			NA			
4-Methylphenol			NA			NA			
4-Nitroaniline			NA			NA			
Benzoic acid			NA			NA			
Benzyl alcohol			NA			NA			
bis(2-Ethylhexyl)phthalate			NA			NA			
Carbazole			NA			NA			
Di-n-octylphthalate			NA			NA			
Total PAHs	benthic invertebrates	benthic invertebrates	NA			2.24 umol/g lipid			EPA, 2004

Notes:
NA = not available
LOED = Lowest observed effect dose
ED50 = The dose at which 50% of the population is affected
LD50 = An ED50 with an endpoint of mortality
ww = wet weight

Table 4-4. Chronic Avian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Chemical Form	Test Species	Exposure Route	Exposure Duration (Days)	Effect	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Source
Total Metals								
Aluminum	$Al_2(SO_4)_3$	Ringed Dove	Incorporation into Food	116	Reproduction	109.7	NA	Sample et al., 1996
Antimony						NA	NA	
Arsenic	Sodium Arsenite	Mallard Duck	Incorporation into Food	128	Mortality	5.14	12.84	Sample et al., 1996
Barium	Barium Hydroxide	1 day old Chick	Incorporation into Food	4 weeks; subchronic to chronic factor of 0.1 applied to data by authors	Mortality	20.8	41.7	Sample et al., 1996
Beryllium						NA	NA	Sample et al., 1996
Cadmium	Cadmium Chloride	Mallard Duck	Incorporation into Food	90	Reproduction	1.45	20.03	Sample et al., 1996
Chromium	Trivalent	Black Duck	Incorporation into Food	290	Reproduction	1	5	Sample et al., 1996
Cobalt	Cobalt chloride	White Pekin Ducklings	Incorporation into Food	28 during critical life stage = chronic	Mortality	15	30	Van Vleet, 1982
Copper	Copper Oxide	1 day old Chick	Incorporation into Food	70	Growth, Mortality	47.0	61.7	Sample et al., 1996
Iron						NA	NA	
Lead	Acetate	Japanese Quail	Incorporation into Food	84	Reproduction	1.13	11.3	Sample et al., 1996
Manganese	Mn_3O_4	Japanese Quail	Incorporation into Food	75	Growth, Behavior	977	NA	Sample et al., 1996
Mercury	Mercuric Chloride	Japanese Quail	Incorporation into Food	365	Reproduction	0.45	0.9	Sample et al., 1996
Nickel	Nickel Sulfate	Mallard Duckling	Incorporation into Food	90	Mortality, Growth, Behavior	77.4	107	Sample et al., 1996
Selenium	Selenomethionine	Mallard Duck	Incorporation into Food	78	Reproduction	0.4	0.8	Sample et al., 1996
Silver						NA	NA	
Thallium						NA	NA	
Vanadium	Vanadyl Sulfate	Mallard Duck	Incorporation into Food	84	Longevity, Mortality	11.4	NA	Sample et al., 1996
Zinc	Zinc Sulfate	White Leghorn Hen	Incorporation into Food	308	Reproduction	14.5	131	Sample et al., 1996
PAHs								
2-Methylnaphthalene						NA	NA	
Acenaphthene						NA	NA	
Acenaphthylene						NA	NA	
Anthracene						NA	NA	
Benzo[a]anthracene						NA	NA	
Benzo[a]pyrene						NA	NA	
Benzo[b]fluoranthene						NA	NA	
Benzo[g,h,i]perylene						NA	NA	
Benzo[k]fluoranthene						NA	NA	
Chrysene						NA	NA	
Dibenz[a,h]anthracene						NA	NA	
Fluoranthene						NA	NA	
Fluorene						NA	NA	
Indeno[1,2,3-cd]pyrene						NA	NA	
Naphthalene						NA	NA	
Phenanthrene						NA	NA	
Pyrene						NA	NA	
Total PAHs	Mix of Petroleum Hydrocarbons	Mallard Duck	Oral	203	Increased liver weight, Decreased body weight up to 4-5 months of study	71.2 [a]	712	Patton & Dieter, 1980

Table 4-4. Chronic Avian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Chemical Form	Test Species	Exposure Route	Exposure Duration (Days)	Effect	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Source
Other SVOCs								
Benzyl alcohol						NA	NA	
Butylbenzylphthalate						NA	NA	
Di-n-octylphthalate						NA	NA	
4-Nitroaniline						NA	NA	
Benzoic Acid						NA	NA	
Dibenzofuran						NA	NA	
1,2-Dichlorobenzene						NA	NA	
4-Methylphenol						NA	NA	
2,4-Dimethylphenol						NA	NA	
bis(2-Ethylhexyl)phthalate	Bis(2-ethylhexyl)phthalate	Ringed Dove	Incorporation into Food	28 during critical life stage = chronic	Reproduction	1.1	NA	Sample et al., 1996
Carbazole						NA	NA	
Petroleum Fractions								
C11-C22 Aromatic Hydrocarbons						NA	NA	
C19-C18 Aliphatic Hydrocarbons						NA	NA	
C9-C18 Aliphatic Hydrocarbons						NA	NA	
VOCs								
Acetone	Acetone	Japanese Quail	Incorporation into Food	5 days	Mortality	524	2621	Hill and Camardese, 1986
Carbon disulfide						NA	NA	
Methyl tert-butyl ether (MTBE)						NA	NA	
Xylene (total)						NA	NA	
Trichlorofluoromethane						NA	NA	

Notes:

NA = Not Available
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
[a] NOAEL value was derived by applying an Acute to Chronic Ratio of 10 to the LOAEL value.

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Table 4-5. Chronic Mammalian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Test Species								
	Exposure Route	Effect Endpoint	Exposure Duration (Days)	Chemical Form	Test Species	Body Weight[a] (kg)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Total Metals									
Aluminum	Oral-water	Reproduction	3 generations	Aluminum Chloride	Mouse	0.03	1.93	19.3	Sample et al., 1996
Antimony	Oral-water	Longevity	lifetime (>1yr)	Antimony Potassium Tartrate	Mouse	0.03	0.125	1.25	Sample et al., 1996
Arsenic	Oral-diet	Growth	730	Arsenite	Rat	0.35	2.5	NA	Byron et al. 1967
Barium	Oral-gavage	Mortality	10	Barium Chloride	Rat	0.435	13.8 [d]	19.8	Sample et al., 1996
Beryllium	Oral intubation	Longevity, weight loss	lifetime (>1yr)	Beryllium Sulfate	Rat	0.35	0.66	NA	Sample et al., 1996
Cadmium	Oral-gavage	Reproduction	42	Cadmium Chloride	Rat	0.303	1	10	Sample et al., 1996
Chromium	Oral-diet	Reprod/Longevity	730	Trivalent Chromium	Rat	0.35	2737	NA	Sample et al., 1996
Cobalt							NA	NA	
Copper	Oral-diet	Reproduction	357	Copper Sulfate	Mink	1	11.7	15.14	Sample et al., 1996
Iron							NA	NA	Sample et al., 1996
Lead	Oral-diet	Reproduction	3 generations	Lead Acetate	Rat	0.35	8	80	Sample et al., 1996
Manganese	Oral-diet	Reproduction	224	Manganese Oxide	Rat	0.35	88	284	Sample et al., 1996
Mercury	Oral-diet	Reproduction	168	Mercuric Chloride	Mink	1	1	NA	Sample et al., 1996
Nickel	See Section 4.1.1 of text						2.03	12.1	USEPA
Selenium	Oral-water	Reproduction	1yr, 2 generations	Potassium Selenate	Rat	0.35	0.2	0.33	Sample et al., 1996
Silver	Oral-water	Body Weight	259 - applied ACR	NA	Rat	0.35	2.2 [b]	22.2	ATSDR
Thallium	Oral-water	Reproduction	60	Thallium Sulfate	Rat	0.365	0.0074	0.074	Sample et al., 1996
Vanadium	Oral-intubation	Reproduction	>60	Sodium Metavanadate	Rat	0.26	0.21	2.1	Sample et al., 1996
Zinc	Oral-diet	Reproduction	16 of gestation	Zinc Oxide	Rat	0.35	160	320	Sample et al., 1996
PAHs									
2-Methylnaphthalene							NA	NA	
Acenaphthene	Oral-gavage	Reproduction	91-applied ACR	NA	Mouse	0.03	35	70	ATSDR
Acenaphthylene							NA	NA	
Anthracene	Oral-gavage	Mortality, Body Weight	90-applied ACR	NA	Mouse	0.03	100	NA	IRIS
Benzo[a]anthracene							NA	NA	
Benzo[a]pyrene	Oral-intubation	Reproduction	10 of gestation	NA	Mouse	0.03	1	10	Sample et al., 1996
Benzo[b]fluoranthene							NA	NA	
Benzo[g,h,i]perylene							NA	NA	
Benzo[k]fluoranthene							NA	NA	
Chrysene							NA	NA	
Dibenz[a,h]anthracene							NA	NA	
Fluoranthene	Oral-gavage	Reproduction	91-applied ACR	NA	Mouse	0.03	50	NA	ATSDR
Fluorene	Oral-gavage	Reproduction	91-applied ACR	NA	Mouse	0.03	50	NA	ATSDR
Indeno[1,2,3-cd]pyrene							NA	NA	
Naphthalene	Oral-gavage	Body Weight	65-applied ACR	NA	Rat	0.35	7.1 [c]	14 [c]	IRIS
Phenanthrene							NA	NA	
Pyrene	Oral-gavage	Kidney effects	91-applied ACR	NA	Mouse	0.03	7.5	13	IRIS
Total PAH							NA	NA	

Table 4-5. Chronic Mammalian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Test Species								
	Exposure Route	Effect Endpoint	Exposure Duration (Days)	Chemical Form	Test Species	Body Weight[a] (kg)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Other SVOCs									
Benzyl alcohol							NA	NA	
Butylbenzylphthalate							NA	NA	
Di-n-octylphthalate							NA	NA	
4-Nitroaniline							NA	NA	
Benzoic Acid							NA	NA	
Dibenzofuran							NA	NA	
1,2-Dichlorobenzene	Oral-gavage	Mortality	515	NA	Rat	0.35	86 [c]	NA	IRIS
4-Methylphenol	Oral-gavage	Mortality	16-20wk, 5-7d/wk, 1x/d	p-cresol	Rat	0.35	17.5	45.0	ATSDR
2,4-Dimethylphenol							NA	NA	
bis(2-Ethylhexyl)phthalate	Oral-diet	Reproduction	28	NA	Mouse	0.03	18.3	183	Sample et al., 1996
Carbazole							NA	NA	
Petroleum Fractions									
C11-C22 Aromatic Hydrocarbons							NA	NA	
C19-C18 Aliphatic Hydrocarbons							NA	NA	
C9-C18 Aliphatic Hydrocarbons							NA	NA	
VOCs									
Acetone	Oral intubation	Liver and kidney damage	90	NA	Rat	0.35	10	50	Sample et al., 1996
Carbon disulfide	Inhalation coverted to oral dose	Fetal toxicity	34 weeks during entire length of pregnancy	NA	Rat	0.35	5	NA	IRIS
Methyl tert-butyl ether (MTBE)	Oral gavage	Immunotoxicity	2 years	NA	Rat	0.35	14.3 [b]	143	ATSDR
Xylene (total)	Oral-gavage	Reproduction	Days 6-15 of gestation	Xylene (mixed isomers)	Mouse	0.03	2.1	2.6	Sample et al., 1996
Trichlorofluoromethane							NA	NA	

[a]If the test species' body weight was not identified in the study then the following values were used: Rat = 0.35kg, Mouse = 0.03kg, Mink = 1.0kg
[b]Calculated from LOAEL
[c]Calculated based on five days per week exposure ((concentration*5)/7)
[d]Borzelleca et al., 1988

NA = Not Available/Not Applicable
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
Exposure duration in days, unless otherwise noted.

References:

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United States Environmental Protection Agency (USEPA). Ecological Soil Screening Levels for Nickel. Unpublished. (See Section 4.1.1 of text.)

Table 4-5. Chronic Mammalian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Muskrat			Raccoon			Shrew		
	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)
Total Metals									
Aluminum	1.35	0.745	7.45	5.74	0.519	5.19	0.015	2.3	23
Antimony	1.35	0.0483	0.483	5.74	0.0336	0.336	0.015	0.149	1.49
Arsenic	1.35	1.78	NA	5.74	1.24	NA	0.015	5.49	NA
Barium	1.35	10.4	14.9	5.74	7.24	10.4	0.015	32	45.9
Beryllium	1.35	0.471	NA	5.74	0.328	NA	0.015	1.45	NA
Cadmium	1.35	0.688	6.88	5.74	0.479	4.79	0.015	2.12	21.2
Chromium	1.35	1950	NA	5.74	1360	NA	0.015	6020	NA
Cobalt	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Copper	1.35	10.9	14	5.74	7.56	9.78	0.015	33.4	43.3
Iron	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Lead	1.35	5.71	57.1	5.74	3.98	39.8	0.015	17.6	176
Manganese	1.35	62.8	203	5.74	43.7	141	0.015	193	624
Mercury	1.35	0.928	NA	5.74	0.646	NA	0.015	2.86	NA
Nickel	1.35	2.03	12.1	5.74	2.03	12.1	0.015	2.03	12.1
Selenium	1.35	0.143	0.235	5.74	0.0994	0.164	0.015	0.44	0.725
Silver	1.35	1.59	15.9	5.74	1.1	11	0.015	4.88	48.8
Thallium	1.35	0.00534	0.0534	5.74	0.00372	0.0372	0.015	0.0164	0.164
Vanadium	1.35	0.139	1.39	5.74	0.0969	0.969	0.015	0.428	4.28
Zinc	1.35	114	228	5.74	79.5	159	0.015	352	703
PAHs									
2-Methylnaphthalene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Acenaphthene	1.35	13.5	27	5.74	9.41	18.8	0.015	41.6	83.2
Acenaphthylene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Anthracene	1.35	38.6	NA	5.74	26.9	NA	0.015	119	NA
Benzo[a]anthracene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Benzo[a]pyrene	1.35	0.386	3.86	5.74	0.269	2.69	0.015	1.19	11.9
Benzo[b]fluoranthene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Benzo[g,h,i]perylene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Benzo[k]fluoranthene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Chrysene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Dibenz[a,h]anthracene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Fluoranthene	1.35	19.3	NA	5.74	13.4	NA	0.015	59.5	NA
Fluorene	1.35	19.3	NA	5.74	13.4	NA	0.015	59.5	NA
Indeno[1,2,3-cd]pyrene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Naphthalene	1.35	5.07	9.99	5.74	3.53	6.96	0.015	15.6	30.8
Phenanthrene	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Pyrene	1.35	2.9	5.02	5.74	2.02	3.5	0.015	8.92	16
Total PAH	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA

Table 4-5. Chronic Mammalian Toxicity Reference Values
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Muskrat			Raccoon			Shrew		
	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)
Other SVOCs									
Benzyl alcohol	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Butylbenzylphthalate	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Di-n-octylphthalate	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
4-Nitroaniline	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Benzoic Acid	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Dibenzofuran	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
1,2-Dichlorobenzene	1.35	61.4	NA	5.74	42.7	NA	0.015	189	NA
3/4-Methylphenol	1.35	12.5	32.1	5.74	8.7	22.4	0.015	38.5	98.9
2,4-Dichlorophenol	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
bis(2-Ethylhexyl)phthalate	1.35	7.07	70.7	5.74	4.92	49.2	0.015	21.8	218
Carbazole	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
Petroleum Fractions									
C11-C22 Aromatic Hydrocarbons	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
C19-C18 Aliphatic Hydrocarbons	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
C9-C18 Aliphatic Hydrocarbons	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA
VOCs									
Acetone	1.35	7.14	35.7	5.74	4.97	24.8	0.015	22	110
Carbon disulfide	1.35	4	NA	5.74	2	NA	0.015	11	NA
Methyl tert-butyl ether (MTBE)	1.35	10.2	102	5.74	7.11	71.1	0.015	31.4	314
Xylene (total)	1.35	0.811	1	5.74	0.565	0.699	0.015	2.5	3.09
Trichlorofluoromethane	1.35	NA	NA	5.74	NA	NA	0.015	NA	NA

Table 4-6
Toxicological Endpoints for Mammals - Acute
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Test Species								
	Exposure Route	Effect Endpoint	Exposure Duration (days)	Chemical Form	Test Species	Body Weight[a] (kg)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Metals									
Aluminum, Total	Oral-diet	Development	13	Aluminum Chloride	Rat	0.35	16 [b]	155	ATSDR
Antimony, Total							NA	NA	
Arsenic, Total	Oral-gavage	Development	1	Arsenic	Mouse	0.03	11	23	ATSDR
Barium, Total	Oral-gavage	Body Weight	1	Barium Chloride	Rat	0.35	66	198	ATSDR
Beryllium, Total							NA	NA	
Cadmium, Total	Oral-gavage	Development	10	NA	Rat	0.35	6.1	18.4	ATSDR
Chromium, Total	Oral-water	Body Weight	19	Potassium Dichromate	Mouse	0.03	57	120	ATSDR
Cobalt, Total	Oral-gavage	Development	10	Cobalt Chloride	Rat	0.35	24.8	NA	ATSDR
Copper, Total	Oral-gavage	Growth	20	Copper Sulfate	Rat	0.35	10 [b]	100	ATSDR
Iron, Total							NA	NA	
Lead, Total	Oral-gavage	Reproduction	11	Lead Acetate	Rat	0.35	39	390	ATSDR
Manganese, Total							NA	NA	
Mercury, Total	Oral-gavage	Body Weight	10	NA	Rat	0.35	5.3 [c]	11 [c]	ATSDR
Nickel, Total	Oral-gavage	Reproduction and Growth	4 - 5	NA	Mouse	0.03	57	NA	USEPA
Selenium, Total	Oral-gavage	Development	1	NA	Hamster	0.094	7.1	7.9	ATSDR
Silver, Total	Oral-water	Mortality	14	NA	Rat	0.35	180	360	ATSDR
Thallium, Total	Oral-gavage	Development - perf	4	Thallium Sulfate	Rat	0.35	0.008 [b]	0.08	ATSDR
Vanadium, Total	Oral-gavage	Mortality-50%	1	Sodium Metavandate	Rat	0.35	16	41	ATSDR
Zinc, Total							NA	NA	
Volatiles									
Acetone							NA	NA	
Carbon Disulfide							NA	NA	
Methyl tert-butyl ether (MTBE)							NA	NA	
Trichlorofluoromethane							NA	NA	
o-Xylene							NA	NA	
Semivolatiles									
1,2-Dichlorobenzene							NA	NA	
2,4-Dimethylphenol							NA	NA	
3/4-Methylphenol	Oral-gavage	Body Weight	10	m-cresol	Rat	0.35	175	450	ATSDR
bis(2-Ethylhexyl)phthalate							NA	NA	
Naphthalene	Oral-gavage	Developmental	13		Rabbit	1.2	40	200	ATSDR
Acenaphthene							NA	NA	
Acenaphthylene							NA	NA	
Fluorene							NA	NA	
Phenanthrene							NA	NA	
Anthracene							NA	NA	
Fluoranthene							NA	NA	
Pyrene							NA	NA	

Table 4-6
Toxicological Endpoints for Mammals - Acute
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Test Species								
	Exposure Route	Effect Endpoint	Exposure Duration (days)	Chemical Form	Test Species	Body Weight[a] (kg)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Benzo[a]anthracene							NA	NA	
Chrysene							NA	NA	
Benzo[b]fluoranthene							NA	NA	
Benzo[k]fluoranthene							NA	NA	
Benzo[a]pyrene	Oral-gavage	Developmental	10		Mouse	0.03	10	40	ATSDR
Indeno[1,2,3-cd]pyrene							NA	NA	
Dibenz[a,h]anthracene							NA	NA	
Benzo[g,h,i]perylene							NA	NA	
2-Methylnaphthalene							NA	NA	
Benzoic acid							NA	NA	
Benzyl alcohol							NA	NA	
Butylbenzyl phthalate							NA	NA	
Carbazole							NA	NA	
Di-n-octylphthalate							NA	NA	
Petroleum fractions									
C11-C22 Aromatic Hydrocarbons							NA	NA	
C19-C36 Aliphatic Hydrocarbons							NA	NA	
C9-C18 Aliphatic Hydrocarbons							NA	NA	

[a]If the test species' body weight was not identified in the study than the following values were used: Rat = 0.35kg, Mouse = 0.03kg, Hamster = .094kg, Mink = 1.0kg, Rabbit = 1.2kg
[b]Calculated from LOAEL
[c]Calculated based on five days per week exposure ((concentration*5)/7)

NA = Not Available/Not Applicable
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level

Reference:
Agency of Toxic Substances and Disease Registry (ATSDR). Toxicological Profiles.
United States Environmental Protection Agency (USEPA). Ecological Soil Screening Levels for Nickel. Unpublished. (See Section 4.1.1 of text.)

Table 4-6
Toxicological Endpoints for Mammals - Acute
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Wildlife Receptors								
	Raccoon			Shrew			Muskrat		
	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)
Metals									
Aluminum, Total	5.74	8.0	77	0.015	35.2	341	1.35	11.4	111
Antimony, Total	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Arsenic, Total	5.74	3.0	6.2	0.015	13.1	27.4	1.35	4.2	8.9
Barium, Total	5.74	33	98	0.015	145	435	1.35	47	141
Beryllium, Total	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Cadmium, Total	5.74	3.0	9.14	0.015	13.4	40.44	1.35	4.4	13.13
Chromium, Total	5.74	15	32	0.015	68	143	1.35	22	46
Cobalt, Total	5.74	12.3	NA	0.015	54.5	NA	1.35	17.7	NA
Copper, Total	5.74	5.0	50	0.015	22.0	220	1.35	7.1	71
Iron, Total	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Lead, Total	5.74	19	194	0.015	86	857	1.35	28	278
Manganese, Total	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Mercury, Total	5.74	2.6	5.5	0.015	11.6	24.2	1.35	3.8	7.8
Nickel, Total	5.74	57	NA	0.015	57	NA	1.35	57	NA
Selenium, Total	5.74	2.5	2.8	0.015	11.2	12.5	1.35	3.6	4.1
Silver, Total	5.74	89	179	0.015	396	791	1.35	128	257
Thallium, Total	5.74	0.004	0.04	0.015	0.018	0.18	1.35	0.006	0.06
Vanadium, Total	5.74	8	20	0.015	35	90	1.35	11	29
Zinc, Total	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Volatiles									
Acetone	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Carbon Disulfide	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Methyl tert-butyl ether (MTBE)	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Trichlorofluoromethane	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
o-Xylene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Semivolatiles									
1,2-Dichlorobenzene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
2,4-Dimethylphenol	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
3/4-Methylphenol	5.74	87	224	0.015	385	989	1.35	125	321
bis(2-Ethylhexyl)phthalate	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Naphthalene	5.74	27	135	0.015	120	598	1.35	39	194
Acenaphthene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Acenaphthylene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Fluorene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Phenanthrene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Anthracene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Fluoranthene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Pyrene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA

Table 4-6
Toxicological Endpoints for Mammals - Acute
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Wildlife Receptors								
	Raccoon			Shrew			Muskrat		
	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)
Benzo[a]anthracene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Chrysene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzo[b]fluoranthene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzo[k]fluoranthene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzo[a]pyrene	5.74	3	11	0.015	12	48	1.35	4	15
Indeno[1,2,3-cd]pyrene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Dibenz[a,h]anthracene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzo[g,h,i]perylene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
2-Methylnaphthalene	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzoic acid	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Benzyl alcohol	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Butylbenzyl phthalate	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Carbazole	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Di-n-octylphthalate	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
Semivolatiles									
C11-C22 Aromatic Hydrocarbons	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
C19-C36 Aliphatic Hydrocarbons	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA
C9-C18 Aliphatic Hydrocarbons	5.74	NA	NA	0.015	NA	NA	1.35	NA	NA

Table 5-1. Comparison of Site Surface Water COPECs to Water Quality Criteria
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Neponset River [1] Maximum surface water concentration (ug/L)	Reference Area Maximum surface water concentration (ug/L)	Ecological surface water screening level (ug/L)	
			Value	Source
Metals				
Aluminum - Dissolved	535	ND (55.6)	NA	
Aluminum - Total	**18000**	60.3	87	NRWQC CCC
Barium - Dissolved	**19.6**	**18.4**	4	Tier II SCV
Barium - Total	**219**	**21.3**	4	Tier II SCV
Cadmium - Dissolved*	**ND (1.1)**	**ND (1.1)**	0.14	NRWQC CCC
Cadmium - Total*	**1.5**	**ND (1.1)**	0.15	NRWQC CCC
Chromium - Dissolved	9.3	2.9	11	NRWQC CCC
Chromium - Total	**38.3**	ND (1.1)	11	NRWQC CCC
Copper - Dissolved*	**17.8**	2.3	4.4	NRWQC CCC
Copper - Total*	**90.5**	2.2	4.6	NRWQC CCC
Iron - Dissolved	1280	394	NA	
Iron - Total	**13800**	503	1000	NRWQC CCC
Lead - Dissolved*	**67.4**	**ND (1.1)**	1	NRWQC CCC
Lead - Total*	**576**	ND (1.1)	1.1	NRWQC CCC
Manganese - Dissolved	**125**	58.3	120	Tier II SCV
Manganese - Total	**950**	**286**	120	Tier II SCV
Nickel - Dissolved*	10.5	2.4	26	NRWQC CCC
Nickel - Total*	**61.3**	1.2	26	NRWQC CCC
Vanadium - Dissolved	**43.6**	ND (11.1)	20	Tier II SCV
Vanadium - Total	**122**	ND (11.1)	20	Tier II SCV
Zinc - Dissolved*	26.9	50.5	59	NRWQC CCC
Zinc - Total*	**340**	ND (11.1)	60	NRWQC CCC
PAHs				
Benzo(a)anthracene	**0.41**	**ND (0.029)**	0.027	Tier II SCV
Benzo(a)pyrene	**0.51**	ND (0.012)	0.014	Tier II SCV
Benzo(b)fluoranthene	0.57	ND (0.029)	NA	
Benzo(g,h,i)perylene	0.31	ND (0.029)	NA	
Benzo(k)fluoranthene	0.3	ND (0.029)	NA	
Chrysene	0.62	ND (0.029)	NA	
Pyrene	1.1	0.0057	NA	
Other SVOC				
4-Nitroaniline	0.71	ND (0.0023)	NA	

Notes:
NA = not available
NRWQC = National Recommended Water Quality Criteria (USEPA, 2004)
CCC = Criterion Continuous Concentration (chronic criterion)
Tier II SCV = Tier II Secondary Chronic Values (calculated using Great Lakes Water Quality Initiative Tier II methodology as presented in Suter and Tsao (1996).
Bolded values exceed the ecological surface water screening level. The potential for ecological effects is based on dissolved water concentrations exceeding ecological surface water screening levels.
[1] Neponset River includes the Lower Former Mill Tailrace. COPECs in the Neponset River and in the Lower Former Mill Tailrace are shown on this table.
* The criteria for these metals are hardness-dependent and were calculated based on the average hardness (44 mg equivalent CaCO3/L) for Neponset River surface water samples.

Table 5-2. Comparison of Site Surface Water COPECs to Water Quality Criteria
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Upper Former Mill Tailrace Maximum surface water concentration (ug/L)	Reference Area Maximum surface water concentration (ug/L)	Ecological surface water screening level (ug/L)	
			Value	Source
Metals				
Aluminum - Dissolved	361	ND (55.6)	NA	
Aluminum - Total	**7330**	60.3	87	NRWQC CCC
Barium - Dissolved	**28.3**	**18.4**	4	Tier II SCV
Barium - Total	**66.9**	**21.3**	4	Tier II SCV
Cadmium - Dissolved*	**ND (1.1)**	**ND (1.1)**	0.13	NRWQC CCC
Cadmium - Total*	**ND (1.1)**	**ND (1.1)**	0.14	NRWQC CCC
Chromium - Dissolved	3.7	2.9	11	NRWQC CCC
Chromium - Total	9.3	ND (1.1)	11	NRWQC CCC
Cobalt - Dissolved	ND (1.1)	ND (1.1)	23	Tier II SCV
Cobalt - Total	2.4	ND (1.1)	23	Tier II SCV
Copper - Dissolved*	**17**	2.3	4.1	NRWQC CCC
Copper - Total*	**23.5**	2.2	4.3	NRWQC CCC
Iron - Dissolved	623	394	NA	
Iron - Total	**5370**	503	1000	NRWQC CCC
Lead - Dissolved*	**28.4**	**ND (1.1)**	0.9	NRWQC CCC
Lead - Total*	**74.4**	**ND (1.1)**	1	NRWQC CCC
Manganese - Dissolved	45.7	58.3	120	Tier II SCV
Manganese - Total	**149**	**286**	120	Tier II SCV
Nickel - Dissolved*	11	2.4	24	NRWQC CCC
Nickel - Total*	15.6	1.2	24	NRWQC CCC
Vanadium - Dissolved	**30.6**	ND (11.1)	20	Tier II SCV
Vanadium - Total	**36.6**	ND (11.1)	20	Tier II SCV
Zinc - Dissolved*	40.7	50.5	54	NRWQC CCC
Zinc - Total*	**93.3**	ND (11.1)	55	NRWQC CCC
PAHs				
2-Methylnaphthalene	0.29	ND (0.029)	NA	
Acenaphthylene	0.27	ND (0.029)	NA	
Benzo[a]anthracene	**0.6**	**ND (0.029)**	0.027	Tier II SCV
Benzo[a]pyrene	**0.89**	ND (0.012)	0.014	Tier II SCV
Benzo[b]fluoranthene	0.9	ND (0.029)	NA	
Benzo[g,h,i]perylene	0.5	ND (0.029)	NA	
Benzo[k]fluoranthene	0.47	ND (0.029)	NA	
Chrysene	0.98	ND (0.029)	NA	
Dibenz[a,h]anthracene	0.12	ND (0.029)	NA	
Indeno[1,2,3-cd]pyrene	0.43	ND (0.029)	NA	
Pyrene	1.6	0.0057	NA	
VOCs				
2-Butanone	ND (2)	ND (0.002)	14000	Tier II SCV

Notes:
NA = not available
ND = not detected (maximum reporting limit in parentheses)
NRWQC = National Recommended Water Quality Criteria (USEPA, 2004)
CCC = Criterion Continuous Concentration (chronic criterion)
Tier II SCV = Tier II Secondary Chronic Values (calculated using Great Lakes Water Quality Initiative Tier II methodology (40 CFR 9 et al.) as presented in Suter and Tsao (1996).
Bolded values exceed the ecological surface water screening level.
The potential for ecological effects is based on dissolved water concentrations exceeding ecological surface water screening levels.
*The criteria for these metals are hardness-dependent and were calculated based on the average hardness (40 mg equivalent $CaCO_3$/L) for Former Mill Tailrace surface water samples.

Table 5-3. Comparison of Fish Body Burdens to TRVs
Neponset River*
Blackburn and Union Privileges Site
Walpole, Massachusetts

	TRVs		Reasonable Maximum Exposure			Central Tendency Exposure		
	NOED (mg/kg-ww)	LOED (mg/kg-ww)	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient
Total Metals[1]								
Aluminum	8.53	NA	5.75	0.7	NC	5.75	0.7	NC
Barium	NA	NA	1.90	NC	NC	1.07	NC	NC
Cobalt	NA	NA	0.0544	NC	NC	0.0544	NC	NC
Iron	NA	NA	80.0	NC	NC	53.3	NC	NC
Lead	2.62	26.2	0.499	0.2	0.02	0.499	0.2	0.02
Manganese	NA	NA	60	NC	NC	34	NC	NC
Nickel	NA	NA	0.37	NC	NC	0.228	NC	NC
Vanadium	0.68	2.7	0.0894	0.1	0.03	0.0894	0.1	0.03
Zinc	5	50	32	**6**	0.6	19.2	**4**	0.4

Notes:
NOED - no observed effect dose
LOED - lowest observed effect dose
NC = not calculated (either the chemical was not detected or no TRV was available)
ND = not detected (maximum reporting limit in parentheses)
Bold and shaded values indicate that measured whole body concentrations in fish exceed toxicity residue values (TRVs) (i.e. have a hazard quotient greater than one).
[1]The narcosis model was used to evaluate semi-volatile organic compounds. See Section 4.2 and Table 5-5.
* Neponset River includes the Lower Former Mill Tailrace.

Table 5-4. Comparison of Fish Body Burdens to TRVs
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

	TRVs		Lewis Pond - Site						Lower Pond Reference Area					
			Reasonable Maximum Exposure			Central Tendency Exposure			Reasonable Maximum Exposure			Central Tendency Exposure		
	NOED (mg/kg-ww)	LOED (mg/kg-ww)	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient	Fish Concentration (mg/kg-ww)	NOED Hazard Quotient	LOED Hazard Quotient
Total Metals[1]														
Aluminum	8.53	NA	18.2	**2**	NC	18.2	**2**	NC	12.4	1	NC	12.4	1	NC
Barium	NA	NA	1.51	NC	NC	1.51	NC	NC	3.12	NC	NC	3.12	NC	NC
Beryllium	5.13	NA	ND (0.032)	NC	NC	ND (0.032)	NC	NC	ND (0.0475)	NC	NC	ND (0.0475)	NC	NC
Cadmium	0.5	1	0.064	0.1	0.06	0.0446	0.09	0.04	0.0116	0.02	0.01	0.0116	0.02	0.01
Chromium	2.3	NA	0.928	0.4	NC	0.928	0.4	NC	0.354	0.2	NC	0.354	0.2	NC
Cobalt	NA	NA	0.0505	NC	NC	0.0505	NC	NC	0.0431	NC	NC	0.0431	NC	NC
Copper	3.92	4.48	2.5	0.6	0.6	1.67	0.4	0.4	1.63	0.4	0.4	1.63	0.4	0.4
Lead	2.62	26.2	0.890	0.3	0.03	0.890	0.3	0.03	0.306	0.1	0.01	0.306	0.1	0.01
Manganese	NA	NA	27.0	NC	NC	27.0	NC	NC	44.3	NC	NC	44.3	NC	NC
Mercury	0.25	2.37	0.100	0.4	0.04	0.100	0.4	0.04	0.226	0.9	0.1	0.0914	0.4	0.04
Nickel	NA	NA	0.500	NC	NC	0.500	NC	NC	0.363	NC	NC	0.363	NC	NC
Selenium	1.14	1.4	0.681	0.6	0.5	0.681	0.6	0.5	0.351	0.3	0.3	0.351	0.3	0.3
Silver	NA	NA	ND (0.032)	NC	NC	ND (0.032)	NC	NC	ND (0.0475)	NC	NC	ND (0.0475)	NC	NC
Thallium	2.72	NA	0.00435	0.002	NC	0.00435	0.002	NC	0.00924	0.003	NC	0.00924	0.003	NC
Vanadium	0.68	2.7	0.122	0.2	0.05	0.122	0.2	0.05	0.196	0.3	0.07	0.196	0.3	0.07
Zinc	5	50	42.5	**8**	0.8	42.5	**8**	0.8	21.5	**4**	0.4	21.5	**4**	0.4

Notes:
NOED - no observed effect dose
LOED - lowest observed effect dose
NC = not calculated (either the chemical was not detected or no TRV was available)
ND = not detected (maximum reporting limit in parentheses)
Bold and shaded values indicate that measured whole body concentrations in fish exceed toxicity residue values (TRVs) (i.e. have a hazard quotient greater than one).
[1]The narcosis model was used to evaluate semi-volatile organic compounds. See Section 4.2 and Table 5-5.

Table 5-5. Calculation of Total Fish Body Burdens for the Narcosis Model
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	RME Lewis Pond Fish Concentration (ug/kg fish w.w.)	RME Lewis Pond Molar Concentration (mM/kg)	RME Neponset River Fish Concentration (ug/kg fish w.w.)	RME Neponset River Molar Concentration (mM/kg)	CTE Lewis Pond Fish Concentration (ug/kg fish w.w.)	CTE Lewis Pond Molar Concentration (mM/kg)	CTE Neponset River Fish Concentration (ug/kg fish w.w.)	CTE Neponset River Molar Concentration (mM/kg)
SVOCs								
2,4-Dimethylphenol	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
2-Methylnaphthalene	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
4-Methylphenol	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Acenaphthene	4.90	0.00003	2.30	0.00001	2.07	0.00001	1.60	0.00001
Acenaphthylene	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Anthracene	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Benzo(a)anthracene	6.70	0.00003	2.90	0.00001	3.27	0.00001	1.84	0.00001
Benzo(a)pyrene	8.40	0.00003	2.01	0.00001	3.55	0.00001	2.01	0.00001
Benzo(b)fluoranthene	11.9	0.00005	3.90	0.00002	11.9	0.00005	3.05	0.00001
Benzo[g,h,i]perylene	2.21	0.00001	ND	0.00000	2.21	0.00001	ND	0.00000
Benzo(k)fluoranthene	8.93	0.00004	3.10	0.00001	8.93	0.00004	2.20	0.00001
Benzoic acid	750	0.00614	2000	0.01638	2117	0.01733	3230	0.02645
Benzyl alcohol	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
bis(2-Ethylhexyl)phthalate	8869	0.02271	7281	0.01864	8869	0.02271	7281	0.01864
Carbazole	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Chrysene	6.00	0.00003	2.60	0.00001	2.93	0.00001	1.98	0.00001
Dibenz[a,h]anthracene	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Di-n-octylphthalate	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Fluoranthene	3.97	0.00002	ND	0.00000	3.97	0.00002	ND	0.00000
Fluorene	4.33	0.00003	2.10	0.00001	4.33	0.00003	2.10	0.00001
Indeno[1,2,3-cd]pyrene	2.74	0.00001	ND	0.00000	2.74	0.00001	ND	0.00000
Naphthalene	2.96	0.00002	ND	0.00000	2.96	0.00002	ND	0.00000
4-Nitroaniline	ND	0.00000	ND	0.00000	ND	0.00000	ND	0.00000
Phenanthrene	7.89	0.00004	4.30	0.00002	7.89	0.00004	2.86	0.00002
Pyrene	13.8	0.00007	2.10	0.00001	13.8	0.00007	2.10	0.00001
Molar Concentration SUM		**0.03**		**0.04**		**0.04**		**0.05**

Note:
95% UCL = 95% upper confidence limit
The 95% UCL exceeded the maximum detected concentration (see Table 3-35) for the following chemicals: acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzoic acid and Chrysene in Neponset River fish; acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, and indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, and benzoic acid in Lewis Pond fish. Therefore, maximum (for RME scenario) or average (or CTE scenario) concentrations were used for these chemicals/exposure points in the narcosis model.

Table 5-6. Comparison of Benthic Invertebrate (*Lumbriculus variegatus*) Body Burdens to Residue Effect Levels
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

	TRVs		Neponset River - Site						Neponset River - Reference Sample		
			Reasonable Maximum Exposure			Central Tendency Exposure					
Compounds (ww)	NOED	LOED	Invertebrate Concentration	NOED Hazard Quotient	LOED Hazard Quotient	Invertebrate Concentration	NOED Hazard Quotient	LOED Hazard Quotient	SedRN-4-B 1/28/03	NOED Hazard Quotient	LOED Hazard Quotient
Metals (mg/kg)											
Aluminum	NA	NA	120	NC	NC	97.7	NC	NC	150	NC	NC
Barium	NA	NA	62	NC	NC	58.3	NC	NC	68	NC	NC
Cobalt	NA	NA	0.35	NC	NC	0.273	NC	NC	0.36	NC	NC
Iron	NA	NA	720	NC	NC	623	NC	NC	560	NC	NC
Lead	48.277	82.67	9.6	0.2	0.1	7.53	0.2	0.09	1.2	0.02	0.01
Manganese	NA	NA	75	NC	NC	46.6	NC	NC	99	NC	NC
Nickel	0.115	1.15	0.95	**8**	0.8	0.743	**6**	0.6	0.8	**7**	0.7
Vanadium	NA	NA	0.86	NC	NC	0.733	NC	NC	0.86	NC	NC
Zinc	53.6	60.8	42	0.8	0.7	37.7	0.7	0.6	39	0.7	0.6
SVOCs (ug/kg)											
Benzoic acid	NA	NA	2800	NC	NC	1637	NC	NC	700 J	NC	NC
bis(2-Ethylhexyl)phthalate	NA	NA	ND (710)	NC	NC	ND (710)	NC	NC	1000 U	NC	NC
Carbazole	NA	NA	ND (280)	NC	NC	ND (280)	NC	NC	280 U	NC	NC
Di-n-octylphthalate	NA	NA	ND (280)	NC	NC	ND (280)	NC	NC	280 U	NC	NC
Total PAHs (umol/g lipid)	2.24	NA	0.054	0.02	NC	0.054	0.02	NC	ND	NC	NC

Notes:
Chemical concentrations are from *Lumbriculus variegatus* tissue analyzed after bioaccumulation testing.
Reference area is the upstream Neponset River reference area.
U - not detected
B - detected in blank sample
J - estimated value
NC - not calculated (either the chemical was not detected or no TRV was available)
ND - not detected (maximum reporting limit in parentheses)
NA - TRV not available
NOED - no observed effect dose
LOED - lowest observed effect dose
Bold and shaded values indicate that measured invertebrate concentrations exceed toxicity residue values (TRVs) (i.e. have a hazard quotient greater than one).

Table 5-7. Comparison of Benthic Invertebrate *(Lumbriculus variegatus)* Body Burdens to Residue Effect Levels
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

	TRVs		Lewis Pond - Site						Lower Pond - Reference Sample			
			Reasonable Maximum Exposure			Central Tendency Exposure						
Compounds (ww)	**NOED**	**LOED**	**Invertebrate Concentration**	**NOED Hazard Quotient**	**LOED Hazard Quotient**	**Invertebrate Concentration**	**NOED Hazard Quotient**	**LOED Hazard Quotient**	**SedRNwd-01-B AVERAGE 1/27/2003**		**NOED Hazard Quotient**	**LOED Hazard Quotient**
Metals (mg/kg)												
Aluminum	NA	NA	130	NC	NC	118	NC	NC	98.5		NC	NC
Barium	NA	NA	65	NC	NC	61.3	NC	NC	74.5		NC	NC
Beryllium	NA	NA	ND (0.03)	NC	NC	ND (0.03)	NC	NC	0.026	U	NC	NC
Cadmium	4.6	6	0.099	0.02	0.02	0.0977	0.02	0.02	0.0875		0.02	0.01
Chromium	NA	NA	8.7	NC	NC	5.57	NC	NC	0.52		NC	NC
Cobalt	NA	NA	0.34	NC	NC	0.293	NC	NC	0.31		NC	NC
Copper	13	18	6	0.5	0.3	4.67	0.4	0.3	3.2		0.2	0.2
Lead	48.277	82.67	34	0.7	0.4	20.6	0.4	0.2	11.2		0.2	0.1
Manganese	NA	NA	17	NC	NC	10.1	NC	NC	19.5		NC	NC
Mercury	0.859	2.33	0.014	0.02	0.006	0.0117	0.01	0.005	0.046		0.05	0.02
Nickel	0.115	1.15	3.5	**30**	**3**	2.19	**20**	**2**	0.92	J	**8**	0.8
Selenium	2.94	6.34	0.59	0.2	0.09	0.517	0.2	0.08	0.57		0.2	0.09
Silver	0.0175	0.175	ND (0.03)	NC	NC	ND (0.03)	NC	NC	0.026	U	NC	NC
Thallium	1.206	12.06	0.0044	0.004	0.0004	0.00255	0.002	0.0002	0.0017	B	0.001	0.0001
Vanadium	NA	NA	0.83	NC	NC	0.64	NC	NC	1.2	J	NC	NC
Zinc	53.6	60.8	38	0.7	0.6	33	0.6	0.5	32		0.6	0.5
SVOCs (ug/kg)												
2,4-Dimethylphenol	NA	NA	ND (280)	NC	NC	ND (280)	NC	NC	250	U	NC	NC
4-Methylphenol	NA	NA	200	NC	NC	167	NC	NC	195	J	NC	NC
4-Nitroaniline	NA	NA	ND (280)	NC	NC	ND (280)	NC	NC	250	U	NC	NC
Benzoic acid	NA	NA	970	NC	NC	873	NC	NC	1200	J	NC	NC
Benzyl alcohol	NA	NA	2400	NC	NC	1733	NC	NC	2500	J	NC	NC
bis(2-Ethylhexyl)phthalate	NA	NA	ND (450)	NC	NC	ND (450)	NC	NC	420	U	NC	NC
Carbazole	NA	NA	ND (280)	NC	NC	ND (280)	NC	NC	250	U	NC	NC
Total PAHs (umol/g lipid)	2.24	NA	0.28	0.1	NC	0.17	0.08	NC	1.4		0.6	NC
VOCs (ug/kg)												
Acetone	NA	NA	NA	NC	NC	NA	NC	NC	NA		NC	NC
Carbon disulfide	NA	NA	NA	NC	NC	NA	NC	NC	NA		NC	NC
Methyl tert-butyl ether (MTBE)	NA	NA	NA	NC	NC	NA	NC	NC	NA		NC	NC

Notes:
Chemical concentrations are from *Lumbriculus variegatus* tissue analyzed after bioaccumulation testing.
Reference area is the Lower Pond.
U - not detected
B - detected in blank sample
J - estimated value
NC - not calculated (either the chemical was not detected or no TRV was available)
ND - not detected (maximum reporting limit in parentheses)
NA - TRV not available
NOED - no observed effect dose
LOED - lowest observed effect dose
Bold and shaded values indicate that measured invertebrate concentrations exceed toxicity residue values (TRVs) (i.e. have a hazard quotient greater than one).

Table 5-8. Comparison of Benthic Invertebrate (*Lumbriculus variegatus*) Body Burdens to Residue Effect Levels
Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

	TRVs		Former Mill Tailrace - Site Sample				Neponset River - Reference Sample			
Compounds (ww)	**NOED**	**LOED**	**TR-3-B 0302001-07 37648**		**NOED Hazard Quotient**	**LOED Hazard Quotient**	**SedRN-4-B 1/28/2003**		**NOED Hazard Quotient**	**LOED Hazard Quotient**
Metals (mg/kg)										
Aluminum	NA	NA	320		NC	NC	150		NC	NC
Barium	NA	NA	25		NC	NC	68		NC	NC
Beryllium	NA	NA	0.027	U	NC	NC	0.025	U	NC	NC
Cadmium	4.6	6	0.033		0.007	0.006	0.49		0.1	0.08
Chromium	NA	NA	0.57		NC	NC	0.62		NC	NC
Cobalt	NA	NA	0.39		NC	NC	0.36		NC	NC
Copper	13	18	1.5		0.1	0.08	3.5		0.3	0.2
Iron	NA	NA	490		NC	NC	560		NC	NC
Lead	48.277	82.67	7.1		0.1	0.09	1.2		0.02	0.01
Manganese	NA	NA	8.5		NC	NC	99		NC	NC
Mercury	0.859	2.33	0.0071	U	NC	NC	0.011		0.01	0.005
Nickel	0.115	1.15	0.97		**8**	0.8	0.8		**7**	0.7
Selenium	2.94	6.34	0.46		0.2	0.07	0.72		0.2	0.1
Thallium	1.206	12.06	0.0024	B	0.002	0.0002	0.004	B	0.003	0.0003
Vanadium	NA	NA	0.92		NC	NC	0.86		NC	NC
Zinc	53.6	60.8	24		0.4	0.4	39		0.7	0.6
SVOCs (ug/kg)										
2,4-Dimethylphenol	NA	NA	270	U	NC	NC	280	U	NC	NC
4-Methylphenol	NA	NA	270	U	NC	NC	250	J	NC	NC
Benzoic acid	NA	NA	360	J	NC	NC	700	J	NC	NC
Benzyl alcohol	NA	NA	5200		NC	NC	1900		NC	NC
bis(2-Ethylhexyl)phthalate	NA	NA	550	U	NC	NC	1000	U	NC	NC
Carbazole	NA	NA	270	U	NC	NC	280	U	NC	NC
Total PAHs (umol/g lipid)	2.24	NA	0.27		0.1	NC	ND		NC	NC
SVOCs (ug/kg)										
2-Butanone	NA	NA	NA		NC	NC	NA		NC	NC
Carbon disulfide	NA	NA	NA		NC	NC	NA		NC	NC

Notes:
Chemical concentrations are from *Lumbriculus variegatus* tissue analyzed after bioaccumulation testing.
Reference area is the upstream Neponset River reference area.
U - not detected
B - detected in blank sample
J - estimated
NC - not calculated (either the chemical was not detected or no TRV was available)
ND - not detected
NA - TRV not available
NOED - no observed effect dose
LOED - lowest observed effect dose
Bold and shaded values indicate that measured invertebrate concentrations exceed toxicity residue values (TRVs) (i.e. have a hazard quotient greater than one).

Table 5-9 Results of 28-Day Sediment Toxicity Tests with Hyalella Azteca
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Mean Proportion Surviving	Mean Weight Growth (mg)
Neponset River		
NR-7 / 12-18-02	0.84	0.466
NR-8 / 12-18-02	0.94	0.401
Neponset River Reference Area		
SedRN-4 / 12-18-02	0.84	0.397
Lewis Pond		
LP-01 / 12-18-02	0.85	0.324
Lower Pond Reference Area		
SedRNwd-01 / 12-17-02	0.91	0.263 *
SedRNwd dup (OW-801)	0.83	0.296
Former Mill Tailrace		
TR-3 / 12-16-02	0.91	0.563
Control groups		
Formulated Sediment A / 12-22-02	0.88	0.194
Natural Sediment Control B / 12-22-02	0.88	0.355

Notes:

A 28-day survival and growth toxicity test was conducted using the Amphipod, Hyalella azteca, using method 100.4HA28.

The lab conducted a statistical comparison of site & reference area sample results to the "Natural Sediment Control" sample results.

* Indicates a statistically significant reduction ($P<0.05$) in the response relative to the response in the "Natural Sediment Control" sample group.

Table 5-10
Summary of (SEM-AVS)/f_{oc} Calculations
Blackburn and Union Privileges Site
Walpole, Massachusetts

Samples with (SEM-AVS)/foc < 130 µmol/g-oc					130 µmol/g-oc ≤ Samples with (SEM-AVS)/foc ≤ 3000 µmol/g-oc			
Sample ID	**Location**	**SEM-AVS**	**TOC in %**	**(SEM-AVS)/foc**	**Sample ID**	**Location**	**TOC in %**	**(SEM-AVS)/foc**
NR-1	Neponset River	0.14	0.16	86.7	NR-2	Neponset River	0.28	164
OW-401	Neponset River	-0.15	1.3	-11.7	NR-8	Neponset River	0.23	385
NR-1 & OW-401	Neponset River	0.14	0.72	19.4				
NR-3	Neponset River	0.14	0.43	32.9				
NR-4	Neponset River	-0.6	0.69	-86.4				
NR-5	Neponset River	0.24	11	2.1				
NR-6	Neponset River	0.33	14	2.4				
NR-7	Neponset River	0.41	0.36	112				
LP-01	Lewis Pond	-0.38	6.2	-6.08				
OW-402	Lewis Pond	2	5.8	34.3				
LP-01 & OW-402	Lewis Pond	2	6.0	33.1				
LP-02	Lewis Pond	5.2	13	41.4				
LP-03	Lewis Pond	4.6	13	36.2				
LP-04	Lewis Pond	-16	8.3	-193				
LP-05	Lewis Pond	8.2	15	54.7				
LP-06	Lewis Pond	9	12	76.3				
LP-07	Lewis Pond	-1.3	6.5	-20.0				
LP-08	Lewis Pond	-4.5	7.8	-57.6				
LP-09	Lewis Pond	-3.5	4.8	-72.2				
LP-10	Lewis Pond	-28	9.1	-307				
TR-1	Upper Former Mill Tailrace	-0.19	13	-1.5				
TR-2	Upper Former Mill Tailrace	-5.9	2.1	-276.8				
TR-3	Upper Former Mill Tailrace	-24	1.7	-1399.7				
TR-4	Neponset River (Lower Former Mill Tailrace)	-3.7	7.0	-52.7				
TR-5	Neponset River (Lower Former Mill Tailrace)	-60	7.1	-841.5				

Notes:
According to USEPA (1999), sediments with (SEM-AVS)/foc > 3,000 are "likely to be toxic; if (SEM-AVS)/foc is between 130 and 3,000 umol/gOC, the sediments are of "uncertain toxicity". Sediments with (SEM-AVS)/foc < 130 umol/gOC are "unlikely to be toxic".

Table 5-11
Comparison of Reference Soil Chemical Concentrations to Site Soil Chemical Concentrations
Chemicals that Lack TRVs for a Receptor Exposed to Soil
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Reference Soil			West of South St. Soil			East of South St. Soil			Orlando Soil			Floodplain Soil		
Chemicals[a]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]
Metals (mg/kg dry)															
Antimony	0.27	1.1	0.5	0.72	0.72	0.4	0.95	4.4	0.8	ND	ND	0.4	0.89	6.7	1
Cobalt	2	5.9	3	2	6.1	4	2.1	10.1	5	2.9	9.6	5	NA	NA	NA
Iron	4460	14800	10000	6680	23600	10000	5080	23300	10000	7290	27800	10000	8800	46800	20000
Thallium	0.053	0.18	0.1	0.038	0.098	0.06	0.048	0.24	0.1	0.048	0.19	0.07	0.063	0.15	0.1
PAHs (ug/kg dry)															
2-Methylnaphthalene	16	150	40	15	1900	200	6.2	2300	300	6.4	780	80	15	1100	100
Acenaphthylene	16	610	80	6.3	2400	300	17	12000	900	7	270	40	28	240	100
Benzo(a)anthracene	14	1300	200	7.3	6400	1000	14	22000	2000	9.9	5000	500	100	3600	700
Benzo(b)fluoranthene	20	1200	300	11	6700	1000	16	30000	3000	14	3500	400	150	3200	700
Benzo(g,h,i)perylene	11	440	100	7.2	3200	500	10	11000	1000	11	1300	100	40	660	200
Benzo(k)fluoranthene	18	880	200	9.3	5200	700	13	14000	2000	7.8	3100	300	120	1800	500
Chrysene	24	1900	400	13	7800	1000	20	24000	3000	14	4600	500	180	3400	800
Dibenz(a,h)anthracene	11	150	40	6.3	880	100	11	3400	300	6.4	610	60	13	160	70
Indeno(1,2,3-cd)pyrene	12	400	100	8.1	4200	600	9.8	13000	1000	7.4	2100	200	50	720	300
Phenanthrene	29	2400	400	7.5	19000	2000	24	22000	2000	11	9200	900	190	11000	1000
Other SVOCs (ug/kg dry)															
1,2-Dichlorobenzene	35	35	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	40	40	100
4-Methylphenol	ND	ND	100	ND	ND	100	120	500	100	56	56	100	93	93	100
Benzoic acid	73	8900	1000	93	4600	500	48	2700	500	48	620	200	50	3300	600
Butylbenzylphthalate	52	220	100	108	108	100	79	79	100	ND	ND	100	37	84	100
Carbazole	79	130	100	83	760	200	53	2000	200	1200	1200	200	37	1200	200
Dibenzofuran	64	100	100	52	210	100	150	2800	300	880	880	200	40	680	100
VOCs (ug/kg dry)															
Carbon disulfide	ND	ND	2	ND	ND	1	1.3	1.3	1	ND	ND	1	NA	NA	NA
o-Xylene	ND	ND	2	1	1	1	ND	ND	1	ND	ND	1	NA	NA	NA
Trichlorofluoromethane	ND	ND	2	4.2	200	40	1.1	2.7	2	ND	ND	1	NA	NA	NA
Petroleum fractions															
C11-C22 Aromatic Hydrocarbons	NA	NA	NA	9800	39000	20000	NA	NA	NA	NA	NA	NA	NA	NA	NA
C19-C36 Aliphatic Hydrocarbons	NA	NA	NA	21000	21000	10000	NA	NA	NA	NA	NA	NA	NA	NA	NA
C9-C18 Aliphatic Hydrocarbons	NA	NA	NA	4500	4500	3000	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
NA - Not analyzed
ND - Not detected
[a] Includes only those chemicals that had neither a NOAEL or LOAEL benchmark dose.
[b]Minimum detected concentration
[c]Maximum detected concentration
[d]Average of detected concentrations and 1/2 of the detection limit or whole detection limit for non-detected compounds (See Setion 3.1)

Table 5-12
Comparison of Reference Earthworm Chemical Concentrations to Site Earthworm Chemical Concentrations
Chemicals that Lack TRVs for a Receptor Exposed to Earthworms
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Reference Earthworm			West of South St. Earthworm			East of South St. Earthworm			Orlando Earthworm			Floodplain Earthworm		
Chemicals[a]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]
Metals (mg/kg wet)															
Antimony	0.045	0.055	0.04	ND	ND	0.02	0.0865	0.0865	0.04	ND	ND	0.02	0.052	0.052	0.03
Cobalt	0.23	0.57	0.4	0.45	0.56	0.5	0.41	0.64	0.5	0.37	0.52	0.4	0.35	0.7	0.5
Iron	205	640	500	420	760	600	360	1100	600	160	280	200	260	980	600
Thallium	0.006	0.015	0.01	0.0058	0.013	0.009	0.0073	0.029	0.02	0.0065	0.0096	0.008	0.0058	0.026	0.01
PAHs (ug/kg wet)															
2-Methylnaphthalene	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
Acenaphthylene	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
Benzo(a)anthracene	ND	ND	200	300	300	200	230	230	200	ND	ND	200	ND	ND	200
Benzo(b)fluoranthene	ND	ND	200	440	440	300	450	450	300	ND	ND	200	ND	ND	200
Benzo(g,h,i)perylene	ND	ND	200	270	270	200	ND	ND	200	ND	ND	200	ND	ND	200
Benzo(k)fluoranthene	ND	ND	200	160	160	200	230	230	200	ND	ND	200	ND	ND	200
Chrysene	ND	ND	200	300	300	200	220	220	200	ND	ND	200	ND	ND	200
Dibenz(a,h)anthracene	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
Indeno(1,2,3-cd)pyrene	ND	ND	200	270	270	200	190	190	200	ND	ND	200	ND	ND	200
Phenanthrene	ND	ND	200	420	420	300	ND	ND	200	ND	ND	200	ND	ND	200
Other SVOCs (ug/kg wet)															
1,2-Dichlorobenzene	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
4-Methylphenol	180	1500	600	150	450	300	170	170	200	240	610	400	160	160	200
Benzoic acid	5400	5500	5000	710	2300	2000	270	4400	2000	600	8200	4000	890	4100	2000
Butylbenzylphthalate	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
Carbazole	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200
Dibenzofuran	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200	ND	ND	200

Notes:
ND - Not detected
[a] Includes only those chemicals that had neither a NOAEL or LOAEL benchmark dose.
[b]Minimum detected concentration
[c]Maximum detected concentration
[d]Average of detected concentrations and 1/2 of the detection limit or whole detection limit for non-detected compounds (See Setion 3.1)

Table 5-13
Comparison of Reference Sediment Chemical Concentrations to Site Sediment Chemical Concentrations
Chemicals that Lack TRVs for a Receptor Exposed to Sediment
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Neponset River Reference Sediment*			Neponset River Sediment*			Lower Pond Reference Sediment			Lewis Pond Sediment			Tailrace Sediment[e]		
Chemicals[a]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]	Min[b]	Max[c]	Average[d]
Metals (mg/kg)															
Barium	10	130	36	11.3	140	33	35	250	150	26	127	87	12.7	143	50
Chromium							11	39	28	35.2	410	98			
Cobalt	2.2	5.85	3	2.2	3.6	3	4.1	22	10	4.7	25	10	2.1	12.5	7
Iron	4400	34000	10000	4130	22200	10000									
Manganese	140	2250	800	103	700	400	210	1400	800	208	1010	500	85.2	2500	900
Thallium							0.19	0.27	0.1	0.084	0.14	0.09	0.044	0.19	0.1
PAHs (ug/kg)															
2-Methylnaphthalene	8.3	22	8	7	240	40	21	460	100	27	190	100	73	730	400
Acenaphthylene	3.6	51	10	18	110	60	81	920	400	290	900	600	30	1300	500
Benzo(a)anthracene	5.2	140	30	59	1700	400	830	5900	3000	1000	3400	2000	30	4000	1000
Benzo(b)fluoranthene	3.5	82	20	59	2200	400	620	6100	3000	1300	4000	2000	26	4600	2000
Benzo(g,h,i)perylene	8.7	75	20	30	550	200	310	1700	800	190	650	400	18	1600	400
Benzo(k)fluoranthene	3.9	87	20	36	890	200	720	5400	3000	950	3900	2000	18	3800	2000
Chrysene	3.1	130	30	80	1900	400	970	7200	4000	1100	4100	2000	30	4500	2000
Dibenz(a,h)anthracene	5	23	6	8.8	210	50	110	690	300	100	250	100	6.3	240	100
Indeno(1,2,3-cd)pyrene	7.8	67	20	34	700	200	330	2200	900	240	720	500	17	1800	500
Phenanthrene	3	150	30	120	1800	600	1900	7100	4000	690	2700	2000	190	6900	2000
Other SVOCs (ug/kg)															
2,4-Dimethylphenol	ND	ND	70				ND	ND	100	52	610	100	ND	ND	100
4-Methylphenol	ND	ND	70				ND	ND	100	74	550	200	150	190	100
Benzoic acid	47	47	60	40	79	50	130	1500	700	120	1600	900	42	620	300
Benzyl alcohol	ND	ND	70				ND	ND	100	47	100	100	ND	ND	80
bis(2-Ethylhexyl)phthalate	ND	ND	80	39	6500	800	4000	5400	2000	220	3000	700	46	290	200
Carbazole	ND	ND	70	50	340	100	210	790	400	100	280	200	170	630	200
Di-n-octylphthalate	ND	ND	70	53	53	100									
VOCs (ug/kg)															
Acetone							75	1200	500	20	440	100			
Carbon disulfide	ND	ND	1				3.4	29	10	3.8	8.2	3	2.1	15	6
Methyl tert-butyl ether (MTBE)							ND	ND	3	2.7	2.7	3			

Notes:
* Neponset River includes the Lower Former Mill Tailrace
NA - Not analyzed
ND - Not detected
[a] Includes only those chemicals that had neither a NOAEL or LOAEL benchmark dose.
[b]Minimum detected concentration
[c]Maximum detected concentration
[d]Average of detected concentrations and 1/2 of the detection limit or whole detection limit for non-detected compounds (See Setion 3.1)
[e]Reference area is the upstream Neponset River reference area.

Table 5-14
Comparison of Reference Invertebrate Chemical Concentrations to Site Invertebrate Chemical Concentrations
Chemicals that Lack TRVs for a Receptor Exposed to Invertebrates
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Neponset River Reference Invertebrate*			Neponset River Invertebrate*			Lower Pond Reference Invertebrate			Lewis Pond Invertebrate			Tailrace Invertebrate		
Chemicals[a]	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**
Metals (mg/kg)															
Barium	68	68	70	55	62	60	74.5	74.5	70	57	65	60	25	25	30
Chromium							0.52	0.52	0.5	1	8.7	6	0.57	0.57	0.6
Cobalt	0.36	0.36	0.40	0.18	0.35	0.3	0.31	0.31	0.3	0.25	0.34	0.3	0.39	0.39	0.4
Iron	560	560	600	480	720	600									
Manganese	99	99	100	6.8	75	50	19.5	19.5	20	4.2	17	10	8.5	8.5	9
Thallium							0.0017	0.0017	0.0017	0.0027	0.0044	0.0026	0.0024	0.0024	0.002
Other SVOCs (ug/kg)															
2,4-Dimethylphenol	ND	ND	140				ND	ND	100	ND	ND	100	ND	ND	100
4-Methylphenol	250	250	250				195	195	200	160	200	200	ND	ND	100
Benzoic acid	700	700	700	910	2800	2000	1200	1200	1000	780	970	900	360	360	400
Benzyl alcohol	1900	1900	1900				2500	2500	3000	1100	2400	2000	5200	5200	5000
bis(2-Ethylhexyl)phthalate	ND	ND	500	ND	ND	300	ND	ND	200	ND	ND	200	ND	ND	300
Carbazole	ND	ND	100	ND	ND	100	ND	ND	100	ND	ND	100	ND	ND	100
Di-n-octylphthalate	ND	ND	100	ND	ND	100									

Notes:
* Neponset River includes the Lower Former Mill Tailrace
ND - Not detected
[a] Includes only those chemicals that had neither a NOED or LOED benchmark dose.
[b]Minimum detected concentration
[c]Maximum detected concentration
[d]Average of detected concentrations and 1/2 of the detection limit or whole detection limit for non-detected compounds (See Setion 3.1)

Table 5-15
Comparison of Reference Fish Chemical Concentrations to Site Fish Chemical Concentrations
Chemicals that Lack TRVs for a Receptor Exposed to Fish
Blackburn and Union Privileges Site
Walpole, Massachusetts

	Lower Pond Reference Fish			Lewis Pond Fish			Neponset River Fish		
Chemicals[a]	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**	**Min[b]**	**Max[c]**	**Average[d]**
Metals (mg/kg)									
Barium	1.3	3.5	2.3	0.64	1.6	1.1	0.22	1.9	1.1
Cobalt	0.043	0.046	0.03	0.035	0.053	0.04	0.061	0.061	0.03
Iron	66	160	100	64	130	90	25	80	50
Manganese	3.1	58	20	6.3	35	20	7.3	60	30
Nickel	0.18	0.44	0.3	0.26	0.62	0.4	0.15	0.37	0.3
Thallium	0.0014	0.0095	0.004	0.00091	0.0044	0.003	0.00092	0.0066	0.002

Notes:
NA - Not analyzed
NC - Not calculated
ND - Not detected
[a] Includes only those chemicals that had neither a NOED or LOED benchmark dose.
[b]Minimum detected concentration
[c]Maximum detected concentration
[d]Average of detected concentrations and 1/2 of the detection limit or whole detection limit for non-detected compounds (See Setion 3.1)

APPENDIX A

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

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DRAFT

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
Blackburn & Union Privileges Superfund Site
Walpole, Massachusetts

September 18, 2002
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TABLE OF CONTENTS:

1.0 SCREENING LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION 1

1.1 INTRODUCTION 1
1.2 SCREENING LEVEL PROBLEM FORMULATION 1
1.2.1 Environmental setting and chemicals known or suspected to exist at the site 2
1.2.2 Chemical Fate and Transport Mechanisms that Might Exist at the Site 5
1.2.3 The Mechanisms of Ecotoxicity Associated with Chemicals and Likely Categories of Receptors That Could be Affected 5
1.2.4 Complete Exposure Pathways 6
1.2.5 Assessment and Measurement Endpoints 6
1.3 SCREENING LEVEL ECOLOGICAL EFFECTS EVALUATION 7

2.0 SCREENING LEVEL EXPOSURE ASSESSMENT AND RISK CALCULATION 8

2.1 SCREENING LEVEL EXPOSURE ASSESSMENT 8
2.2 SCREENING LEVEL RISK CALCULATION 9
2.2.1 Method 9
2.2.2 Chemicals of Potential Ecological Concern 10
2.2.3 Conclusion 12

3.0 REFERENCES 14

LIST OF TABLES

Table 2-1 Summary of COPECs for each Exposure Area and Media or Medium Within the Area

Table 2-2 Surface Water COPEC Screening – Neponset River

Table 2-3 Surface Water COPEC Screening - Tailrace

Table 2-4 Sediment COPEC Screening – Neponset River

Table 2-5 Sediment COPEC Screening – Tailrace

Table 2-6 Sediment COPEC Screening –Lewis Pond

Table 2-7 On-Site Soil COPEC Screening

Table 2-8 Soil COPEC Screening – Floodplain

LIST OF FIGURES:

Figure 1-1 Locus Map

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1.0 SCREENING LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION

1.1 Introduction

This document is a Screening Level Ecological Risk Assessment (SLERA) that addresses risk at the Blackburn and Union Privileges Superfund Site (Site) in Walpole, Massachusetts. It includes a Screening Level Problem Formulation (subsection 1.2), Screening Level Ecological Effects Evaluation (subsection 1.3), Screening Level Exposure Assessment (subsection 2.2), and a Screening Level Risk Calculation (subsection 2.3). The structure and content of these subsections follow USEPA guidance (USEPA, 1997). The chemical data (sediment, surface water, soil, and groundwater sampling and chemical analyses) and site characterization are from the Initial Site Characterization Report: Phase 1A Remedial Investigation (SHA, 2002). The screening is a comparison of maximum measured concentrations from these data to media specific ecotoxicity values (obtained from the literature). The risk calculation is the hazard quotient approach (USEPA, 1997).

The purpose of the screening level assessment is to identify exposure pathways and preliminary chemicals of concern for the baseline risk assessment by eliminating those chemicals and exposure pathways that pose negligible risks. Therefore, the goal of the screening level assessment is to conduct a conservative assessment of all potential chemicals of concern and carry to a baseline assessment only those Site-related chemicals that pose a potential ecological risk.

The product of this SLERA is a list of Chemicals of Potential Ecological Concern (COPECs), and an opinion that these COPECs present a risk of adverse ecological effects along several exposure pathways.

Subsequent ecological field programs measured these COPECs and appropriate supporting parameters (e.g. Total Organic Carbon) in representative environmental media and biota. These data provided exposure point concentrations, doses, or tissue burdens of the COPECs along relevant exposure pathways (based on discussion with representative of USEPA Region I). These measurements provided the data for a Baseline Ecological Risk Assessment.

1.2 Screening Level Problem Formulation

This screening-level problem formulation develops an initial conceptual model for the Site that addresses five issues:

Environmental setting and chemicals known or suspected to exist at the site (Section 1.2.1);

Chemical fate and transport mechanisms that might exist at the site (Section 1.2.2);

The mechanisms of ecotoxicity associated with chemicals and likely categories of receptors that could be affected (Section 1.2.3);

What complete exposure pathways might exist at the site (a complete exposure pathway is one in which the chemical can be traced or expected to travel from the source to a receptor that can be affected by the chemical) (Section 1.2.4); and

Selection of endpoints to screen for ecological risk (Section 1.2.5).

1.2.1 Environmental setting and chemicals known or suspected to exist at the site

SHA (2002 and references cited therein) describe the site history and environmental setting. The Blackburn and Union Privileges Site is approximately one-half mile south/southeast of the center of Walpole, Massachusetts (Figure 1-1). It is south of the intersection of South Street and Common Street with South Street bisecting the Site in a north/south direction and the Neponset River bisecting the Site in an east/west direction. Lewis pond is 0.7 miles north of the Site. The Site, as defined in the Administrative Order by Consent consists of "On-Facility" and "Off-Facility" properties with residential lots and industrial facilities. The “On-Facility” properties have been industrial for several hundred years while the “Off-Facility” properties have historically been undeveloped or residential. The industrial processes conducted on “On-Facility” properties have included, but are not limited to the manufacturing of: cloth, rubber goods, asbestos brake and clutch linings, cotton and rayon flock, and instant coffee. Currently, five buildings east of South Street are foundry-related and associated support operations.

1.2.1.1 Environmental Setting

A local habitat survey (NAI, 2001 contained in SHA, 2002) described four general habitat types: wetlands, uplands, the Neponset River, and the Neponset River floodplains.

Wetlands

The wetlands are eleven bordering vegetative wetlands, shallow emergent marshes, and small pools of the Neponset River. They occur upstream, adjacent to, and downstream of the Site in a generally discontinuous pattern broken by an approximately 800 feet long culvert north of South Street, and relatively long channelized reaches of the river. These wetlands offer a diverse vegetative habitat among eleven distinctly defined wetlands that are generally less than one or two acres (the downstream seven acre Lewis Pond is the largest of these wetlands and includes emergent marsh and small open water areas. In sum, the wetlands can support invertebrates, large mammals (white tail deer) and various small mammals (e.g. mice, shrews, raccoon, muskrat), and avian predators (kingfisher, heron).

Uplands

The uplands are generally small and too disconnected to provide breeding territories. They include residential lawn, mowed fields, small white pine oak forest, and industrialized property with its attendant compacted and covered soil. The upland supports small mammals, songbirds, and terrestrial invertebrates.

Neponset River Surface Water and River Bottom

The Neponset River includes a surface water and benthic environment. The river is generally 20 feet wide and two feet deep. Upstream it is a riffle and run environment over a cobble bottom until it runs through a small sandy wetland before entering an 800 feet long culvert that runs adjacent to and through the Site. Downstream of the culvert, the river is a steep-sided cobbley stream until it begins to meander through Lewis Pond, an extensive emergent wetland and small open water area. Immediately downstream of Lewis Pond, the river encounters a dam with a control weir in Walpole Center. The river will support benthic invertebrates and a warm water fishery.

Neponset River Floodplain

The 100-year floodplain of the Neponset River is 60 to 450 feet wide and encompasses bordering wetlands and residential or commercial properties all along its length. Most of the floodplain is residential and will support small mammals and provide feeding areas for songbirds.

1.2.1.2 Chemicals Measured at the Site

USEPA (1997) notes that the initial list of chemicals addressed in the screening level assessment should include all chemicals identified or suspected to be at the Site. It also states (USEPA, 1997 section 3.2) that the results of the screening level assessment "should have indicated which chemicals found at the Site can be eliminated from further consideration and which should be evaluated further."

SHA (2002) provides summaries of measured chemicals by media and sample locations. The chemical classes measured in each media included:

Groundwater - SVOCs, VOCs, metals, anions, alkalinity, TKN;

Soil – SVOCs, VOCs, metals, WAD cyanide, VPH/EPH, pesticides, PCBs (note that VPH/EPH, pesticides, and PCBs were measured at a subset of the soil sampling locations);

Surface Water – SVOCs, VOCs, metals, WAD cyanide, TOC, Asbestos;

Sediment - SVOCs, VOCs, metals, WAD cyanide, TOC, AVS/SEM, grain size, percent solids, Asbestos.

This screening analysis addressed only chemicals detected in ecological exposure media (soil, sediment, surface water) from among these measured chemical categories for further consideration in the screening ecological assessment. These detected chemicals included:

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Cyanide
Cyanide (weak acid dissociable)
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

PAHs

2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Benzo[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[g,h,i]perylene
Benzo[k]fluoranthene
Chrysene
Dibenz[a,h]anthracene
Fluoranthene
Fluorene
Indeno[1,2,3-cd]pyrene
Naphthalene
Phenanthrene
Pyrene

Other SVOCs

1,2-Dichlorobenzene
1,4-Dichlorobenzene
2,4-Dimethylphenol
2-Methylphenol
4-Methylphenol
4-Nitroaniline
Benzoic acid
Benzyl alcohol
bis(2-Ethylhexyl)phthalate
Butylbenzylphthalate
Carbazole
Di-n-butylphthalate
Di-n-octylphthalate
Dibenzofuran
Diethylphthalate
Isophorone
Pentachlorophenol
Phenol

Pesticides

4,4'-DDD
4,4'-DDE
4,4'-DDT
alpha-chlordane
delta-BHC
gamma-BHC
Dieldrin
endosulfan sulfate
endrin ketone
gamma-chlordane
heptachlor
Heptachlor epoxide (B)

PCBs

Aroclor 1260

Petroleum fractions

C5-C8 Aliphatic Hydrocarbons
C9-C10 Aromatic Hydrocarbons
C9-C12 Aliphatic Hydrocarbons
C11-C22 Aromatic Hydrocarbons
C19-C36 Aliphatic Hydrocarbons
C9-C18 Aliphatic Hydrocarbons

VOCs

1,1,1-Trichloroethane	cis-1,2-Dichloroethene	o-Xylene
2-Butanone	Ethylbenzene	Styrene
Acetone	Methyl tert-butyl ether	Toluene
Benzene	(MTBE)	Trichloroethene
Carbon disulfide	methylene chloride	Trichlorofluoromethane
Chloroform	m/p-Xylene	

1.2.2 Chemical Fate and Transport Mechanisms that Might Exist at the Site

Physical, chemical, and biological transport mechanisms that likely to affect the distribution of the detected chemicals in the observed habitats on, proximate to, and downstream of the Site include:

Deposition of particles in runoff from the Site to bordering vegetated wetlands, Neponset River and Lewis Pond surface water and sediment, and the Neponset River floodplain;

Dissolution of chemicals from sediments or suspended sediments to surface water of the Neponset River and Lewis Pond;

Dissolution of chemicals from Site soil to groundwater with subsequent migration to surface water or sediment of the Neponset River;

Transport of particles from erosive areas to depositional areas in the Neponset River and Lewis Pond;

Bioaccumulation and potential biomagnification from soil invertebrates in floodplain soil, wetlands soil, and terrestrial soil to small mammals and songbirds;

Bioaccumulation and potential biomagnification from benthic invertebrates in Neponset River and Lewis Pond sediments to fish, piscivorous birds, and semi-aquatic mammals.

1.2.3 The Mechanisms of Ecotoxicity Associated with Chemicals and Likely Categories of Receptors That Could be Affected

The scientific literature recognizes that the detected chemicals are toxic to aquatic and terrestrial receptors. The toxicity depends on various chemical and receptor-specific concentrations in soil, sediment, water, or diet. Several reviews summarize the toxic mechanisms and their specific effects for metals, PAHs, SVOCs, pesticides, and PCBs (e.g. Landis and van der Schalie, 1990; Rand, 1995).

1.2.4 Complete Exposure Pathways

The potentially complete exposure pathways on the Site and adjacent, proximate, and downstream habitats include:

Benthic organisms, fish, and semi-aquatic organisms exposed to chemicals in surface water in the Neponset River and its associated wetlands and Lewis Pond through direct contact, ingestion, and uptake across the gills;

Benthic organisms exposed to chemicals in sediment in the Neponset River and its associated wetlands and Lewis Pond through direct contact and ingestion;

Terrestrial plants exposed to chemicals in On-Facility surface soils through root uptake;

Terrestrial invertebrates exposed to chemicals in On-Facility surface soils through ingestion and direct contact;

Higher-level aquatic and semi-aquatic consumers exposed to chemicals in prey from surface water and sediment; and

Higher-level terrestrial consumers exposed to chemicals in prey exposed to contaminated soil.

We considered higher-level consumers, which are exposed via the aquatic and terrestrial food chains in the screening-level ecological risk assessment because several bioaccumulative compounds were detected at the Site and/or adjacent, proximate, or downstream habitats.

1.2.5 Assessment and Measurement Endpoints

USEPA (1997) notes that for the screening-level ecological risk assessment, assessment endpoints are any adverse effects on ecological receptors, and that many of the screening ecotoxicity values depend on generic assessment endpoints (e.g., protection of aquatic communities from changes in structure or function) and are assumed to be widely applicable to sites around the United States.

For this SLERA we assumed generic assessment endpoints as: indications of adverse affects on aquatic organisms from exposures to chemicals in sediment or surface water, and indications of adverse affects on terrestrial organisms from exposures to chemicals in soil. The SLERA employed conservative measurement endpoints of exposure, the maximum concentration of any detected chemical in the appropriate media.

1.3 Screening Level Ecological Effects Evaluation

USEPA (1997) indicates that the screening level assessment should establish conservative thresholds called screening ecotoxicity values. This document used several sources of screening ecotoxicity values. These are No Observed Adverse Effect Levels from various summary sources. These summaries reviewed the literature to establish conservative threshold values.

Surface Water Screening Ecotoxicity Values

We used three sources, sequentially, to select values for screening surface water for potential ecotoxicity:

1. The EPA National Recommended Water Quality Criteria (NRWQC) (USEPA, 1999) (freshwater continuous criteria);

2. Great Lakes Water Quality Initiative Tier II Methodology benchmarks (Suter and Tsao, 1996) when chronic NRWQC were not available.

3. Secondary Chronic Values for aquatic biota (Suter and Tsao, 1996), if criteria were unavailable from any of the previous sources.

Sediment Screening Criteria

We used the five sources, sequentially, to select values for screening sediment for potential ecotoxicity:

1. The National Oceanic and Atmospheric Administration (NOAA) Effects Range Low (ER-L) for sediments (Long and Morgan, 1990);

2. Threshold Effects Levels (TELs) and Probable Effects Levels (PELs) for freshwater sediments (Smith et al., 1996);

3. Ontario Ministry of the Environment Lowest Effect Levels (Persaud et al., 1993);

4. Sediment Quality Benchmarks derived based on 1% TOC (Jones et al., 1997), and adjusted using site-specific TOC for this screening assessment; and

5. Equilibrium partitioning-derived benchmarks for sediment-associated biota based on Chronic NAWQC and Secondary Chronic Values (Jones et al., 1997).

Soil Screening Criteria

We used three sources to select values for screening soil for potential ecotoxicity:

1. Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Screening Potential Effects on Terrestrial Plants (Efroymson et al., 1997a);

2. ORNL Toxicological Benchmarks for Chemicals of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process (Efroymson et al., 1997b); and

ORNL Toxicological Benchmarks for Wildlife (Sample et al., 1996) – we specifically used No Observed Adverse Effect Level (NOAEL)-based values for food ingestion for the robin (songbird) and short-tail shrew.

2.0 SCREENING LEVEL EXPOSURE ASSESSMENT AND RISK CALCULATION

USEPA (1997) indicates that the screening level exposure assessment and risk calculation should include estimating exposure levels, and screening for ecological risks. The estimates of exposure levels should be the highest measured or estimated on-site chemical concentration for each environmental media involved in a complete exposure pathway.

Upon the completion of the risk calculation, the SLERA should come to one of three potential conclusions:

Ecological threats are negligible;

The ecological risk assessment should continue to determine whether a risk exists; or

There is a potential for adverse ecological effects, and a more detailed ecological risk assessment, incorporating more site-specific information, is needed.

2.1 Screening Level Exposure Assessment

Sanborn, Head & Associates, Inc. (2000) provides the details of sampling, analysis, and station locations from which we estimated exposure point concentrations. These were the maximum measured concentrations of detected chemicals from environmental media in five exposure areas (Neponset River, Former Mill Tailrace, Lewis Pond, On-Site soil, and Floodplain soil:

Neponset River surface water represented by six stations along the length of the river as it flows through the site. The sampling program included measurement of chemicals under relatively high flow conditions (April 4 and 5, 2001) and relatively low flow conditions (August 1 and 2, 2001). SHA obtained the samples from mid-depth in the universally shallow water of this reach of the Neponset River.

Neponset River sediment represented by eight stations along the length of the river as it flows through the site and immediately downstream. The sampling program included measurement of chemicals, total organic carbon, percent solids, and grain size distribution during July 25 and 26, 2001. SHA obtained the samples from the surface sediment layer that represents exposure to benthic organisms and bottom feeding fish.

Former Mill Tailrace (a partially filled former industrial tailrace that includes a small area of surface water and wetland isolated from the main flow of the Neponset River) surface water represented by two stations in the tailrace. The sampling program included measurement of chemicals under relatively high flow conditions (April 4 and 5, 2001) and relatively low flow conditions (August 1 and 2, 2001). SHA obtained the samples from mid-depth in this shallow isolated area.

The Former Mill Tailrace sediment represented by seven samples. The sampling program included measurement of chemicals, total organic carbon, percent solids, and grain size distribution on July 25, 2001. SHA obtained the samples from the surface sediment layer that represents exposure to benthic organisms (bottom feeding fish are not expected in the Former Mill Tailrace because it is small and physically isolated from the Neponset River).

Lewis Pond (a wide meandering reach of the Neponset River that terminates in a downstream dam) sediment represented by ten samples in three cross-stream transects. The sampling program included measurement of chemicals, total organic carbon, percent solids, and grain size distribution on July 26, 2001. The transects ran across the pond just upstream of the dam, and two more transects at approximately even intervals further upstream. SHA obtained the samples from the surface sediment layer (0.5 foot) that represents exposure to benthic organisms and bottom feeding fish.

On-Site soil represented by 55 surface (0 to 1foot) soil samples. The sampling program (SHA, 2002) included a hierarchical random sampling of on-site soil and analysis of chemicals (some chemical categories were measured in a subset of samples), pH, and total organic carbon. The near surface samples represent the exposure of soil dwelling organisms and the higher trophic levels that feed on them.

Floodplain soil represented by 15 near surface samples. The sampling program (SHA, 2002) included chemical sampling, total organic carbon, grain size, and asbestos. The near surface samples represent the exposure of soil dwelling organisms and the higher trophic levels that feed on them.

2.2 Screening Level Risk Calculation

2.2.1 Method

We compared Site concentrations to several media-specific screening ecotoxicity values to develop a list of chemicals of potential ecological concern (COPECs). We considered that these COPECs and the complete exposure pathways along which they occur present a

potentially adverse ecological effect and are therefore subject to further analysis in a baseline ecological risk assessment. The screening approach generally followed Suter's stepwise approach for screening level assessments (Suter, 1995).

Step 1: If the chemical is not detected at detection limits specified in the QAPP and the analytical method is acceptable, then the chemical may be excluded from further assessment.

> We eliminated from further assessment chemicals that were detected in each medium of each exposure zone at a detection frequency of less than 5%.

Step 2: If the chemical concentration is below concentrations that constitute a potential toxicological hazard, the chemical may be excluded.

> We used ecotoxicological screening levels to estimate if a chemical constitutes a potential ecological hazard.

Step 3: Retain chemicals as COECs that are detected at a frequency greater than 5 % and have no screening criteria.

Step 4: Retain compounds that have a chemical concentration below concentrations that constitute a potential toxicological hazard as a COEC if:

> The compound is biomagnifiable; and
>
> It is detected at 5% frequency or greater.

2.2.2 Chemicals of Potential Ecological Concern

Table 2-1 is a summary of the COPECs for each exposure area and exposure medium. Note that USEPA guidance cautions that if new chemicals are discovered or chemicals are found at higher concentrations later in the RI, those chemicals may need to be added to the ecological risk assessment at that time.

Tables 2-2 to 2-8 provide the lists of COPECs by the five exposure areas and environmental medium or media. Each table presents the chemicals detected in the exposure area by media or medium, their detection frequencies, their maximum measured concentration, the screening ecotoxicity value, and its source.

COPECs in Surface water

In the Neponset River (Table 2-2) the COPECs include:

> Barium, iron, and manganese COPECs because they exceed screening ecotoxicity values; and

Six SVOCs because they do not have screening ecotoxicity value.

In the Former Mill Tailrace (Table 2-3) COPECs include:

Twelve metals;

Eleven PAHs, nine of which had no screening ecotoxicity value;

One VOC, 2-butanone because no screening ecotoxicity value is available; and

Calcium, magnesium, potassium, and sodium are all eliminated as COECs in surface water because they are essential nutrients.

Sediment

Tables 2-4 to 2-6 compare maximum concentrations in Neponset River, former mill tailrace and Lewis Pond sediment to ecotoxicological screening levels. In all areas, calcium, magnesium, potassium, and sodium were eliminated as COECs in sediment because they are essential nutrients.

In the Neponset River (Table 2-4) the COPECs include:

Iron, lead, and manganese because they exceed screening ecotoxicity values;

Aluminum, cobalt, barium, and vanadium are retained because they have no screening ecotoxicity value; and

Twenty-one SVOCs (five of these lack screening ecotoxicity value).

In the Former Mill tailrace (Table 2-5) the COPECs include:

Lead, manganese, mercury, and nickel are COECs because they exceed screening ecotoxicity values;

Aluminum, barium, beryllium, cobalt, selenium, thallium, and vanadium are COECs because they do not have screening ecotoxicity values;

Twenty-three SVOCs are COECs (six of these lack screening ecotoxicity values); and

One VOC, carbon disulfide.

In Lewis Pond (Table 2-6) the COPECs include:

Aluminum, barium, beryllium, cobalt, selenium, thallium, and vanadium because they do not have screening ecotoxicity values;

Cadmium, chromium, copper, lead, mercury, manganese, nickel, silver, and zinc because they exceed screening ecotoxicity values;

Twenty-three SVOCs are COECs (six of these lack screening ecotoxicity values); and

Acetone, carbon disulfide (exceed screening ecotoxicity values), and MTBE (no screening ecotoxicity value).

Soil

Tables 2-7 and 2-8 compare maximum concentrations in On-site and floodplain soil to screening ecotoxicity values. Calcium, magnesium, potassium, and sodium were eliminated as COECs in soil because they are essential nutrients.

In On-Site shallow soil samples (Table 2-7) COPECs include:

Seventeen metals because they exceeded screening ecotoxicity values (silver screened out due to low frequency of detection);

Twenty-two SVOCs (nineteen do not have screening ecotoxicity values);

Eleven pesticides (three do not have screening ecotoxicity values, and the maximum concentration of alpha-chlordane, dieldrin, endosulfan sulfate, gamma-BHC, gamma chlordane, and heptachlor are less than their screening ecotoxicity values; however they are biomagnifiable and detected at 5% frequency or greater);

PCB aroclor 1260 because it is biomagnifiable and detected at 5% frequency or greater;

Five petroleum fractions because the have no screening ecotoxicity values; and

Three VOCs because they do not have screening ecotoxicity values.

In floodplain soil samples (Table 2-8) OPECs include:

Sixteen metals (beryllium and cobalt did not exceed screening ecotoxicity values);

Twenty-one SVOCs (benzo(a)pyrene is the only SVOC with a maximum concentration greater than its screening ecotoxicity values; the other 20 SVOCs do not have screening ecotoxicity values).

2.2.3 Conclusion

The screening level assessment indicates that in the aquatic environments (surface water and sediment) adjacent to or downstream of the Site (Neponset River, Lewis Pond, and the Former Mill Tailrace) there is potential for risk due to exposure to seventeen metals,

seventeen PAH compounds, nine other SVOCs, and four VOCs, which we considered in the modeling analysis. These include:

Metals	**PAHs**	**Other SVOCs**
Aluminum	2-Methylnaphthalene	2,4-Dimethylphenol
Barium	Acenaphthene	4-Nitroaniline
Beryllium	Acenaphthylene	4-Methylphenol
Cadmium	Anthracene	Benzoic acid
Chromium	Benzo[a]anthracene	Benzyl alcohol
Cobalt	Benzo[a]pyrene	bis(2-Ethylhexyl)phthalate
Copper	Benzo[b]fluoranthene	Butylbenzylphthalate
Iron	Benzo[g,h,i]perylene	Carbazole
Lead	Benzo[k]fluoranthene	Di-n-octylphthalate
Manganese	Chrysene	Dibenzofuran
Mercury	Dibenz[a,h]anthracene	
Nickel	Fluoranthene	
Selenium	Fluorene	*VOCs*
Silver	Indeno[1,2,3-cd]pyrene	Acetone
Thallium	Naphthalene	2-Butanone
Vanadium	Phenanthrene	Carbon disulfide
Zinc	Pyrene	(MTBE)

The screening level assessment indicates that in the terrestrial environments there is potential for risk due to exposure to seventeen metals, seventeen PAH compounds, nine other SVOCs, and four VOCs. These include:

Metals	**PAHs**	**Other SVOCs**	
Aluminum	2-Methylnaphthalene	1,2 Dichlorobenzene	endosulfan sulfate
Antimony	Acenaphthene	4-Methylphenol	endrin ketone
Arsenic	Acenaphthylene	Benzoic acid	gamma-chlordane
Barium	Anthracene	Butylbenzylphthalate	Heptachlor
Cadmium	Benzo[a]anthracene	Carbazole	Heptachlor epoxide
Chromium	Benzo[a]pyrene	Dibenzofuran	**PCBs**
Cobalt	Benzo[b]fluoranthene	**VOCs**	Aroclor 1260
Copper	Benzo[g,h,i]perylene	Carbon disulfide	**Petroleum fractions**
Iron	Benzo[k]fluoranthene	o-xylene	C11-C22 Aromatics
Lead	Chrysene	Trichlorofluoromethane	C19-C36 Aliphatics
Manganese	Dibenz[a,h]anthracene	**Pesticides**	C9-C10 Aromatics
Mercury	Fluoranthene	4,4'-DDD	C9-C12 Aliphatics
Nickel	Fluorene	4,4'-DDE	C9-C18 Aliphatics
Selenium	Indeno[1,2,3-cd]pyrene	4,4'-DDT	
Thallium	Naphthalene	alpha-chlordane	
Vanadium	Phenanthrene	delta-BHC	
Zinc	Pyrene	Dieldrin	

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TABLES

Table 2-1. Summary of COPECs For Each Exposure Area and Media or Medium Within The Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Neponset River Surface Water	Neponset River Sediment	Tailrace Surface Water	Tailrace Sediment	Lewis Pond Sediment	On-Site Soil	Floodplain Soil
Metals							
Aluminum		x [a]	x	x [a]	x [a]	x	x
Antimony						x	x
Arsenic						x	x
Barium	x	x [a]	x	x [a]	x [a]	x	x
Beryllium				x [a]	x [a]		
Cadmium			x		x	x	x
Calcium	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]
Chromium			x		x	x	x
Cobalt		x [a]	x	x [a]	x [a]	x	
Copper			x		x	x	x
Iron	x	x	x			x [a]	x [a]
Lead		x	x	x	x	x	x
Magnesium	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]
Manganese	x	x	x	x	x	x	x
Mercury				x	x	x	x
Nickel			x	x	x	x	x
Potassium	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]
Selenium				x [a]	x [a]	x	x
Silver					x		
Sodium	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]	x[b]
Thallium				x [a]	x [a]	x	x
Vanadium		x [a]	x	x [a]	x [a]	x	x
Zinc			x	x	x	x	x
PAHs							
2-Methylnaphthalene		x	x [a]	x	x	x[a]	x[a]
Acenaphthene		x		x	x	x	
Acenaphthylene		x [a]	x [a]	x [a]	x [a]	x[a]	x[a]
Anthracene		x		x	x	x[a]	x[a]
Benzo[a]anthracene		x	x	x	x	x[a]	x[a]
Benzo[a]pyrene		x	x	x	x	x	x
Benzo[b]fluoranthene	x [a]	x [a]	x [a]	x [a]	x [a]	x[a]	x[a]
Benzo[g,h,i]perylene	x [a]	x	x [a]	x	x	x[a]	x[a]
Benzo[k]fluoranthene	x [a]	x	x [a]	x	x	x[a]	x[a]
Chrysene	x [a]	x	x [a]	x	x	x[a]	x[a]
Dibenz[a,h]anthracene		x	x [a]	x	x	x[a]	x[a]
Fluoranthene		x		x	x	x[a]	x[a]
Fluorene		x		x	x	x	
Indeno[1,2,3-cd]pyrene		x	x [a]	x	x	x[a]	x[a]
Naphthalene		x		x	x	x[a]	x[a]
Phenanthrene		x		x	x	x[a]	x[a]
Pyrene	x [a]	x	x [a]	x	x	x[a]	x[a]
Other SVOCs							
1,2-Dichlorobenzene							x[a]
2,4-Dimethylphenol				x [a]	x [a]		

Table 2-1. Summary of COPECs For Each Exposure Area and Media or Medium Within The Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Chemical	Neponset River Surface Water	Neponset River Sediment	Tailrace Surface Water	Tailrace Sediment	Lewis Pond Sediment	On-Site Soil	Floodplain Soil
4-Nitroaniline	x [a]						
4-Methylphenol				x [a]	x [a]	x[a]	x[a]
Benzoic acid		x [a]		x [a]	x [a]	x[a]	x[a]
Benzyl alcohol				x	x		
bis(2-Ethylhexyl)phthalate		x		x	x		
Butylbenzylphthalate						x[a]	x[a]
Carbazole		x [a]		x [a]	x [a]	x[a]	x[a]
Di-n-octylphthalate		x [a]					
Dibenzofuran						x[a]	x[a]
Pesticides							
4,4'-DDD						x	
4,4'-DDE						x	
4,4'-DDT						x	
alpha-chlordane						x[c]	
delta-BHC						x[a]	
Dieldrin						x[c]	
endosulfan sulfate						x[c]	
endrin ketone						x[a]	
gamma-chlordane						x[c]	
heptachlor						x[c]	
Heptachlor epoxide (B)						x[a]	
PCBs							
Aroclor 1260						x[c]	
Petroleum fractions							
C11-C22 Aromatic Hydrocarbons						x[a]	
C19-C36 Aliphatic Hydrocarbons						x[a]	
C9-C10 Aromatic Hydrocarbons						x[a]	
C9-C12 Aliphatic Hydrocarbons						x[a]	
C9-C18 Aliphatic Hydrocarbons						x[a]	
VOCs							
Acetone					x		
2-Butanone			x[a]				
Carbon disulfide				x	x	x[a]	
cis-1,2-Dichloroethene							
Ethylbenzene							
Methyl tert-butyl ether (MTBE)					x[a]		
o-Xylene						x[a]	
Trichlorofluoromethane						x[a]	

[a] Compound is a COPEC because no screening level is available for that compound.
[b] Compound is not included as a COPEC because it is an essential nutrient.
[c] The maximum concentration of this compound is less than the screening level, but is a COPEC because it is bioaccumulative and is detected at 5% frequency or greater.

Table 2-2
Surface Water COPEC Screening - Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum surface water concentration (ug/L)	Ecological surface water screening level (ug/L)	Source of ecological surface water screening level	COEC?
Aluminum - Total	Metals/CN	7429-90-5 T	No	68.3	87	NRWQC	No
Arsenic - Dissolved	Metals/CN	7440-38-2 D	No	3.6	150	NRWQC	No
Barium - Dissolved	Metals/CN	7440-39-3 D	No	19.6	3.9	ET (Tier II)	Yes
Barium - Total	Metals/CN	7440-39-3 T	No	22.7	3.9	ET (Tier II)	Yes
Calcium - Dissolved	Metals/CN	7440-70-2 D	No	16600	Nutrient	NA	No
Calcium - Total	Metals/CN	7440-70-2 T	No	17100	Nutrient	NA	No
Chromium - Dissolved	Metals/CN	7440-47-3 D	No	3.8	11	NRWQC	No
Copper - Dissolved	Metals/CN	7440-50-8 D	No	2.8	4.4	NRWQC	No
Copper - Total	Metals/CN	7440-50-8 T	No	2.5	4.6	NRWQC	No
Iron - Dissolved	Metals/CN	7439-89-6 D	No	1280	1000	NRWQC	Yes
Iron - Total	Metals/CN	7439-89-6 T	No	555	1000	NRWQC	No
Magnesium - Dissolved	Metals/CN	7439-95-4 D	No	4340	Nutrient	NA	No
Magnesium - Total	Metals/CN	7439-95-4 T	No	4300	Nutrient	NA	No
Manganese - Dissolved	Metals/CN	7439-96-5 D	No	62.7	80	ET (Tier II)	No
Manganese - Total	Metals/CN	7439-96-5 T	No	194	80	ET (Tier II)	Yes
Nickel - Dissolved	Metals/CN	7440-02-0 D	No	3.7	26	NRWQC	No
Nickel - Total	Metals/CN	7440-02-0 T	No	1.3	26	NRWQC	No
Potassium - Dissolved	Metals/CN	7440-09-7 D	No	3160	Nutrient	NA	No
Potassium - Total	Metals/CN	7440-09-7 T	No	3190	Nutrient	NA	No
Selenium - Dissolved	Metals/CN	7782-49-2 D	No	1.5	4.6	NRWQC	No
Selenium - Total	Metals/CN	7782-49-2 T	No	2.3	5	NRWQC	No
Sodium - Dissolved	Metals/CN	7440-23-5 D	No	43000	Nutrient	NA	No
Sodium - Total	Metals/CN	7440-23-5 T	No	45500	Nutrient	NA	No
Zinc - Total	Metals/CN	7440-66-6 T	No	24	60	NRWQC	No
4-Nitroaniline	SVOCs	100-01-6	No	0.71	No SL	NA	Yes
Acenaphthene	SVOCs	83-32-9	No	0.028	23	FCV	No
Benzo[a]pyrene	SVOCs	50-32-8	No	0.006	0.014	ET (Tier II)	No
Benzo[b]fluoranthene	SVOCs	205-99-2	No	0.0063	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	0.012	No SL	NA	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	0.0052	No SL	NA	Yes
Benzyl alcohol	SVOCs	100-51-6	No	1	8.6	Tier II SCV	No
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	1.5	32	ET (Tier II)	No
Chrysene	SVOCs	218-01-9	No	0.0054	No SL	NA	Yes
Fluoranthene	SVOCs	206-44-0	No	0.014	8.1	FCV	No
Fluorene	SVOCs	86-73-7	No	0.017	3.9	ET (Tier II)	No
Naphthalene	SVOCs	91-20-3	No	0.03	24	ET (Tier II)	No
Phenanthrene	SVOCs	85-01-8	No	0.028	6.3	FCV	No
Pyrene	SVOCs	129-00-0	No	0.011	No SL	NA	Yes
Acetone	VOCs	67-64-1	No	1.2	1500	Tier II SCV	No

Notes:
NA = Not Available
NRWQC = EPA National Recommended Water Quality Criteria (USEPA 1999)
ET (Tier II) = Great Lakes Water Quality Initiative Tier II Methodology (Suter & Tsao 1996).
Tier II SCV = Secondary Chronic Values for Aquatic Biota (Suter & Tsao 1996)
FCV = Final Chronic Value (Suter & Tsao 1996)

Table 2-3
Surface Water COPEC Screening - Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum surface water concentration (ug/L)	Ecological surface water screening level (ug/L)	Source of ecological surface water screening level	COPEC?
Aluminum - Dissolved	Metals/CN	7429-90-5 D	No	535	87	NRWQC	Yes
Aluminum - Total	Metals/CN	7429-90-5 T	No	18000	87	NRWQC	Yes
Arsenic - Dissolved	Metals/CN	7440-38-2 D	No	24.7	150	NRWQC	No
Arsenic - Total	Metals/CN	7440-38-2 T	No	28	150	NRWQC	No
Barium - Dissolved	Metals/CN	7440-39-3 D	No	28.3	3.9	ET (Tier II)	Yes
Barium - Total	Metals/CN	7440-39-3 T	No	219	3.9	ET (Tier II)	Yes
Cadmium - Total	Metals/CN	7440-43-9 T	No	1.5	0.14	NRWQC	Yes
Calcium - Dissolved	Metals/CN	7440-70-2 D	No	22800	Nutrient	NA	No
Calcium - Total	Metals/CN	7440-70-2 T	No	25400	Nutrient	NA	No
Chromium - Dissolved	Metals/CN	7440-47-3 D	No	9.3	11	NRWQC	No
Chromium - Total	Metals/CN	7440-47-3 T	No	38.3	11	NRWQC	Yes
Cobalt - Total	Metals/CN	7440-48-4 T	No	9	3	ET (Tier II)	Yes
Copper - Dissolved	Metals/CN	7440-50-8 D	No	17.8	4.1	NRWQC	Yes
Copper - Total	Metals/CN	7440-50-8 T	No	90.5	4.3	NRWQC	Yes
Iron - Dissolved	Metals/CN	7439-89-6 D	No	790	1000	NRWQC	No
Iron - Total	Metals/CN	7439-89-6 T	No	13800	1000	NRWQC	Yes
Lead - Dissolved	Metals/CN	7439-92-1 D	No	67.4	0.9	NRWQC	Yes
Lead - Total	Metals/CN	7439-92-1 T	No	576	1	NRWQC	Yes
Magnesium - Dissolved	Metals/CN	7439-95-4 D	No	3250	Nutrient	NA	No
Magnesium - Total	Metals/CN	7439-95-4 T	No	9170	Nutrient	NA	No
Manganese - Dissolved	Metals/CN	7439-96-5 D	No	125	80	ET (Tier II)	Yes
Manganese - Total	Metals/CN	7439-96-5 T	No	950	80	ET (Tier II)	Yes
Mercury - Dissolved	Metals/CN	7439-97-6 D	No	0.014	0.77	NRWQC	No
Mercury - Total	Metals/CN	7439-97-6 T	No	0.044	0.91	NRWQC	No
Nickel - Dissolved	Metals/CN	7440-02-0 D	No	11	24	NRWQC	No
Nickel - Total	Metals/CN	7440-02-0 T	No	61.3	24	NRWQC	Yes
Potassium - Dissolved	Metals/CN	7440-09-7 D	No	3227	Nutrient	NA	No
Potassium - Total	Metals/CN	7440-09-7 T	No	4670	Nutrient	NA	No
Selenium - Dissolved	Metals/CN	7782-49-2 D	No	2.3	4.6	NRWQC	No
Selenium - Total	Metals/CN	7782-49-2 T	No	2.9	5	NRWQC	No
Sodium - Dissolved	Metals/CN	7440-23-5 D	No	432000	Nutrient	NA	No
Sodium - Total	Metals/CN	7440-23-5 T	No	433000	Nutrient	NA	No
Vanadium - Dissolved	Metals/CN	7440-62-2 D	No	43.6	20	Tier II SCV	Yes
Vanadium - Total	Metals/CN	7440-62-2 T	No	122	20	Tier II SCV	Yes
Zinc - Dissolved	Metals/CN	7440-66-6 D	No	40.7	54	NRWQC	No
Zinc - Total	Metals/CN	7440-66-6 T	No	340	55	NRWQC	Yes
2-Methylnaphthalene	SVOCs	91-57-6	No	0.6	No SL	NA	Yes
Acenaphthene	SVOCs	83-32-9	No	0.39	23	FCV	No
Acenaphthylene	SVOCs	208-96-8	No	0.27	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	0.19	0.73	Tier II SCV	No
Benzo[a]anthracene	SVOCs	56-55-3	No	0.6	0.027	Tier II SCV	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	0.89	0.014	ET (Tier II)	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	0.9	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	0.5	No SL	NA	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	0.47	No SL	NA	Yes
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	1.2	32	ET (Tier II)	No
Chrysene	SVOCs	218-01-9	No	0.98	No SL	NA	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	0.12	No SL	NA	Yes
Fluoranthene	SVOCs	206-44-0	No	1.3	8.1	FCV	No
Fluorene	SVOCs	86-73-7	No	0.26	3.9	ET (Tier II)	No
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	0.43	No SL	NA	Yes
Naphthalene	SVOCs	91-20-3	No	1.2	24	ET (Tier II)	No
Phenanthrene	SVOCs	85-01-8	No	0.96	6.3	FCV	No
Pyrene	SVOCs	129-00-0	No	1.6	No SL	NA	Yes
2-Butanone (MEK)	VOCs	78-93-3	No	1.9	No SL	NA	Yes
Acetone	VOCs	67-64-1	No	6.1	1500	Tier II SCV	No
Toluene	VOCs	108-88-3	No	1.2	130	ET (Tier II)	No

Notes:
NA = Not Available
NRWQC = EPA National Recommended Water Quality Criteria (USEPA 1999)
ET (Tier II) = Great Lakes Water Quality Initiative Tier II Methodology (Suter & Tsao 1996).
Tier II SCV = Secondary Chronic Values for Aquatic Biota (Suter & Tsao 1996)
FCV = Final Chronic Value (Suter & Tsao 1996)

Table 2-4
Sediment COPEC Screening - Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum sediment concentration (ug/kg)	Ecological sediment screening level (ug/kg)	Source of ecological sediment screening level	COEC?
Aluminum	Metals/CN	7429-90-5	No	4220000	No SL	NA	Yes
Arsenic	Metals/CN	7440-38-2	No	1600	33000	NOAA ER-L 1990	No
Barium	Metals/CN	7440-39-3	No	30800	No SL	NA	Yes
Cadmium	Metals/CN	7440-43-9	No	580	5000	NOAA ER-L 1990	No
Calcium	Metals/CN	7440-70-2	No	1140000	Nutrient	NA	No
Chromium	Metals/CN	7440-47-3	No	6300	80000	NOAA ER-L 1990	No
Cobalt	Metals/CN	7440-48-4	No	3600	No SL	NA	Yes
Copper	Metals/CN	7440-50-8	No	34400	70000	NOAA ER-L 1990	No
Iron	Metals/CN	7439-89-6	No	22200000	21200000	LEL	Yes
Lead	Metals/CN	7439-92-1	No	63000	35000	NOAA ER-L 1990	Yes
Magnesium	Metals/CN	7439-95-4	No	2190000	Nutrient	NA	No
Manganese	Metals/CN	7439-96-5	No	692000	460000	LEL	Yes
Nickel	Metals/CN	7440-02-0	No	5200	30000	NOAA ER-L 1990	No
Potassium	Metals/CN	7440-09-7	No	188000	Nutrient	NA	No
Sodium	Metals/CN	7440-23-5	No	73000	Nutrient	NA	No
Vanadium	Metals/CN	7440-62-2	No	18300	No SL	NA	Yes
Zinc	Metals/CN	7440-66-6	No	99900	120000	NOAA ER-L 1990	No
2-Methylnaphthalene	SVOCs	91-57-6	No	240	65	NOAA ER-L 1990	Yes
Acenaphthene	SVOCs	83-32-9	No	290	150	NOAA ER-L 1990	Yes
Acenaphthylene	SVOCs	208-96-8	No	110	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	600	85	NOAA ER-L 1990	Yes
Benzo[a]anthracene	SVOCs	56-55-3	No	1700	230	NOAA ER-L 1990	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	1900	400	NOAA ER-L 1990	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	2200	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	550	170	LEL	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	890	240	LEL	Yes
Benzoic acid	SVOCs	65-85-0	No	79	No SL	NA	Yes
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	6500	182	TEL	Yes
Carbazole	SVOCs	86-74-8	No	340	No SL	NA	Yes
Chrysene	SVOCs	218-01-9	No	1900	400	NOAA ER-L 1990	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	210	60	NOAA ER-L 1990	Yes
Dibenzofuran	SVOCs	132-64-9	No	120	6000	SQB	No
Di-n-octylphthalate	SVOCs	117-84-0	No	53	No SL	NA	Yes
Fluoranthene	SVOCs	206-44-0	No	2700	600	NOAA ER-L 1990	Yes
Fluorene	SVOCs	86-73-7	No	370	35	NOAA ER-L 1990	Yes
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	700	200	LEL	Yes
Naphthalene	SVOCs	91-20-3	No	730	340	NOAA ER-L 1990	Yes
Phenanthrene	SVOCs	85-01-8	No	1800	225	NOAA ER-L 1990	Yes
Pyrene	SVOCs	129-00-0	No	2100	350	NOAA ER-L 1990	Yes

Notes:
NA = Not Available
NOAA ER-L 1990 = the National Oceanic and Atmospheric Administration (NOAA) effects range-low (ER-L) threshold concentrations in sediment from "The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program" (1990).
LEL = lowest effect level indicating a level of sediment contamination at which the majority of benthic organisms are unaffected.
TEL = threshold effect level derived in MacDonald (1994) and cited in Jones et al. (1997)
SQB = the EPA sediment quality benchmark derived from an EPA Tier II chronic value, assuming one percent total organic carbon (see Jones et al. 1997).

Table 2-5
Sediment COPEC Screening - Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum sediment concentration (ug/kg)	Ecological sediment screening level (ug/kg)	Source of ecological sediment screening level	COPEC?
Aluminum	Metals/CN	7429-90-5	No	14000000	No SL	NA	Yes
Arsenic	Metals/CN	7440-38-2	No	9300	33000	NOAA ER-L 1990	No
Barium	Metals/CN	7440-39-3	No	143000	No SL	NA	Yes
Beryllium	Metals/CN	7440-41-7	No	590	No SL	NA	Yes
Cadmium	Metals/CN	7440-43-9	No	2100	5000	NOAA ER-L 1990	No
Calcium	Metals/CN	7440-70-2	No	10700000	Nutrient	NA	No
Chromium	Metals/CN	7440-47-3	No	38000	80000	NOAA ER-L 1990	No
Cobalt	Metals/CN	7440-48-4	No	12500	No SL	NA	Yes
Copper	Metals/CN	7440-50-8	No	53300	70000	NOAA ER-L 1990	No
Iron	Metals/CN	7439-89-6	No	19100000	21200000	LEL	No
Lead	Metals/CN	7439-92-1	No	850000	35000	NOAA ER-L 1990	Yes
Magnesium	Metals/CN	7439-95-4	No	14500000	Nutrient	NA	No
Manganese	Metals/CN	7439-96-5	No	2500000	460000	LEL	Yes
Mercury	Metals/CN	7439-97-6	No	160	150	NOAA ER-L 1990	Yes
Nickel	Metals/CN	7440-02-0	No	93100	30000	NOAA ER-L 1990	Yes
Potassium	Metals/CN	7440-09-7	No	875000	Nutrient	NA	No
Selenium	Metals/CN	7782-49-2	No	610	No SL	NA	Yes
Sodium	Metals/CN	7440-23-5	No	3620000	Nutrient	NA	No
Thallium	Metals/CN	7440-28-0	No	110	No SL	NA	Yes
Vanadium	Metals/CN	7440-62-2	No	49100	No SL	NA	Yes
Zinc	Metals/CN	7440-66-6	No	264000	120000	NOAA ER-L 1990	Yes
2,4-Dimethylphenol	SVOCs	105-67-9	No	72	No SL	NA	Yes
2-Methylnaphthalene	SVOCs	91-57-6	No	730	65	NOAA ER-L 1990	Yes
4-Methylphenol	SVOCs	106-44-5	No	190	No SL	NA	Yes
Acenaphthene	SVOCs	83-32-9	No	600	150	NOAA ER-L 1990	Yes
Acenaphthylene	SVOCs	208-96-8	No	1300	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	1400	85	NOAA ER-L 1990	Yes
Benzo[a]anthracene	SVOCs	56-55-3	No	4000	230	NOAA ER-L 1990	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	3200	400	NOAA ER-L 1990	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	4600	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	1600	170	LEL	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	3800	240	LEL	Yes
Benzoic acid	SVOCs	65-85-0	No	620	No SL	NA	Yes
Benzyl alcohol	SVOCs	100-51-6	No	66	6.6	SCV	Yes
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	290	182	TEL	Yes
Carbazole	SVOCs	86-74-8	No	630	No SL	NA	Yes
Chrysene	SVOCs	218-01-9	No	4500	400	NOAA ER-L 1990	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	240	60	NOAA ER-L 1990	Yes
Dibenzofuran	SVOCs	132-64-9	No	460	12000	SQB	No
Fluoranthene	SVOCs	206-44-0	No	9000	600	NOAA ER-L 1990	Yes
Fluorene	SVOCs	86-73-7	No	870	35	NOAA ER-L 1990	Yes
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	1800	200	LEL	Yes
Naphthalene	SVOCs	91-20-3	No	920	340	NOAA ER-L 1990	Yes
Phenanthrene	SVOCs	85-01-8	No	6900	225	NOAA ER-L 1990	Yes
Phenol	SVOCs	108-95-2	No	95	186	NAWQC chronic	No
Pyrene	SVOCs	129-00-0	No	8500	350	NOAA ER-L 1990	Yes
Carbon disulfide	VOCs	75-15-0	No	15	5.1	SCV	Yes
Ethylbenzene	VOCs	100-41-4	No	5.4	21600	SQB	No
m/p-Xylene	VOCs	108-38-3	No	8.6	150	SQB	No
o-Xylene	VOCs	95-47-6	No	5.4	150	SQB	No
Toluene	VOCs	108-88-3	No	5.8	4020	SQB	No

Notes:
NA = Not Available
NOAA ER-L 1990 = the National Oceanic and Atmospheric Administration (NOAA) effects range-low (ER-L) threshold
LEL = lowest effect level indicating a level of sediment contamination at which the majority of benthic organisms are unaffected.
TEL = threshold effect level derived in MacDonald (1994) and cited in Jones et al. (1997)
SQB = the EPA sediment quality benchmark derived from an EPA Tier II chronic value, assuming one percent total organic carbon
SCV = Equilibrium partitioning-derived benchmark based on Secondary Chronic Value water quality criteria (Jones et al., 1997).
NAWQC chronic = Equilibrium partitioning-derived benchmark based on chronic National Ambient Water Quality Criteria (Jones et al., 1997).

Table 2-6
Sediment COPEC Screening - Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum sediment concentration (ug/kg)	Ecological sediment screening level (ug/kg)	Source of ecological sediment screening level	COPEC?
Aluminum	Metals/CN	7429-90-5	No	9830000	No SL	NA	Yes
Antimony	Metals/CN	7440-36-0	No	1600	2000	NOAA ER-L 1990	No
Arsenic	Metals/CN	7440-38-2	No	28200	33000	NOAA ER-L 1990	No
Barium	Metals/CN	7440-39-3	No	127000	No SL	NA	Yes
Beryllium	Metals/CN	7440-41-7	No	890	No SL	NA	Yes
Cadmium	Metals/CN	7440-43-9	No	8000	5000	NOAA ER-L 1990	Yes
Calcium	Metals/CN	7440-70-2	No	6570000	Nutrient	NA	No
Chromium	Metals/CN	7440-47-3	No	99400	80000	NOAA ER-L 1990	Yes
Cobalt	Metals/CN	7440-48-4	No	12800	No SL	NA	Yes
Copper	Metals/CN	7440-50-8	No	136000	70000	NOAA ER-L 1990	Yes
Iron	Metals/CN	7439-89-6	No	19700000	21200000	LEL	No
Lead	Metals/CN	7439-92-1	No	1260000	35000	NOAA ER-L 1990	Yes
Magnesium	Metals/CN	7439-95-4	No	12400000	Nutrient	NA	No
Manganese	Metals/CN	7439-96-5	No	1010000	460000	LEL	Yes
Mercury	Metals/CN	7439-97-6	No	670	150	NOAA ER-L 1990	Yes
Nickel	Metals/CN	7440-02-0	No	57900	30000	NOAA ER-L 1990	Yes
Potassium	Metals/CN	7440-09-7	No	667000	Nutrient	NA	No
Selenium	Metals/CN	7782-49-2	No	1300	No SL	NA	Yes
Silver	Metals/CN	7440-22-4	No	1900	1000	NOAA ER-L 1990	Yes
Sodium	Metals/CN	7440-23-5	No	394000	Nutrient	NA	No
Thallium	Metals/CN	7440-28-0	No	140	No SL	NA	Yes
Vanadium	Metals/CN	7440-62-2	No	84600	No SL	NA	Yes
Zinc	Metals/CN	7440-66-6	No	477000	120000	NOAA ER-L 1990	Yes
1,2-Dichlorobenzene	SVOCs	95-50-1	No	59	3060	SQB	No
1,4-Dichlorobenzene	SVOCs	106-46-7	No	54	3150	SQB	No
2,4-Dimethylphenol	SVOCs	105-67-9	No	120	No SL	NA	Yes
2-Methylnaphthalene	SVOCs	91-57-6	No	250	65	NOAA ER-L 1990	Yes
4-Methylphenol	SVOCs	106-44-5	No	550	No SL	NA	Yes
Acenaphthene	SVOCs	83-32-9	No	230	150	NOAA ER-L 1990	Yes
Acenaphthylene	SVOCs	208-96-8	No	900	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	930	85	NOAA ER-L 1990	Yes
Benzo[a]anthracene	SVOCs	56-55-3	No	2800	230	NOAA ER-L 1990	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	2600	400	NOAA ER-L 1990	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	3900	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	520	170	LEL	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	3900	240	LEL	Yes
Benzoic acid	SVOCs	65-85-0	No	1600	No SL	NA	Yes
Benzyl alcohol	SVOCs	100-51-6	No	100	9.9	SCV	Yes
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	3000	182	TEL	Yes
Butylbenzylphthalate	SVOCs	85-68-7	No	650	99000	SQB	No
Carbazole	SVOCs	86-74-8	No	280	No SL	NA	Yes
Chrysene	SVOCs	218-01-9	No	3100	400	NOAA ER-L 1990	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	200	60	NOAA ER-L 1990	Yes
Dibenzofuran	SVOCs	132-64-9	No	160	18000	SQB	No
Di-n-butylphthalate	SVOCs	84-74-2	No	72	99000	SQB	No
Fluoranthene	SVOCs	206-44-0	No	5100	600	NOAA ER-L 1990	Yes
Fluorene	SVOCs	86-73-7	No	360	35	NOAA ER-L 1990	Yes
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	590	200	LEL	Yes
Naphthalene	SVOCs	91-20-3	No	760	340	NOAA ER-L 1990	Yes
Phenanthrene	SVOCs	85-01-8	No	2700	225	NOAA ER-L 1990	Yes
Phenol	SVOCs	108-95-2	No	110	279	NAWQC chronic	No
Pyrene	SVOCs	129-00-0	No	5200	350	NOAA ER-L 1990	Yes
2-Butanone (MEK)	VOCs	78-93-3	No	68	2430	SCV	No
Acetone	VOCs	67-64-1	No	440	78.3	SCV	Yes
Carbon disulfide	VOCs	75-15-0	No	8.2	7.65	SCV	Yes
Methyl tert-butyl ether (MTBE)	VOCs	1634-04-4	No	2.7	No SL	NA	Yes
Toluene	VOCs	108-88-3	No	4.5	6030	SQB	No

Notes:
NA = Not Available
NOAA ER-L 1990 = the National Oceanic and Atmospheric Administration (NOAA) effects range-low (ER-L) threshold
LEL = lowest effect level indicating a level of sediment contamination at which the majority of benthic organisms are unaffected.
TEL = threshold effect level derived in MacDonald (1994) and cited in Jones et al. (1997)
SQB = the EPA sediment quality benchmark derived from an EPA Tier II chronic value, assuming one percent total organic carbon
SCV = Equilibrium partitioning-derived benchmark based on Secondary Chronic Value water quality criteria (Jones et al., 1997).
NAWQC chronic = Equilibrium partitioning-derived benchmark based on chronic National Ambient Water Quality Criteria (Jones et al., 1997).

Table 2-7
On-Site Soil COPEC Screening
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum soil concentration (ug/kg)	Ecological soil screening level (ug/kg)	Source of ecological soil screening level	COPEC?
Aluminum	Metals/CN	7429-90-5	No	12200000	3825	ORNL mammal	Yes
Antimony	Metals/CN	7440-36-0	No	15000	248	ORNL mammal	Yes
Arsenic	Metals/CN	7440-38-2	No	106000	250	ORNL mammal	Yes
Barium	Metals/CN	7440-39-3	No	1320000	17200	ORNL avian	Yes
Beryllium	Metals/CN	7440-41-7	No	870	2420	ORNL mammal	No
Cadmium	Metals/CN	7440-43-9	No	4000	1200	ORNL avian	Yes
Calcium	Metals/CN	7440-70-2	No	45800000	Nutrient	NA	No
Chromium	Metals/CN	7440-47-3	No	58000	400	ORNL earthworm	Yes
Cobalt	Metals/CN	7440-48-4	No	501000	20000	ORNL phyto	Yes
Copper	Metals/CN	7440-50-8	No	1110000	38900	ORNL avian	Yes
Cyanide (weak acid dissociable)	Metals/CN	WAD CN	No	3200	236500	ORNL mammal	No
Iron	Metals/CN	7439-89-6	No	135000000	No SL	NA	Yes
Lead	Metals/CN	7439-92-1	No	5850000	940	ORNL avian	Yes
Magnesium	Metals/CN	7439-95-4	No	12500000	Nutrient	NA	No
Manganese	Metals/CN	7439-96-5	No	723000	322000	ORNL mammal	Yes
Mercury	Metals/CN	7439-97-6	No	14000	100	ORNL earthworm	Yes
Nickel	Metals/CN	7440-02-0	No	98700	30000	ORNL phyto	Yes
Potassium	Metals/CN	7440-09-7	No	908000	Nutrient	NA	No
Selenium	Metals/CN	7782-49-2	No	1700	331	ORNL avian	Yes
Silver	Metals/CN	7440-22-4	Yes	15000	2000	ORNL phyto	No
Sodium	Metals/CN	7440-23-5	No	1180000	Nutrient	NA	No
Thallium	Metals/CN	7440-28-0	No	1500	27	ORNL mammal	Yes
Vanadium	Metals/CN	7440-62-2	No	199000	714	ORNL mammal	Yes
Zinc	Metals/CN	7440-66-6	No	5410000	12000	ORNL avian	Yes
1,2-Dichlorobenzene	SVOCs	95-50-1	Yes	54	No SL	NA	No
1,4-Dichlorobenzene	SVOCs	106-46-7	Yes	69	20000	ORNL earthworm	No
2,4-Dimethylphenol	SVOCs	105-67-9	Yes	370	No SL	NA	No
2-Methylnaphthalene	SVOCs	91-57-6	No	31000	No SL	NA	Yes
2-Methylphenol	SVOCs	95-48-7	Yes	160	1043900	ORNL mammal	No
4-Methylphenol	SVOCs	106-44-5	No	9200	No SL	NA	Yes
Acenaphthene	SVOCs	83-32-9	No	25000	20000	ORNL phyto	Yes
Acenaphthylene	SVOCs	208-96-8	No	12000	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	40000	No SL	NA	Yes
Benzo[a]anthracene	SVOCs	56-55-3	No	39000	No SL	NA	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	35000	1980	ORNL mammal	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	39000	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	11000	No SL	NA	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	23000	No SL	NA	Yes
Benzoic acid	SVOCs	65-85-0	No	4600	No SL	NA	Yes
Benzyl alcohol	SVOCs	100-51-6	Yes	48	No SL	NA	No
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	460	910	ORNL avian	No
Butylbenzylphthalate	SVOCs	85-68-7	No	4200	No SL	NA	Yes
Carbazole	SVOCs	86-74-8	No	23000	No SL	NA	Yes
Chrysene	SVOCs	218-01-9	No	39000	No SL	NA	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	3500	No SL	NA	Yes
Dibenzofuran	SVOCs	132-64-9	No	28000	No SL	NA	Yes
Diethylphthalate	SVOCs	84-66-2	Yes	82	100000	ORNL phyto	No
Di-n-butylphthalate	SVOCs	84-74-2	Yes	350	90	ORNL avian	No
Fluoranthene	SVOCs	206-44-0	No	110000	No SL	NA	Yes
Fluorene	SVOCs	86-73-7	No	35000	30000	ORNL earthworm	Yes
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	13000	No SL	NA	Yes
Isophorone	SVOCs	78-59-1	Yes	93	No SL	NA	No
Naphthalene	SVOCs	91-20-3	No	82000	No SL	NA	Yes
Pentachlorophenol	SVOCs	87-86-5	Yes	68	3000	ORNL phyto	No
Phenanthrene	SVOCs	85-01-8	No	140000	No SL	NA	Yes
Phenol	SVOCs	108-95-2	Yes	310	30000	ORNL earthworm	No
Pyrene	SVOCs	129-00-0	No	85000	No SL	NA	Yes
4,4'-DDD	Pesticides	72-54-8	No	7.5	2	ORNL avian	Yes
4,4'-DDE	Pesticides	72-55-9	No	8.9	2	ORNL avian	Yes
4,4'-DDT	Pesticides	50-29-3	No	13	2	ORNL avian	Yes
alpha-chlordane	Pesticides	5103-71-9	No	2.2	1800	ORNL avian	Yes
delta-BHC	Pesticides	319-86-8	No	22	No SL	NA	Yes
Dieldrin	Pesticides	60-57-1	No	27	64	ORNL avian	Yes
endosulfan sulfate	Pesticides	1031-07-8	No	4	550	ORNL mammal	Yes

Table 2-7
On-Site Soil COPEC Screening
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum soil concentration (ug/kg)	Ecological soil screening level (ug/kg)	Source of ecological soil screening level	COPEC?
endrin ketone	Pesticides	53494-70-5	No	8.9	No SL	NA	Yes
gamma-BHC	Pesticides	58-89-9	Yes	4.2	1660	ORNL avian	No
gamma-chlordane	Pesticides	5103-74-2	No	5.6	1800	ORNL avian	Yes
heptachlor	Pesticides	76-44-8	No	0.91	476	ORNL mammal	Yes
Heptachlor epoxide (B)	Pesticides	1024-57-3	No	4.8	No SL	NA	Yes
Aroclor 1260	PCBs	11096-82-5	No	28	40000	ORNL phyto	Yes
C5-C8 Aliphatic Hydrocarbons	VPH	VPH C5-8	Yes	23000	No SL	NA	No
C9-C10 Aromatic Hydrocarbons	VPH	VPH C9-10	No	14000	No SL	NA	Yes
C9-C12 Aliphatic Hydrocarbons	VPH	VPH C9-12	No	36000	No SL	NA	Yes
C11-C22 Aromatic Hydrocarbons	EPH	EPH C11-22	No	190000	No SL	NA	Yes
C19-C36 Aliphatic Hydrocarbons	EPH	EPH C19-36	No	290000	No SL	NA	Yes
C9-C18 Aliphatic Hydrocarbons	EPH	EPH C9-18	No	210000	No SL	NA	Yes
1,1,1-Trichloroethane	VOCs	71-55-6	Yes	5.1	2060000	ORNL mammal	No
2-Butanone (MEK)	VOCs	78-93-3	No	17	6487000	ORNL mammal	No
Acetone	VOCs	67-64-1	No	150	36600	ORNL mammal	No
Benzene	VOCs	71-43-2	No	9.4	52200	ORNL mammal	No
Carbon disulfide	VOCs	75-15-0	No	13	No SL	NA	Yes
Chloroform	VOCs	67-66-3	Yes	1.3	55000	ORNL mammal	No
cis-1,2-Dichloroethene	VOCs	156-59-2	Yes	64	No SL	NA	No
Ethylbenzene	VOCs	100-41-4	Yes	7.6	No SL	NA	No
m/p-Xylene	VOCs	108-38-3 106-42-3	No	100	4162	ORNL mammal	No
Methylene chloride	VOCs	75-09-2	Yes	42	21400	ORNL mammal	No
o-Xylene	VOCs	95-47-6	No	57	No SL	NA	Yes
Styrene	VOCs	100-42-5	Yes	1.5	300000	ORNL phyto	No
Toluene	VOCs	108-88-3	No	160	51500	ORNL mammal	No
Trichloroethene	VOCs	79-01-6	Yes	4500	1387	ORNL mammal	No
Trichlorofluoromethane	VOCs	75-69-4	No	200	No SL	NA	Yes

Notes:
ORNL phyto = Benchmark for terrestrial plants from Efroymson et al. 1997a.
ORNL earthworm = Benchmark for earthworms from Efroymson et al. 1997b.
ORNL avian = NOAEL-based benchmark for food ingestion for the robin from Sample et al. 1996.
ORNL mammal = NOAEL-based benchmark for food ingestion for the short-tailed shrew from Sample et al. 1996.

Table 2-8
Soil COPEC Screening - Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Analyte	Class	CAS	Detection frequency <5%?	Maximum soil concentration (ug/kg)	Ecological soil screening level (ug/kg)	Source of ecological soil screening level	COPEC?
Aluminum	Metals/CN	7429-90-5	No	10400000	3825	ORNL mammal	Yes
Antimony	Metals/CN	7440-36-0	No	6700	248	ORNL mammal	Yes
Arsenic	Metals/CN	7440-38-2	No	28300	250	ORNL mammal	Yes
Barium	Metals/CN	7440-39-3	No	156000	17200	ORNL avian	Yes
Beryllium	Metals/CN	7440-41-7	No	420	2420	ORNL mammal	No
Cadmium	Metals/CN	7440-43-9	No	2800	1200	ORNL avian	Yes
Calcium	Metals/CN	7440-70-2	No	7240000	Nutrient	NA	No
Chromium	Metals/CN	7440-47-3	No	96800	400	ORNL earthworm	Yes
Cobalt	Metals/CN	7440-48-4	No	6000	20000	ORNL phyto	No
Copper	Metals/CN	7440-50-8	No	163000	38900	ORNL avian	Yes
Iron	Metals/CN	7439-89-6	No	46800000	No SL	NA	Yes
Lead	Metals/CN	7439-92-1	No	730000	940	ORNL avian	Yes
Magnesium	Metals/CN	7439-95-4	No	7780000	Nutrient	NA	No
Manganese	Metals/CN	7439-96-5	No	965000	322000	ORNL mammal	Yes
Mercury	Metals/CN	7439-97-6	No	1400	100	ORNL earthworm	Yes
Nickel	Metals/CN	7440-02-0	No	165000	30000	ORNL phyto	Yes
Potassium	Metals/CN	7440-09-7	No	692000	Nutrient	NA	No
Selenium	Metals/CN	7782-49-2	No	1500	331	ORNL avian	Yes
Sodium	Metals/CN	7440-23-5	No	249000	Nutrient	NA	No
Thallium	Metals/CN	7440-28-0	No	150	27	ORNL mammal	Yes
Vanadium	Metals/CN	7440-62-2	No	48600	714	ORNL mammal	Yes
Zinc	Metals/CN	7440-66-6	No	460000	12000	ORNL avian	Yes
1,2-Dichlorobenzene	SVOCs	95-50-1	No	40	No SL	NA	Yes
2-Methylnaphthalene	SVOCs	91-57-6	No	1100	No SL	NA	Yes
4-Methylphenol	SVOCs	106-44-5	No	93	No SL	NA	Yes
4-Nitrophenol	SVOCs	100-02-7	No	49	7000	ORNL earthworm	No
Acenaphthene	SVOCs	83-32-9	No	1300	20000	ORNL phyto	No
Acenaphthylene	SVOCs	208-96-8	No	250	No SL	NA	Yes
Anthracene	SVOCs	120-12-7	No	1500	No SL	NA	Yes
Benzo[a]anthracene	SVOCs	56-55-3	No	3600	No SL	NA	Yes
Benzo[a]pyrene	SVOCs	50-32-8	No	2700	1980	ORNL mammal	Yes
Benzo[b]fluoranthene	SVOCs	205-99-2	No	3200	No SL	NA	Yes
Benzo[g,h,i]perylene	SVOCs	191-24-2	No	660	No SL	NA	Yes
Benzo[k]fluoranthene	SVOCs	207-08-9	No	1800	No SL	NA	Yes
Benzoic acid	SVOCs	65-85-0	No	830	No SL	NA	Yes
bis(2-Ethylhexyl)phthalate	SVOCs	117-81-7	No	210	910	ORNL avian	No
Butylbenzylphthalate	SVOCs	85-68-7	No	37	No SL	NA	Yes
Carbazole	SVOCs	86-74-8	No	1200	No SL	NA	Yes
Chrysene	SVOCs	218-01-9	No	3400	No SL	NA	Yes
Dibenz[a,h]anthracene	SVOCs	53-70-3	No	160	No SL	NA	Yes
Dibenzofuran	SVOCs	132-64-9	No	680	No SL	NA	Yes
Fluoranthene	SVOCs	206-44-0	No	10000	No SL	NA	Yes
Fluorene	SVOCs	86-73-7	No	970	30000	ORNL earthworm	No
Indeno[1,2,3-cd]pyrene	SVOCs	193-39-5	No	720	No SL	NA	Yes
Naphthalene	SVOCs	91-20-3	No	1100	No SL	NA	Yes
Phenanthrene	SVOCs	85-01-8	No	11000	No SL	NA	Yes
Pyrene	SVOCs	129-00-0	No	9200	No SL	NA	Yes
Acetone	VOCs	67-64-1	No	73	36600	ORNL mammal	No
Chloroform	VOCs	67-66-3	No	1	55000	ORNL mammal	No

Notes:
ORNL phyto = Benchmark for terrestrial plants from Efroymson et al. 1997a.
ORNL earthworm = Benchmark for earthworms from Efroymson et al. 1997b.
ORNL avian = NOAEL-based benchmark for food ingestion for the robin from Sample et al. 1996.
ORNL mammal = NOAEL-based benchmark for food ingestion for the short-tailed shrew from Sample et al. 1996.

FIGURES

Appendix B-1
Fish Habitat Survey

June 2003

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

An Assessment of the Potential Fish Communities Present Near the Blackburn & Union Privileges Superfund Site, Walpole, MA

By
Philip C. Downey, Ph.D.
Aquatec Biological Sciences, Inc.

1.0 Introduction

As part of a Remedial Investigation (RI) at the Blackburn and Union Privileges Superfund Site (Site) in Walpole, Massachusetts (Site), an assessment of the fisheries habitat was conducted to identify what fish species may be present in the vicinity of the Site. This assessment is intended to support the ecological and human health risk assessments for the Site.

On November 21, 2002, Philip C. Downey, Aquatec Biological Sciences, Inc. (Aquatec), Ms. Nikki Roy, Sanborn Head & Associates, Inc. (SHA), and Messrs Nathan Henderson and David Ceppetelli, Metcalf and Eddy, Inc. (M&E), visited three areas in the vicinity of the Site to assess fisheries habitat and potential fish utilization of these areas. These three areas were: the former mill tailrace (located on the Site); the Neponset River adjacent to the Site (extending from the downstream end of the culvert to approximately 50 meters downstream of the confluence of the former mill tailrace); and Lewis Pond, an impounded stretch of the Neponset River, located less than one mile downstream of the former mill tailrace, as depicted in Figure 1.

1.1 Background

In 1999, the Massachusetts Department of Environmental Protection (MADEP) conducted a biological assessment of the Boston Harbor Watershed which included the Neponset River Sub-basin (Fiorentino, 2000). A checklist of fishes collected and identified during MADEP study is presented in Table 1.

In the sampled East Branch segment of the Neponset River, Fiorentino observed minnows (spottail shiner and fallfish), bullhead, eels and a variety of members of the Centrarchidae family including bass, pumpkinseed, bluegill, redbreasted sunfish, and black crappie, suggesting a lentic fish community in this segment of the River. He attributed the fish species composition to the presence of impoundments both above and below the sampling station.

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Of the twelve stations sampled by Fiorentino (2000), only three stations (Mill Brook, Traphole Brook, and Beaver Brook) yielded trout (brook and brown trout) (Figure 2). These three stations represented the smallest stream segments sampled in his study. Each station had an average drainage area of only 2.5 square miles which is significantly smaller than the Neponset River drainage area near the Site. The observation that trout were found only in smaller 'headwater' streams and not routinely in the main stem of the Neponset is not unexpected. The Neponset River segment (segment MA73-01) from the outlet of Neponset Reservoir to the confluence with East Branch, Canton, is classified as Class B Warm Water Fishery (O'Brien et al. 2002). The temperature standard for Class B Warm Water Fishery is listed as water temperature less than 28.3 °C (O'Brien et al. 2002). Trout generally require temperatures less than 20 °C to thrive.

On November 21, 2002, Aquatec evaluated three regions of MA73-01 as part of a habitat survey assessing potential target fish communities present and at risk from Site contaminants. One region, the former mill tailrace originates at the Site and ends at the Neponset River. The other two regions, the Neponset River adjacent to the Site and Lewis Pond, are part of the Neponset River in the MA73-01 segment. The fisheries habitat in these three regions are discussed individually below.

2.0 Former Mill Tailrace:

During the fish habitat survey performed on November 21, 2002, the on-Site former mill tailrace was almost devoid of water in upper reaches, from the concrete diversion east to the Area of Containment (AOC). The only area where standing water was observed was a small pool (approximately 1-2" deep) immediately above the concrete diversion. Although standing water was observed during the November 21, 2002 site visit, SHA's reported observations during the Phase 1A RI indicate that this segment of the tailrace is virtually dry during most of the year. Additionally, heavy rains had occurred several days prior to the Site visit, likely resulting in the anomalously high water levels in this reach of the former mill tailrace. The bottom of this small pool of standing water was covered with leaves and other decaying vegetation. This upstream reach of the tailrace had virtually no quality fisheries habitat. Although it is possible that a few hearty fish (such as bullhead) could potentially survive in this reach, there was little viable fish habitat east of the concrete diversion; therefore, it is unlikely that fish permanently reside in this reach of the former mill tailrace.

The reach of former mill tailrace downstream (west) of the concrete diversion, is about 30-40 meters in length. About two-thirds of this reach from the diversion to the confluence with the Neponset River was essentially dry on November 21, 2002 and was filled in with leaves and other organic material. The last third of the former mill tailrace (in essence, the confluence of the tailrace with the Neponset River) was relatively shallow (inches deep) and slow flowing. It is possible that this area could

provide a limited refuge for adult fish, juvenile fish, and smaller resident species of fish (such as minnows and darters) that might inhabit the adjacent segment of the Neponset River (see discussion below).

Overall, it appears that the former mill tailrace provides little habitat for supporting a permanent resident fish population.

3.0 Neponset River Adjacent to the Site and Downstream of the Former Mill Tailrace.

The following discussion relates to the region of the Neponset River extending from the downstream end of the aluminum culvert for South Street to approximately 50 meters downstream of its confluence with the former mill tailrace (see Figure 1). In order to better describe the stream morphology and fish habitat, this section of the Neponset River has been divided into two subsections, hereafter referred to as the "upstream reach" of the Neponset River and the "downstream reach" of the Neponset River.

The terms upstream and downstream are intended to indicate the position of these two subsections relative to the confluence of the former mill tailrace and the Neponset River. The area designated as the 'upstream reach' of the Neponset River is defined as the span of the Neponset River that extends from the downstream end of the aluminum culvert to approximately 50 meters (m) upstream of the confluence of the former mill tailrace with the Neponset River.

The term 'downstream reach' of the Neponset River refers to the span of the Neponset River that extends from approximately 50 m upstream and downstream from the confluence of the former mill tailrace with the Neponset River. Figure 1 depicts the approximate locations of these sections of the Neponset River. The downstream reach of the Neponset River contains moderate quality fish habitat. Epifaunal substrate consisted of a number of riffles with an abundance of cobbles and some boulders. The percentage of pool to riffle ratio provides moderate rearing habitat for supporting fish populations of fish adapted to fast shallow and fast shallow riffle/runs. The riparian cover is fairly intact with a mix of mature deciduous trees with little bank side vegetation.

Residential properties border both sides of this segment, with only a thin band of streamside stable (tree) vegetation present. There was some evidence of erosion observed, particularly where access from residential properties may be occurring. It appeared that there was a moderately high level of sediment deposition indicated by the presence of a small sandbar (although it was difficult to assess because of the higher than average river flows due to recent rains).

The upstream reach was similar to the quality of fish habitat present in the downstream reach of the Neponset River; however, due to less bank side development, the riparian vegetative habitat appeared more stable.

Based upon the initial habitat assessment, it is likely that the fish community in the Neponset River adjacent to the Site (within the downstream and upstream reaches), may include minnows, darters, and possibly suckers. Other riverine fish, particularly salmonids (brook and brown trout), would not likely be found in great abundance, if at all. Since this section of the Neponset River is downstream of an impoundment (Blackburn Pond), more lentic (pond-like) species, perches, pickerel and particularly individuals of the Centrarchidae family (sunfishes, bass and crappie) may be present on a temporary and periodic basis within the Neponset River; however, these lentic species are not likely to be present on a year round permanent basis.

4.0 Lewis Pond:

The segment of the Neponset River referred to as Lewis Pond consists of an impounded area that is regulated by a small dam at West Street. The habitat in Lewis Pond provides poor fish habitat. This habitat was characterized as a depositional area with soft sediment deposit blanketing the substrate. Aquatic emergent vegetation was observed and could provide some limited additional fish habitat if routinely submerged.

Lewis Pond was characteristic of a small impoundment during the November visit. However, SHA personnel had indicated that lower flows associated with the summer and early fall, reduce Lewis Pond to a small, slow-flowing channel several feet deep. The banks of this 'channel', which were not visible in November, are likely to be characterized by exposed flat soft organic rich sediments rather than the small impoundment observed. The riparian habitat and bank-side vegetation provided poor fish habitat with a large asphalt-paved parking lot immediately adjacent to the Pond.

Based on the habitat observed, the description of pond conditions during the summer months, and the considerable pond-side urban development, it is expected that Lewis Pond supports a more limited 'pollution tolerant' fish community. Sparse populations of bullheads, redfin pickerel, sunfishes (including perhaps even an occasional largemouth bass) and minnows such as golden shiners would likely be the predominant species encountered. More riverine species would not routinely inhabit this area, but may be present incidentally.

5.0 Summary:

Fiorentino (2000) found a warm water fishery at many of stations sampled throughout the Neponset River. In smaller 'headwater' stations trout were encountered but none of the larger river stations yielded trout. Based on water quality considerations, the

MA73-01 segment of the Neponset River (which includes the three regions evaluated by Aquatec for the Phase 1B RI) is classified by MADEP as a Class B Warm Water Fishery. This segment of the Neponset River is not stocked with trout suggesting a high probability that a warm water fish community would be present in the three target regions.

The upper tailrace segment offers no significant fish habitat. The portion of the former mill tailrace in the vicinity of its confluence with the Neponset River, may provide limited habitat for smaller fish found in the adjacent Neponset River segment. . The area above the concrete diversion, and most of the tailrace downstream from the diversion, is not likely to support resident fish populations due to the lack of suitable habitat.

The Neponset River segment in proximity to the Site may provide adequate habitat for a warm water fish community predominantly consisting of smaller minnows, darters, and suckers. Although the available habitat may be suitable for smallmouth bass, previous studies by MADEP do not find this species in abundance. The Lepomis spp. Might be occasionally present, but probably are not year round resident species adjacent to the site. The Neponset River is managed as a warm water fishery due to summer water temperatures and other water quality limitations. These lower water quality standards suggest that this segment of the River may not support significant naturally occurring resident trout species. Based upon the available information, this segment of the Neponset River is not expected to have an abundance of game fish targeted by humans for consumption.

Lewis Pond provides poor fish habitat but may support limited 'pollution tolerant' fish species such as bullheads, sunfish, and some minnow species.

Based upon MADEP's sampling results and Aquatec's November fish habitat assessment, we anticipate that a warm water fish community may be present in the Neponset River adjacent to the Site, in Lewis Pond and to a greatly limited extent in the confluence of the tailrace with the Neponset River. Predominant species potentially present would likely include minnows, suckers, and other smaller non-game forage fish. It is unlikely that significant numbers of game fish species inhabit these three regions; it also unlikely that these regions support a sustenance fishery for food consumption. A fisheries study is planned for the summer of 2003 to document the fish communities in these locations and capture, available species for risk assessment.

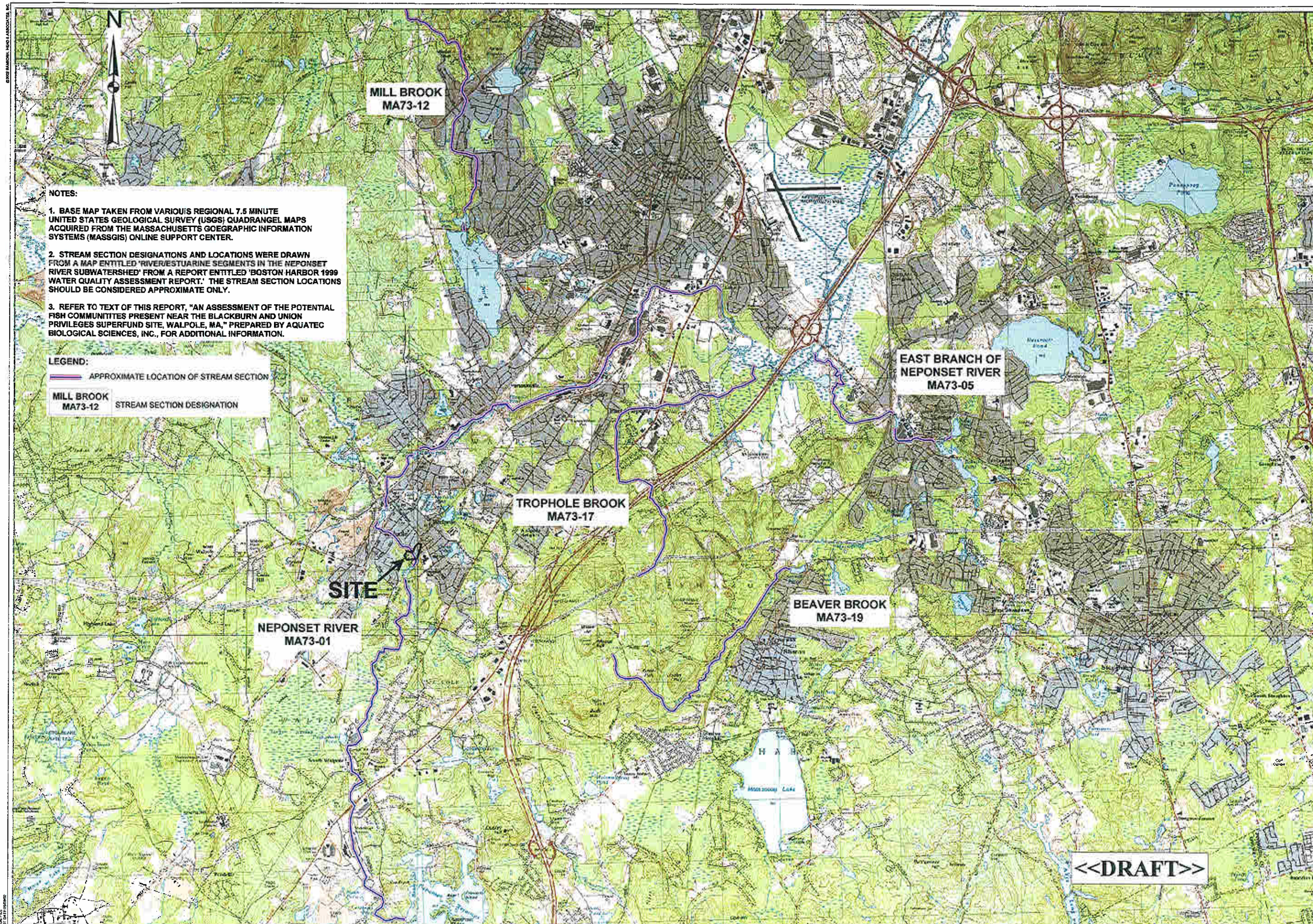
6.0 Literature Cited:

Fiorentino, John. 2000. Boston Harbor Watershed 1999 Biological Assessment. Technical Memorandum, Dept. of Environmental Protection, Division of Watershed Management, Worcester, MA.

O'Brien, Katie, Mollie Weinstein, and Richard McVoy, PhD. October 2002. Boston Harbor 1999 Water Quality Assessment Report. Report Number: 70-AC-1 DWM Control Number: 49.0, Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, Massachusetts.

Table 1. A checklist of fish collected from the Neponset River Sub-basin. Source of data are from Table A7 in Fiorentino (2000).

Family Taxon	Common Name
Salmonidae	Salmon and Trouts
Salmo trutta	brown trout
Salvelinus fontinalis	brook trout
Cyprinidae	Minnows
Notropis hudsonius	spottail shiner
Semotilus corporalis	fallfish
Catostomidae	Suckers
Catostomus commersoni	white sucker
Percidae	Perches
Perca flavescens	yellow perch
Etheostoma olmstedi	tessellated darter
Ictaluridae	Bullheads
Ameiurus natalis	yellow bullhead
Ameiurus nebulosus	brown bullhead
Anguillidae	Eels
Anguilla rostrata	American eel
Esocidae	Pikes
Esox niger	chain pickerel
Esox americanus	redfin pickerel
Centrarchidae	Sunfishes
Micropterus salmoides	largemouth bass
Lepomis macrochirus	bluegill
Lepomis gibbosus	pumpkinseed
Lepomis auritis	redbreasted sunfish
Pomoxis nigromaculatus	black crappie



NOTES:

1. BASE MAP TAKEN FROM VARIOUS REGIONAL 7.5 MINUTE UNITED STATES GEOLOGICAL SURVEY (USGS) QUADRANGEL MAPS ACQUIRED FROM THE MASSACHUSETTS GOEGRAPHIC INFORMATION SYSTEMS (MASSGIS) ONLINE SUPPORT CENTER.

2. STREAM SECTION DESIGNATIONS AND LOCATIONS WERE DRAWN FROM A MAP ENTITLED 'RIVER/ESTUARINE SEGMENTS IN THE *NEPONSET* RIVER SUBWATERSHED' FROM A REPORT ENTITLED 'BOSTON HARBOR 1999 WATER QUALITY ASSESSMENT REPORT.' THE STREAM SECTION LOCATIONS SHOULD BE CONSIDERED APPROXIMATE ONLY.

3. REFER TO TEXT OF THIS REPORT, "AN ASSESSMENT OF THE POTENTIAL FISH COMMUNITITES PRESENT NEAR THE BLACKBURN AND UNION PRIVILEGES SUPERFUND SITE, WALPOLE, MA," PREPARED BY AQUATEC BIOLOGICAL SCIENCES, INC., FOR ADDITIONAL INFORMATION.

LEGEND:

APPROXIMATE LOCATION OF STREAM SECTION

MILL BROOK MA73-12 — STREAM SECTION DESIGNATION

GRAPHICAL SCALE

2,500 0 2,500 5,000 7,500 Feet

NO.	DATE	DESCRIPTION	BY

AQUATEC BIOLOGICAL SCIENCES, INC.
AND SANBORN, HEAD & ASSOCIATES, INC.

DRAWN BY: SJR
DESIGNED BY: SJR
CHECKED BY: BAG
REVIEWED BY: CLH
PROJECT MGR: CLH
PIC: PMB
DATE: JUN 03

AN ASSESSMENT OF THE POTENTIAL FISH COMMUNITIES PRESENT NEAR THE BLACKBURN & UNION PRIVILEGES SUPERFUND SITE

BLACKBURN & UNION PRIVILEGES SUPERFUND SITE
WALPOLE, MASSACHUSETTS

REFERENCED STREAM SEGMENTS IN THE NEPONSET RIVER WATERSHED

PROJECT NUMBER : 2032

FIGURE NUMBER : 1

Notes:

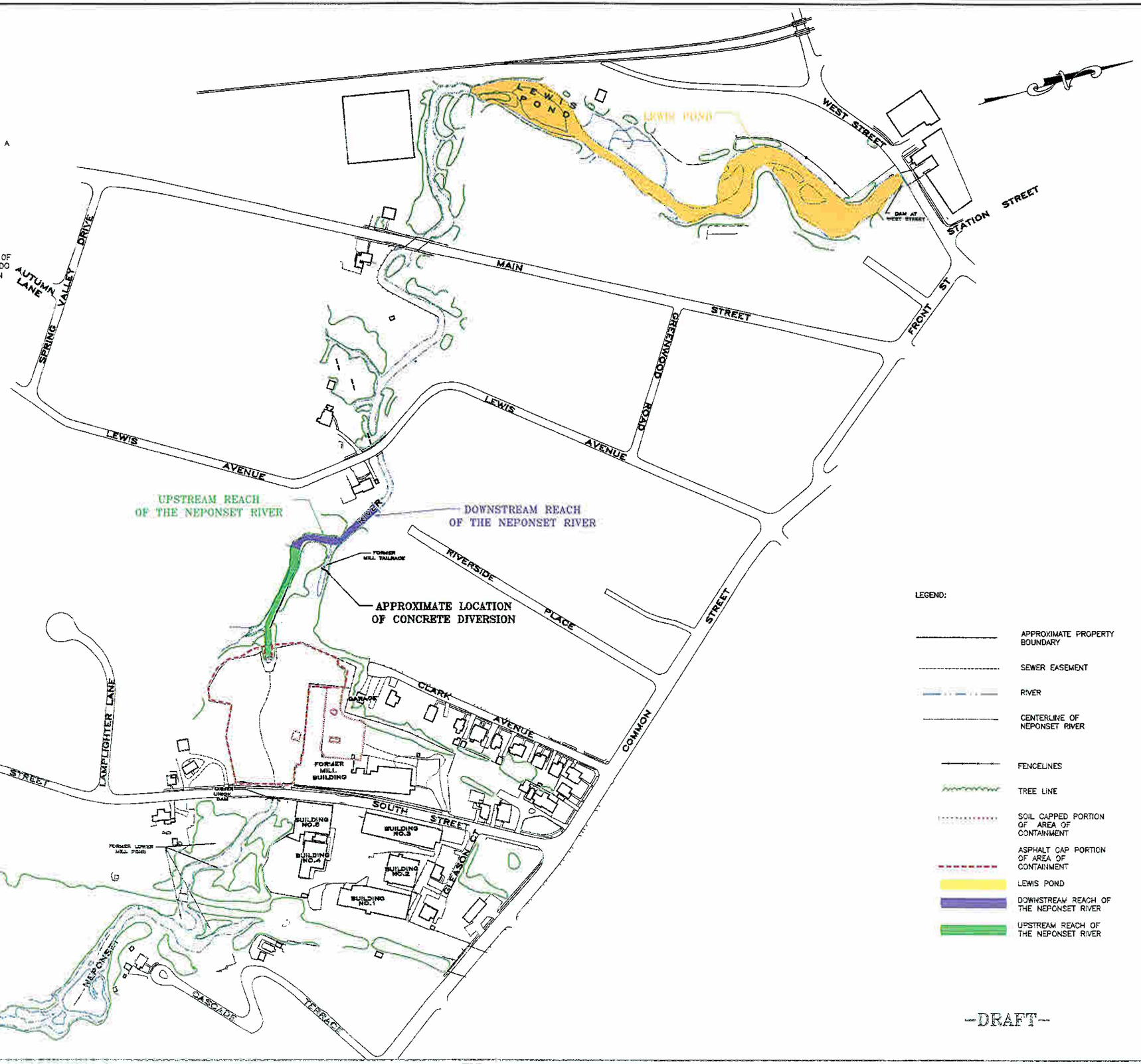
1. THE BASE MAP WAS DRAWN FROM A PLAN ELECTRONICALLY TRANSMITTED TO SANBORN, HEAD AND ASSOCIATES, INC. (SHA), PREPARED BY BRYANT ASSOCIATES, INC. (BRYANT) OF BOSTON, MASSACHUSETTS ON SEPTEMBER 16, 2001.

2. AERIAL MAPPING PROVIDED BY COL-EAST, INC. OF NORTH ADAMS, MASSACHUSETTS FOR BRYANT WITH PHOTO CONTROL PROVIDED BY BRYANT WITH ADDITIONAL INFORMATION OBTAINED FROM THE TOWN OF WALPOLE ASSESSOR'S MAP NO. 33.

3. INFORMATION ON SELECT PROPERTY LINES PROVIDED BY BRYANT ON A PLAN ELECTRONICALLY TRANSMITTED TO SHA ON AUGUST 8, 2001. PROPERTY LINES SHOWN ARE BASED ON-THE-GROUND SURVEY AND RECORD RESEARCH BY BRYANT.

4. THE DEFINITION OF THE SITE, INCLUDING PROPERTIES IDENTIFIED AS ON- AND OFF-FACILITY IS BASED ON THE ADMINISTRATIVE ORDER BY CONSENT FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) DOCKET NO. 1-99-0027, EFFECTIVE OCTOBER 4, 1999 (ORDER). TAX MAP PARCEL NUMBERS HAVE BEEN RE-ISSUED BY THE TOWN OF WALPOLE; THEREFORE, CURRENT TAX MAP PARCEL NUMBERS (OBTAINED FROM AN UNDATED TOWN OF WALPOLE ASSESSORS MAP [NO. 33]) ARE DEPICTED ON THIS AND SUBSEQUENT FIGURES AND ARE DISCUSSED IN THE TEXT OF THIS REPORT. IT SHOULD BE NOTED THAT THE LOT NUMBERS SHOWN DO NOT MATCH THOSE PROVIDED IN THE ORDER. TABLE G-1 (INCLUDED IN APPENDIX G OF THIS REPORT) PROVIDES A REFERENCE BETWEEN TAX MAPS REFERRED TO IN THE ORDER AND CURRENT TAX MAP PARCEL NUMBERS.

5. HORIZONTAL DATUM IS MASSACHUSETTS STATE PLANE COORDINATE SYSTEM (N.A.D. 1983) AND VERTICAL DATUM IS N.G.V.D. 1929.



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- SEWER EASEMENT
- RIVER
- CENTERLINE OF NEPONSET RIVER
- FENCELINES
- TREE LINE
- SOIL CAPPED PORTION OF AREA OF CONTAINMENT
- ASPHALT CAP PORTION OF AREA OF CONTAINMENT
- LEWIS POND
- DOWNSTREAM REACH OF THE NEPONSET RIVER
- UPSTREAM REACH OF THE NEPONSET RIVER

—DRAFT—

NO.	DATE	DESCRIPTION	BY

GRAPHICAL SCALE
150' 75' 0' 150' 300'

Aquatec Biological Sciences, Inc. and Sanborn, Head & Associates, Inc.

DRAWN BY: PGP
DESIGNED BY: SRN
CHECKED BY: BAG
REVIEWED BY: CLH
PROJECT MGR: CLH
PIC: PMS
DATE: JUN 03

INITIAL SITE CHARACTERIZATION REPORT
BLACKBURN & UNION PRIVILEGES SUPERFUND SITE
WALPOLE, MASSACHUSETTS

LOCATION OF ON-SITE SURFACE WATER FEATURES

PROJECT NUMBER: 2032

FIGURE NUMBER: 2

Appendix B-2
Natural Heritage and Endangered Species Program Letter

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

June 1, 2001

Lee E. Carbonneau
Normandeau Associates, Inc.
25 Nashua Road
Bedford, NH 03110-5500

Re: Blackburn & Union Privileges Superfund Site
Walpole, MA
NHESP File: 01-8987

Dear Mr. Carbonneau,

Thank you for contacting the Natural Heritage and Endangered Species Program for information regarding state-protected rare species in the vicinity of the site identified above.

At this time we are not aware of any rare plants or animals or exemplary natural communities in the area of this site.

This review concerns only rare species of plants and animals and ecologically significant natural communities for which the Program maintains site-specific records. This review does not rule out the possibility that more common wildlife or vegetation might be adversely affected if this site is developed, especially if it will modify currently undeveloped areas. Should site plans change, or new rare species information become available, this evaluation may be reconsidered.

Please call me at (508)792-7270 x.154 if you have any questions.

Sincerely,

Christine Vaccaro

Christine Vaccaro
Environmental Review Assistant

Natural Heritage & Endangered Species Program
Route 135, Westborough, MA 01581 **Tel:** (508) 792-7270 x 200 **Fax:** (508) 792-7275
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement

NORMANDEAU ASSOCIATES, INC.
25 Nashua Road
Bedford, NH 03110-5500
(603) 472-5191
(603) 472-7052 (Fax)

May 23, 2001

Ms. Hanni Dinkeloo, Endangered Species Counsel
Massachusetts Natural Heritage Inventory
Division of Fisheries and Wildlife
Route 135
Westborough, MA 01581

RE: Data Base Search – Vicinity of the Blackburn & Union Privileges Superfund Site, Walpole, MA

Dear Ms. Dinkeloo:

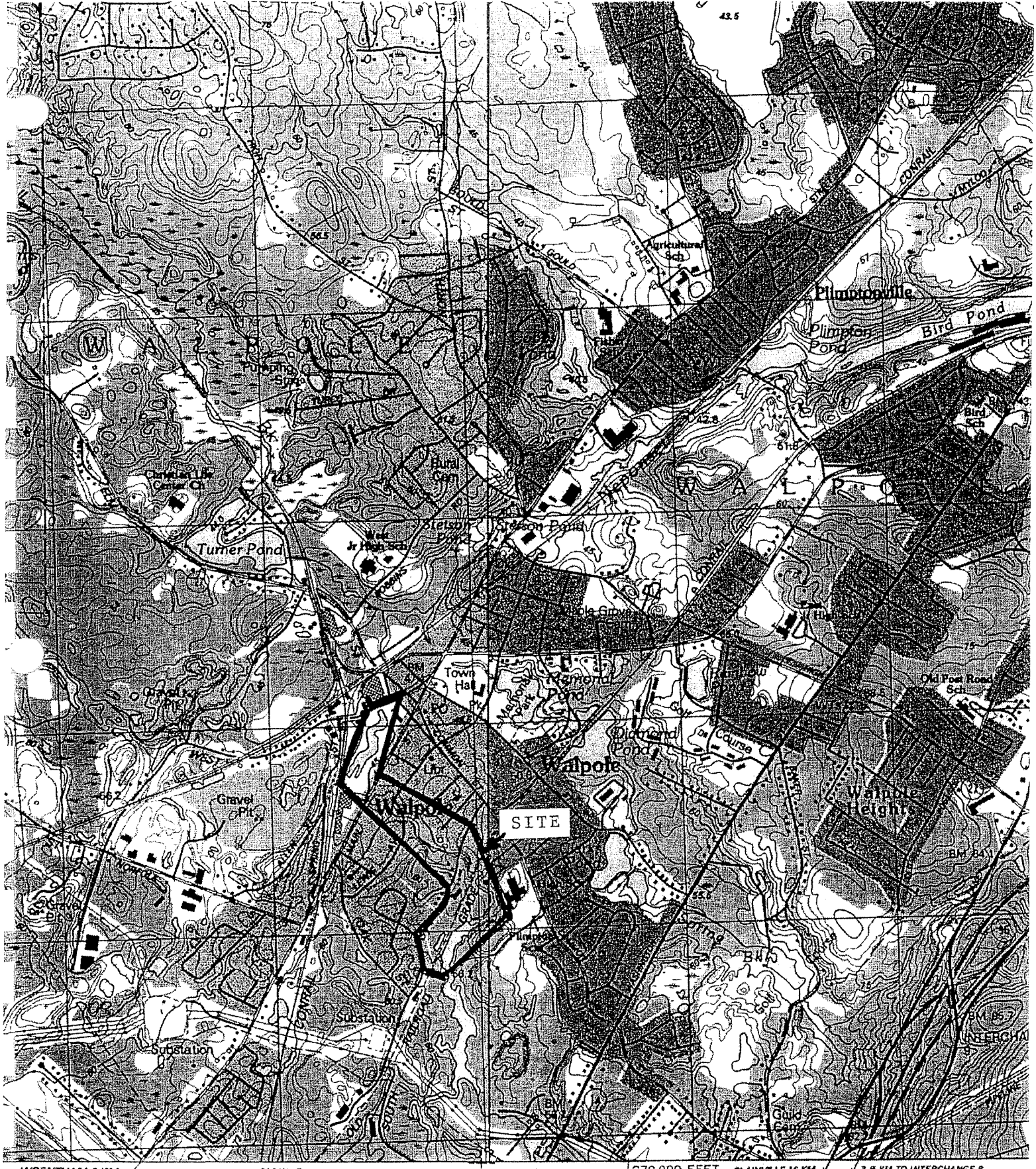
Normandeau Associates Inc. is providing wetland and ecological services for the remediation of the Blackburn & Union Privileges Superfund Site on South Street in Walpole, Massachusetts. To comply with Wetland Regulations and identify potential ecological receptors, we are requesting a data base search for protected species and exemplary natural communities in the vicinity of the site. A project location map is attached. Thank you for your assistance.

Sincerely,
NORMANDEAU ASSOCIATES INC.

Lee E. Carbonneau

Lee E. Carbonneau
Senior Wetland Scientist

Attach.
CC: Nicole Delude Roy, Sanborn, Head & Associates, Inc.



MEDFIELD, MASSACHUSETTS **NORWOOD, MASSACHUSETTS**

42071-B3-TM-025 **42071-B1-TM-025**

1987 **1985**

C) 1997, Maptech, Inc.

Appendix C-1
Bioaccumulation Laboratory Report

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Ms. Nicole Delude Roy, P.G.
Sanborn, Head & Associates, Inc.
6 Gavins Falls Road
Concord, NH 03301

Dear Ms. Roy:

Enclosed please find one bound and one unbound copies of the reports and data packages for the *Hyalella azteca* 28-day survival and growth whole sediment toxicity tests and the *Lumbriculus variegates* 28-day bioaccumulation whole sediment tests for the Blackburn Union Privileges Superfund Site Ecological Analyses and Support.

If you have any questions, please call Dr. Philip C. Downey or me.

Sincerely,

John Williams
Manager, Environmental Toxicology

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Toxicity Summary Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/17/2003
Project: 02070
SDG 6669
Site: Blackburn Union

Method: 100.3Lv

Species: *Lumbriculus variegatus*

Sample ID	Sample Name	Control Group	Tissue Harvested (g)
023395	TR-3/12-16-02	A	6.40
023401	Sed RN-4/12-18-02	B	6.60
023402	LP-09/12-18-02	A	7.10
023403	LP-06/12-18-02	A	7.40
023404	NR-8/12-18-02	B	6.30
023405	NR-7/12-18-02	B	7.70
023406	LP-01/12-18-02	A	6.10
023407	NR-5/12-18-02	B	6.10
023411	Sed Nwd-1/12-17-02	B	8.30
023412	OW-801/12-17-02	B	6.50
023414	Formulated sediment control	A	23.10
023423	Formulated sediment control	B	20.40

Samples Received

Number	Sample Name	Date Time and Collected		Type
023395	TR-3/12-16-02	12/16/2002	3:00:00 PM	Sediment
023401	Sed RN-4/12-18-02	12/18/2002	3:30:00 PM	Sediment
023402	LP-09/12-18-02	12/18/2002	10:45:00 AM	Sediment
023403	LP-06/12-18-02	12/18/2002	11:15:00 AM	Sediment
023404	NR-8/12-18-02	12/18/2002	1:30:00 PM	Sediment
023405	NR-7/12-18-02	12/18/2002	2:00:00 PM	Sediment
023406	LP-01/12-18-02	12/18/2002	12:30:00 PM	Sediment
023407	NR-5/12-18-02	12/18/2002	2:45:00 PM	Sediment
023411	Sed Nwd-1/12-17-02	12/17/2002	10:15:00 AM	Sediment
023412	OW-801/12-17-02	12/17/2002	10:15:00 AM	Sediment

Submitted By: _____

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Quality Assurance Report

Sanborn, Head & Associates, Inc.		Date:	2/17/2003
6 Gavins Falls Road		Project:	02070
		SDG	6669
Concord, NH	03301	Site:	Blackburn Union

Qualifiers and Special Conditions

Sediments were press-sieved through a 3 mm Nitex mesh screen to remove debris before testing with Lumbriculus variegatus.

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Supportive Documentation

Chain-Of-Custody

Toxicity Test Methods

Lumbriculus variegatus Bioaccumulation Test

Standard Reference Toxicant Control Charts

Chain-Of-Custody

Sanborn, Head & Associates, Inc.

Chain-of-Custody Record

Woods Hole Group — Aquatic Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

COMPANY INFORMATION

Name: Sanborn Head + Assoc.
Address: 6 Garvins Falls Rd
Concord NH 03301
Telephone: (603) 229-1900
Facsimile: (603) 229-1919
Contact Name: N. Roz

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: DWPS
Project Number: 2032
P.O. #
Sampler Name(s): B. Green + M. Turner

SHIPPING INFORMATION

Carrier: Fed Ex
Airbill Number: [illegible]
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	2 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	LP-09/12-18-02	12-18-02	1015	G	SED	LUMBRICULUS	BAG + MBC	1					
	LP-06/12-18-02	12-18-02	1115	G	SED	" "	"	1					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[illegible]	[illegible]	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Dorney
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole — Aquatech B.O (BAC Group)

375 Paramount Drive
Raynham, MA 02767 BAC

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	SAMPLE CONTAINERS (NOTE 4)
Name: (BAC) Southern Head Assoc	Regulatory Protocol:	Carrier: Fed ex	PRESERVATIVE: ice
Address: 6 Garvins Falls Rd, Conord, NH 03301	For the State of:	Airbill Number: 831424409681	CONTAINER TYPE: Plastic Bucket
	Project Name: BUPS	Date Shipped: 12-16-02	
	Project Number: 2032		
	P.O. #	Quote #:	
Telephone: 603-229-1900	Sampler Name(s): B. Green, M. Thomas		VOLUME: 2 gallons
Facsimile: 603-229-1919			
Contact Name: N. Roy			

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr. 24 Hr Other

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS
	TR-3 / 12-16-02	12-16-02	1500	C	Sediment	Sediment Toxicity (Hyella) / Sed. Bioaccum (Lumbriculus)	BAG/MBT	1

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12-16-02	1630 hrs	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/17/02	10:00	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: SDG-BU 801

Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole Group

Aquatech Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE ___ OF ___

COMPANY INFORMATION

Name: Sanborn Head + Assoc
Address: 6 Lawns Falls Rd
Concord, NH 03301
Telephone: (603) 229-1960
Facsimile: (603) 229-1919
Contact Name: N. Roy

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BUPS
Project Number: 2032
P.O. #
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: Fed Exp.
Airbill Number: 8314244048 41
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INITIALS	NUMBER OF CONTAINERS					
	Sed PN-41 12-18-02	12-18-02	1530	C	SED	LUMBRICULUS + HYALELLA	BAG + MOT	2					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole Group Aqua Tech

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION

Name: Sanborn Head + Assoc
Address: 6 Garvins Falls Rd
Concord NH 03301
Telephone: (603) 229-1900
Facsimile: (603) 229-1919
Contact Name: N. Roy

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BUPS
Project Number: 2037
P.O. #
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: Fed Exp
Airbill Number: 831424404911
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	NR-81 12-18-02	12-18-02	1330	C	SED.	LUMBRICULUS + HYALELLA	BAL + MBT	2					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab:
Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole Group

Aquatech Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE ___ OF ___

COMPANY INFORMATION

Name: Snaddon Hess + Assoc
Address: 6 Grove Falls Rd
Concord, NH 03301
Telephone: (603) 229-1900
Facsimile: (603) 229-1919
Contact Name: N. Roy

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BHPS
Project Number: 2032
P.O. #
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: Fed Ex
Airbill Number: 831424404852
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 L					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	NR-71 12-18-02	12-18-02	1400	C	SED.	LUMBRICULUS + HYALELLA	BAC + MBT						

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp =

Chain-of-Custody Record

Woods Hole Group

Aquatic Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION

Name: Sanborn Head + Assoc
Address: 6 Garvins Falls Rd
Concord, NH 03301
Telephone: (603) 779-1900
Facsimile: (603) 229-1919
Contact Name:

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BUPS
Project Number: 2032
P.O. #
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: Fed Exp
Airbill Number: 8342440487 4
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE	ICE	ICE			
CONTAINER TYPE	PLASTIC	PLASTIC	PLASTIC			
VOLUME	2 L	1 L	½ L			

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INITIALS	NUMBER OF CONTAINERS					
	LP-01/ 12-18-02	12-18-02	1230	C	SED	LUMBRICULUS + HYALELLA	BAG + MBT	1					
	NR-5/ 12-18-02	12-18-02	1445	C	"	LUMBRICULUS	"		1	1			

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp =

Chain-of-Custody Record

Woods Hole Group

AQUATECH BIO

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION
Name: Sanborn Head + Assoc.	Regulatory Protocol:	Carrier: Fed. Exp.
Address: 6 Garvins Falls Rd Concord NH 03301	For the State of:	Airbill Number: 8314244477740
	Project Name: BWPS	Date Shipped: 12-17-02
	Project Number: 2032	Quote #:
Telephone: (603) 229-1900	P.O. #	
Facsimile: (603) 229-1919	Sampler Name(s): B. Green + M. Thomas	
Contact Name: N. Roy		

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC BUCKET					
VOLUME	2 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INITIALS	NUMBER OF CONTAINERS					
	Sed Nwd-1/ 12-17-02	12-17-02	1015	C/G	SED	LUMBRICULUS + HYALELLA	BAG + ABS	1			1		
	OW-801/ 12-17-02	12-17-02	1015	C/G	SED	" " "	"	1					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12-17-02	1705	
Relinquished by: (signature)	DATE 12/20/02	TIME 11:20	Received by: (signature) Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: SDG # BW801 Cooler Temp = 0.0°C

No tape was on the cooler when we received it from Fedex

Please fax written changes to (508) 822-3288

Aquatec Biological Sciences
Chain-of-Custody Record

273 Commerce Street
Williston, VT 05495
TEL: (802) 860-1638
FAX: (802) 658-3189

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name: John Williams	Project Name: Sanborn Head Blackburn Union	Carrier:	500 mL [illegible]
Address: Aquatec Biol Science 273 Commerce St.	Project Number: Aquatec 02070	Airbill Number:	
City/State/Zip: Williston VT 05495	Sampler Name(s):	Date Shipped:	
Telephone: (802) 860-1638			
Facsimile:			
Contact Name: Phil Downey	Quote #: ___ Client Code: ___	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)	COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS					
Aquatec Control												
Sediment	12/29/02	16:30	✓		Sediment	Multi-Analysis	2					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12/30/02	17:11	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
Relinquished by: (signature)	DATE	TIME	Received by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) *Field duplicates are separate sample;* (4) *e.g.: 40 ml/glass/H_2SO_4*

Notes to Lab:

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Aquatec Biological Sciences
Chain-of-Custody Record

273 Commerce Street
Williston, VT 05495
TEL: (802) 860-1638
FAX: (802) 658-3189

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name: Aquatec Biological Scienc	Project Name: Sanborn Head Blackburn Union	Carrier: Fed Ex	1 glass 1 jars
Address: 273 Commerce St.	Project Number:	Airbill Number: 838834847819	Tissue weight (grams)
City/State/Zip: Williston VT, 05495	Sampler Name(s): John Williams, Phil Downey	Date Shipped: 1/29/03	
Telephone: (802) 860-1638			
Facsimile: (802) 658-3189			
Contact Name: John Williams	Quote #: Client Code:	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)		COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS	
AQUATEC #	Client ID						Lumbriculus Bioaccumulation		
23395	TR-3	1/27/03	18:50		✓	TISSUE	PARAMETERS	1	6.4
23402	LP-09	1/27/03	18:00		✓			1	7.1
23403	LP-06	1/27/03	19:50		✓			1	7.4
23404	NR-8	1/28/03	15:45		✓			1	6.3
23405	NR-7	1/28/03	17:20		✓			1	7.7
23406	LP-01	1/27/03	18:55		✓			1	6.1
23407	NR-5	1/28/03	17:40		✓			1	6.1
23411	Sed Nwd	1/27/03	18:55		✓			1	8.3
23412	OW-801	1/27/03	19:00		✓			1	6.5

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	1/29/03	13:00	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
Relinquished by: (signature)	DATE	TIME	Received by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab: CAUTION
Samples shipped - packed in dry ice

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Aquatec Biological Sciences
Chain-of-Custody Record

273 Commerce Street
Williston, VT 05495
TEL: (802) 860-1638
FAX: (802) 658-3189

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name: Aquatec Biological Sciences	Project Name: Sanborn Head Blackburn Urina	Carrier: FED EX	1 gal liter / Biomass Cal Tissue
Address: 273 Commerce St.	Project Number:	Airbill Number: 838834847819	
City/State/Zip: Williston, VT	Sampler Name(s): John Williams, Phil Downey	Date Shipped: 1/29/03	
Telephone: (802) 860-1638			
Facsimile:			
Contact Name: John Williams	Quote #: Client Code:	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)	COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS					
Aquatec ID						Lumbriculus						
23414 Control A	1/27/03	18:45		✓	Tissue	Bioaccumulation Bioassay	1	~~65~~ 3.1				
23423 Control B	1/28/03	23:00		✓	Tissue		1	20.4				
— Day 0 - Initial A	12/31/02	—		✓	Tissue		40 ml vial	21.29				
— Day 0 - Initial B	12/31/02	—		✓	Tissue		40 ml vial	14.56				

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	1/29/03	18:00	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
Relinquished by: (signature)	DATE	TIME	Received by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab:
CAUTION
Samples shipped - packed in dry ice.

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Toxicity Test Methods

Sanborn, Head & Associates, Inc.

Client: Sanborn, Head & Associates	Project: 02070, Blackburn Union	SDG: 6669
Test Description: Oligochaete, *Lumbriculus variegatus*, 28-day bioaccumulation test		

ASSOCIATED PROTOCOL: EPA March 2000 (2nd Ed). *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates* (EPA/600/R-99/064 Method 100.3)

1. Test type:	Whole sediment toxicity (static renewal)
2. Test temperature:	23 ± 1°C
3. Light quality:	Ambient laboratory illumination
4. Photoperiod:	16 hr. light, 8 hr. dark
5. Test chamber:	4-L glass aquarium chamber with glass standpipe for overflow of renewal water
6. Sediment / overlying water volumes:	1000 g / 2.5L
7. Renewal of overlying water:	2 volume exchanges per day (renewed twice daily)
8. Age of test organisms:	Adult
9. Source of organisms	Aquatic Research Organisms
10. No. organisms / test chamber:	1 – 5 g wet weight per replicate (ratio of sediment TOC to organism dry weight should be ≥50:1). Allowance for water carry-over with worms is 1.33, resulting in up to 6.65 g loading.
11. No. of replicate chambers / sample	5
12. Feeding regime:	None
13. Cleaning:	None during test
14. Aeration:	None, unless dissolved oxygen drops below 2.5 mg/L
15. Overlying water:	Moderately hard reconstituted water
16. Control sediment:	Formulated sediment
17. Test duration:	28 days (sediment exposure), 6-8 h depuration, organisms then frozen
18. Monitoring (bioaccumulation test):	Overlying water chemistry: Daily: temperature and dissolved oxygen Days 0, 27: pH, conductivity, hardness, alkalinity, and ammonia Day 14: pH, conductivity Daily: Systems and biological monitoring Day 28: Remove test organisms from sediment, combine organisms from replicates of same samples, depurate 6-8 h. Transfer organisms from each sample to a vial, store frozen for subsequent chemical analyses
19. End points:	Bioaccumulation test: Day 28, tissue levels of target compounds
20. Reference toxicant test:	Potassium chloride 96-h LC50, water only
21. Test acceptability	Performance-based criteria (EPA/600/R-99/064 Table 13.4)
22. Data interpretation:	None, ship frozen tissues to analytical laboratory

Reviewer: _____ Date 12/30/02

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

Lumbriculus variegatus Bioaccumulation Test

Sanborn, Head & Associates, Inc.

Lumbriculus variegatus Organism Recovery and Depuration Data

Client: Sanborn, Head & Associates, Inc.	SDG: 6669
Project: 02070, Blackburn Union	

Sample #	Replicates	SIEVED Depuration Start Date Time Init.	Depuration End Date Time Init.	Post-depuration biomass (g)	Organisms frozen Date Time Init.
23395 Group A	A, B, C, D, E pooled	1/27/03 - 09:30	1/27/03 - 18:50	6.4	1/27/03 - 18:50
23402 Group A	A, B, C, D, E pooled	1/27/03 - 10:15	1/27/03 - 18:00	7.1	1/27/03 18:15
23403 Group A	A, B, C, D, E pooled	1/27/03 - 11:15	1/27/03 - 19:50	7.4	1/27/03 19:50
23406 Group A	A, B, C, D, E pooled	1/27/03 - 11:00	1/27/03 - 18:55	6.1	1/27/03 - 18:55
23411 Group A	A, B, C, D, E pooled	1/27/03 - 12:00	1/27/03 - 18:55	8.3	1/27/03 18:55
23412 Group A	A, B, C, D, E pooled	1/27/03 - 12:20	1/27/03 19:00	6.5	1/27/03 19.00
23414 Group A	A, B, C, D, E pooled	1/27/03 - 12:30	1/27/03 - 18:45	23.1	1/27/03 18:45
23401 Group B	A, B, C, D, E pooled	1/28/03 - 10:00	1/28/03 17:30	6.6	1/28/03 17:30
23404 Group B	A, B, C, D, E pooled	1/28/03 - 10:50	1/28/03 15:45	6.3	1/28/03 15:45
23405 Group B	A, B, C, D, E pooled	1/28/03 - 11:15	1/28/03 - 17:20	7.7	1/28/03 17:20
23407 Group ~~BA~~ B	A, B, C, D, E pooled	1/28/03 - 11:30	1/28/03 - 17:40	6.1	1/28/03 17:40
23423 Group B	A, B, C, D, E pooled	1/28/03 - 15:30	1/28/03 2300	20.4	1/28/03 11:05

23405 Reps C & D had ≈ 600 g sediment loaded at start of test.

Reviewer: _____ Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

Project: 02070, Sanborn, Head Blackburn Union
Calculation of *Lumbriculus variegatus* loading

	Sample #	Client ID	TOC 1 (%)	TOC 2 (%)	Mean TOC	Replicate Sediment Target Loading (g)	Replicate g TOC Available	Lv loading (g dry wt.)	Lv loading (g wet wt.)	Water factor	Replicate Nominal Loading	Maximum Loading (g)
✓A	23395	TR-3	1.05		0.011	1000	10.5	0.21	2.10	1.33	2.79	3.0
B	23401	Sed-RN-4	0.22		0.002	1000	2.2	0.04	0.44	1.33	0.59	2.0
✓A	23402	LP-09	6.9		0.069	1000	69.0	1.38	13.80	1.33	18.35	6.65 ✓
✓A	23403	LP-06	9.5		0.095	1000	95.0	1.90	19.00	1.33	25.27	6.65 ✓
B	23404	NR-8	0.57		0.006	1000	5.7	0.11	1.14	1.33	1.52	~~6.65~~ ~~1.52~~ 2
B	23405	NR-7	0.35		0.004	1000	3.5	0.07	0.70	1.33	0.93	2.0
✓A	23406	LP-01	5.8		0.058	1000	58.0	1.16	11.60	1.33	15.43	6.65 ✓
B	23407	NR-5	1.06		0.011	1000	10.6	0.21	2.12	1.33	2.82	≅ 3.00
✓A	23411	Sed Nwd-1	3.9		0.039	1000	39.0	0.78	7.80	1.33	10.37	6.65
A	23412	OW-801	3.2		0.032	1000	32.0	0.64	6.40	1.33	8.51	6.65

Loading per replicate = 1000 g (nominal).

JLW/PCD
12/30/02

Client: Sanborn, Head & Associates, Inc.	SDG: 6669
Project: 02070, Blackburn Union	

Biomass (g wet weight) of *Lumbriculus variegatus* distributed per Replicate Test Chamber

Sample Number / Date	Sample ID	Rep. A	Rep. B	Rep. C	Rep. D	Rep. E
23395 12/30/03 15:20	TR-3/12-16-02	3.01	3.07	3.16	3.26	3.10
23401	Sed RN-4/12-18-02	2.61	2.56	2.57	2.34	2.46
23402 12/30 15:35	LP-09/12-18-02	6.62	6.84	6.66	6.81	6.63
23403 12/30 15:42	LP-06/12-18-02	6.58	6.69	6.79	6.91	6.72
23404	NR-8/12-18-02	2.43	2.26	2.54	2.45	2.34
23405	NR-7/12-18-02	2.40	2.76	2.53	2.54	2.66
23406 12/30 15:50	LP-01/12-18-02	6.79	6.77	6.76	6.85	6.70
23407	NR-5/12-18-02	3.42	3.67	~~3.84~~ 3.47 DCD	3.84	3.88
23411 12/30 15:58	Sed Nwd-1/12-17-02	7.00	6.74	6.54	6.99	6.91
23412 12/30 16:10	OW-801/12-17-02	6.81	6.86	6.96	6.82	6.85
23414 12/30 16:22	Control *Lv* A	6.78	6.82	6.90	6.92	6.60
23423	Control *Lv* B	5.65	5.47	6.72	6.01	6.75
Time 0 worms* *		14.56	21.29			

Date / Time / Initials organisms distributed to test chambers:

*Archive at least one 10g aliquot of *Lumbriculus variegaitus* in 40 mL vials, store frozen for background chemical analysis.

* Frozen 12/31/03

Reviewer: _____ Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

Client: Sanborn, Head & Associates, Inc.	SDG: 6669
Project: 02070, Blackburn Union	

Wet weight / dry weight data for *Lv*:

Sample ID	Pan Weight (g)	Pan + Wet Organism Weight (g)	Pan + Dried Organism Weight (g)	Organism Dry Weight (g)
Lv A	2.55	3.92	2.72	0.17
Lv B	2.56	3.86	2.73	0.17

Into oven: 12/31/02 16:00 JG. 81°C
Out of oven: 1/1/03 16:00 JG 80°C

A WET WT: 1.37 DRY WT: ~~0.07~~ 0.17 = 12.4%

B WET WT: 1.3 DRY WT: 0.17 DRY WT / WET WT. = 13.1%

Avg. DRY WT = 12.8% of WET weight.

Reviewer: [illegible] Date 2/17/03
Laboratory: Aquatec Biological Sciences, Inc Williston Vermont

Lv28dpkg

Organism Holding and Acclimation

Species: *Lumbriculus variegatus*	Date Received: 12/27/02 (~275g)
Supplier: Aquatic Research Organisms	Age: Adult
Apparent Condition: Active, appear healthy.	Culture ID: 122702Lv

Acclimation / Holding Procedures: Transfer to holding culture boxes, add laboratory water. Acclimate to water to be used for testing (sediment overlying water formulation). Aerate lightly. Water change at least once (50%) weekly.
Daily Feeding: None

2002 Date	Fed	Temp	pH	D.O.	Cond uct.	Behavior *	Water Chg.	Init.
12/27	NO					N	✓ ✓	JG
12/28						N	✓ ✓	JG
12/29								
12/30		21.6	7.1	3.1	395	N	50%	JW
12/31		21.4	7.4	7.7	381	N	50%	JG

* N = normal, appear healthy. Record # dead if any observed.

Aquatic Research Organisms

DATA SHEET

I. Organism History

Species: Lumbriculus variegatus

Source: Lab reared ✓ Hatchery reared ____ Field collected ____

Hatch date 9-02 Receipt date ____

Lot number 090002LV Strain ____

Brood Origination Rochester NY

II. Water Quality

Temperature 18 °C Salinity <1 ppt DO —

pH 7.5 Hardness — ppm

III. Culture Conditions

System: Flo thru

Diet: Flake Food ____ Phytoplankton ____ Trout Chow ✓

Brine Shrimp ____ Rotifers ____ Other ____

Prophylactic Treatments: ____

Comments: ____

IV. Shipping Information

Client: Aquatech VT # of Organisms: 275+gr

Carrier: FedX Date Shipped: 12-26-02

Biologist: Mark Rosengrant

1 - 800 - 927 - 1650

PO Box 1271 • One Lafayette Road • Hampton, NH 03842 • (603) 926-1650

Rec'd 12-27-02 JG
Temp = 4.5°C
pH = 7.8
D.O. = 17
Cond. = 767

Condition = normal.
H_2O change 2x

Oligochaete (*Lumbriculus variegatus*) BioaccumulationTest, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070, Blackburn Union	SDG: 6669

Day of Analysis

Sample	Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
23395	pH	8.3				8.0					7.9								7.7			
	DO	7.0	5.8	8.5	6.6	7.8	7.6	8.2	7.5	7.2	7.2	7.0	7.0	6.3	6.7	6.8	6.8	6.5	6.7	7.9	7.7	7.6
	Cond	481				453					449								430			
23402	pH	7.4				JG ~~7.0~~ 7.3					7.3								7.3			
	DO	6.1	4.8	7.8	5.8	~~8.0~~ 6.5	6.0	7.8	7.3	6.6	6.2	6.6	6.9	6.7	6.5	6.6	6.5	6.6	6.6	7.5	7.3	7.2
	Cond	341				364					378								375			
23403	pH	7.3				7.3					7.8								7.6			
	DO	6.7	4.6	8.0	7.9	JG ~~6.5~~ 7.9	7.2	8.9	7.9	8.4	8.4	8.5	8.2	8.2	8.4	8.4	8.4	8.0	8.5	8.2	7.6	7.9
	Cond	443				391					384								375			
23406	pH	7.2				7.2					7.3								7.6			
	DO	6.3	5.4	8.0	7.8	7.3	7.1	8.7	7.4	7.4	6.3	6.6	7.7	8.1	7.6	7.8	8.0	8.0	8.6	8.5	8.5	8.0
	Cond	312				354					374								369			
23411	pH	7.1		JG		7.1					7.3								7.3			
	DO	4.5	4.5	~~7.6~~	7.1	6.4	6.3	6.7	5.8	6.3	5.5	6.4	6.1	8.0	6.2	6.6	7.4	7.7	7.6	7.5	7.1	7.4
	Cond	387				379					386								382			
2002 2003	I / D	12/30 JW	12/31 JG	1/1 JG	1/2 JW	1/3 JG	1/4 JG	1/5 JW	1/6 JW	1/7 JW	1/8 JW	1/9 JW	1/10 JG	1/11 JG	1/12 JW	1/13 JW	1/14 JG	1/15 JG	1/16 JG	1/17 JG	1/18 JG	1/19 JW

Test Start 12/30/02 - 15:20 Added Aeration 12/31/02 JG.

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. Temperature is monitored continuously and at least once daily by manual measurement.

Review: J Date: 2/17/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Lv28dpkg

GROUP H

Oligochaete (*Lumbriculus variegatus*) Bioaccumulation Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070, Blackburn Union	SDG: 6669

Day of Analysis

Sample	Parameter	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
23395	pH			8.0				7.9														
	DO	7.6	8.0	8.0	7.6	7.9	7.8	7.7	8.0													
	Cond			462				426														
23402	pH			7.8				7.8														
	DO	8.0	8.2	8.3	7.2	8.1	7.9	7.9	7.8													
	Cond			383				376														
23403	pH			7.7				7.7														
	DO	8.2	8.2	8.2	8.1	8.2	8.0	7.8	8.6													
	Cond			385				378														
23406	pH			7.8				7.8														
	DO	8.4	8.8	8.6	8.0	8.3	8.4	8.2	8.5													
	Cond			378				374														
23411	pH			7.6				7.7														
	DO	7.5	8.1	7.7	7.8	8.0	8.0	7.7	7.2													
	Cond			389				354														
2002	I / D	1/20 JW	1/21 JG	1/22 JW	1/23 JW	1/24 JG	1/25 JG	1/26 JW	1/27 JW													

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. Temperature is monitored continuously and at least once daily by manual measurement.

Review: J Date: 2/12/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Lv28dpkg

Oligochaete (*Lumbriculus variegatus*) BioaccumulationTest, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070, Blackburn Union	SDG: 6669

Day of Analysis

Sample	Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
23412	pH	7.1				7.2					7.3								7.3			
	DO	5.4	3.2	7.7	7.5	7.2	6.6	8.3	6.4	6.1	5.9	6.2	7.5	6.4	6.4	6.3	5.9	6.5	7.4	7.6	7.9	8.3
	Cond	390				381					380								381			
23414	pH	7.9				7.8					7.8								7.6			
	DO	8.3	5.7	8.2	8.3	8.4	8.3	9.2	7.9	8.4	7.8	6.5	7.6	6.9	7.0	7.9	6.8	5.4	7.8	7.7	7.5	7.2
	Cond	360				399					414								412			
	pH																					
	DO																					
	Cond																					
	pH																					
	DO																					
	Cond																					
	pH																					
	DO																					
	Cond																					
2002 2003	I / D	12/30 JW	12/31 JG	1/1 JG	1/2 JW	1/3 JG	1/4 JG	1/5 JW	1/6 JW	1/7 JW	1/8 JW	1/9 JW	1/10 JG	1/11 JG	1/12 JW	1/13 JW	1/14 JG	1/15 JG	1/16 JG	1/17 JG	1/18 JG	1/19 JW

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. Temperature is monitored continuously and at least once daily by manual measurement.

Review J Date: ~~12~~ 2/17/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Lv28dpkg

Xyo D&H

Oligochaete (*Lumbriculus variegatus*) Bioaccumulation Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070, Blackburn Union	SDG: 6669

Day of Analysis

Sample	Parameter	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
23412	pH			7.5				7.9														
	DO	8.4	8.7	6.9	8.6	8.5	8.4	8.3	7.8													
	Cond			385				376														
23414	pH			7.9				7.8														
	DO	7.5	7.9	8.1	7.5	7.6	7.4	7.1	8.5													
	Cond			440				427														
	pH																					
	DO																					
	Cond																					
	pH																					
	DO																					
	Cond																					
	pH																					
	DO																					
	Cond																					
2003	I / D	1/20 JW	1/21 JG	1/22 JW	1/23 JW	1/24 JG	1/25 JG	1/26 JW	1/27 JW													

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. Temperature is monitored continuously and at least once daily by manual measurement.

Review: J Date: 2/17/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Lv28dpkg

Group 3

Oligochaete (*Lumbriculus variegatus*) BioaccumulationTest, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc. | Project: 02070, Blackburn Union | SDG: 6669

Day of Analysis

Sample	Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
23401	pH	7.2			7.8					7.7								7.9				
	DO	7.4	8.8	7.9	8.0	7.5	9.1	8.4	8.0	8.1	8.4	8.0	8.4	8.4	8.5	8.8	8.7	8.7	7.4	8.3	8.5	8.6
	Cond	*374			366					378								381				
23404	pH	7.3			7.6					7.6								7.6				
	DO	7.7	8.8	8.7	8.4	8.6	9.2	8.3	8.1	7.7	8.5	8.0	8.7	8.4	8.4	8.4	8.7	8.6	8.3	8.2	8.2	8.2
	Cond	*360			368					356								355				
23405	pH	7.3			7.4					7.8								7.6				
	DO	7.4	8.4	8.3	8.1	6.5	9.2	7.8	7.7	8.4	8.6	8.1	8.8	8.2	8.2	8.3	8.8	8.8	8.0	8.1	8.2	8.3
	Cond	*360			352					375								375				
23407	pH	7.3			7.4					7.6								7.7				
	DO	7.5	7.9	8.3	8.3	8.1	8.8	7.9	7.8	7.9	7.5	7.8	7.5	7.6	8.0	7.8	7.7	8.8	7.5	8.5	8.5	8.4
	Cond	*347			358					373								366				
23423	pH	7.8			7.7					7.6								7.6				
	DO	8.6	8.4	7.7	7.8	7.5	8.3	7.4	7.4	7.2	7.2	7.9	7.3	7.0	7.4	8.1	JG ~~7.7~~ 8.2	7.8	7.7	7.5	7.6	7.6
	Cond	*370			401					413								412				
2002 2003	I / D	12/31 JG	1/1 JG	1/2 JW	1/3 JG	1/4 JG	1/5 JW	1/6 JW	1/7 JW	1/8 JW	1/9 JW	1/10 JG	1/11 JG	1/12 JW	1/13 JW	1/14 JG	1/15 JG	1/16 JG	1/17 JG	1/18 JG	1/19 JW	1/20 JW

Test start 12/31/02 15:30 JG Added aeration 12/31/02 JG.

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. Temperature is monitored continuously and at least once daily by manual measurement.

*conductivity saved and measured at a later date. Conductivity meter not working 12/31/02 JW

Conductivity measured 1/2/03 JW Conductivity meter working properly.

Review: Date:

Lv28dpkg

Aquatec Biological Sciences, Inc. Willison, Vermont

Oligochaete (*Lumbriculus variegatus*) Bioaccumulation Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070, Blackburn Union	SDG: 6669

Day of Analysis

Sample	Parameter	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
23401	pH		7.9					8.1														
	DO	8.7	8.6	8.5	8.6	8.5	8.6	8.7	8.5													
	Cond		383					395														
23404	pH		7.9					8.0														
	DO	8.7	8.6	8.6	8.5	8.6	8.3	8.6	8.6													
	Cond		386					375														
23405	pH		7.9					7.9														
	DO	8.8	8.4	8.2	8.4	8.5	8.1	8.4	8.4													
	Cond		384					373														
23407	pH		7.9					8.0														
	DO	8.9	8.7	8.5	8.8	8.4	8.4	8.5	8.5													
	Cond		384					378														
23423	pH		7.9					7.9														
	DO	8.0	8.0	7.8	7.6	7.6	7.6	7.6	7.6													
	Cond		417					409														
2002	I / D	1/21 JG	1/22 JW	1/23 JW	1/24 JG	1/25 JG	1/26 JW	1/27 JW	1/28 JG													

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0, 27 Measure DO daily. Measure pH and conductivity once weekly. *Temperature is monitored continuously and at least once daily by manual measurement.*

Review: _____ Date: _____

Aquatec Biological Sciences, Inc. Willison, Vermont

Lv28dpkg

Alkalinity and Hardness Worksheet

				Alkalinity						Hardness					
Sample Identifier	LIMS Identifier	Sub ID Code	Sampling Date	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Alkalinity	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Hardness
23395	TR-3/12-16-02	L.v. Day 0	12/30/02	25	15	19.1	TW	1/2/03	164.0	50	5.7	10	JG	12/31/02	86.0
23395	TR-3/12-16-02	L.v. Day 27	1/26/03	25	3.9	5.9	JG	1/30/03	80.0	50	5.4	11.1	JG	1/29/03	114.0
23401	Sed RN-4/12-18-02	L.v. Day 0	12/31/02	25	19.1	20.6	TW	1/2/03	60.0	50	10	14.9	JG	12/31/02	98.0
23401	Sed RN-4/12-18-02	L.v. Day 27	1/27/03	25	5.9	7.6	JG	1/30/03	68.0	50	11.1	16.3	JG	1/29/03	104.0
23402	LP-09/12-18-02	L.v. Day 0	12/30/02	25	20.6	22	TW	1/2/03	56.0	50	14.9	19.6	JG	12/31/02	94.0
23402	LP-09/12-18-02	L.v. Day 27	1/26/03	25	7.6	9.3	JG	1/30/03	68.0	50	16.3	21.3	JG	1/29/03	100.0
23403	LP-06/12-18-02	L.v. Day 0	12/30/02	25	22	23.2	TW	1/2/03	48.0	50	19.6	24.9	JG	12/31/02	106.0
23403	LP-06/12-18-02	L.v. Day 27	1/26/03	25	9.3	11	JG	1/30/03	68.0	50	21.3	26.5	JG	1/29/03	104.0
23404	NR-8/12-18-02	L.v. Day 0	12/31/02	25	23.2	24.8	TW	1/2/03	64.0	50	24.9	29.9	JG	12/31/02	100.0
23404	NR-8/12-18-02	L.v. Day 27	1/27/03	25	11	12.7	JG	1/30/03	68.0	50	26.5	31.7	JG	1/29/03	104.0
23405	NR-7/12-18-02	L.v. Day 0	12/31/02	25	24.8	26.3	TW	1/2/03	60.0	50	29.9	34.7	JG	12/31/02	96.0
23405	NR-7/12-18-02	L.v. Day 27	1/27/03	25	12.7	14.4	JG	1/30/03	68.0	50	31.7	36.8	JG	1/29/03	102.0
23406	LP-01/12-18-02	L.v. Day 0	12/30/02	25	26.3	27.4	TW	1/2/03	44.0	50	34.7	38.4	JG	12/31/02	74.0
23406	LP-01/12-18-02	L.v. Day 27	1/26/03	25	14.4	16.1	JG	1/30/03	68.0	50	36.8	41.9	JG	1/29/03	102.0
23407	NR-5/12-18-02	L.v. Day 0	12/31/02	25	32.9	34.3	TW	1/2/03	56.0	50	44.6	49	JG	12/31/02	88.0
23407	NR-5/12-18-02	L.v. Day 27	1/27/03	25	16.1	17.8	JG	1/30/03	68.0	50	41.9	46.9	JG	1/29/03	100.0
23411	Sed Nwd-1/12-17-0	L.v. Day 0	12/30/02	25	27.4	29.2	TW	1/2/03	72.0	50	36.4	39.2	JG	12/31/02	16.0
23411	Sed Nwd-1/12-17-0	L.v. Day 27	1/26/03	25	17.8	19.5	JG	1/30/03	68.0	50	0	5.1	JG	1/29/03	102.0
23412	OW-801/12-17-02	L.v. Day 0	12/30/02	25	29.2	31.1	TW	1/2/03	76.0	*			JG	12/31/02	
23412	OW-801/12-17-02	L.v. Day 27	1/26/03	25	19.5	21.1	JG	1/30/03	64.0	50	5.1	10.1	JG	1/29/03	100.0
23414	Formulated sedime	L.v. Day 0	12/30/02	25	31.1	32.9	TW	1/2/03	72.0	50	39.4	44.6	JG	12/31/02	104.0
23414	Formulated sedime	L.v. Day 27	1/26/03	25	21.1	23.6	JG	1/30/03	100.0	50	10.1	16.9	JG	1/29/03	136.0

* Hardness could not be determined using this method due to possible

Alkalinity and Hardness Worksheet

					Alkalinity					Hardness					
Sample Identifier	LIMS Identifier	Sub ID Code	Sampling Date	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Alkalinity	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Hardness
23423	Lab Control, L.v. B	L.v. Day 0	12/31/02	25	34.3	36	TW	1/2/03	68.0	50	0	5.2	JG	12/31/02	104.0
23423	Lab Control, L.v. B	L.v. Day 27	1/27/03	25	23.6	25.9	JG	1/30/03	92.0	50	16.9	23	JG	1/29/03	122.0

Total Ammonia (mg/L)
Porewater
Day 0 - Hyalella & Lumbriculus

File name: A:\010703B.RST
Date: January 07, 2003
Operator: JJG

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
1	6	Sync	SYNC	1	1	172879	1.002977	
2	0	CarryOver	CO	1	1	2924	0.027876	
3	0	CarryOver	CO	1	1	534	0.014142	
5	0	Baseline	RB	1	1	0	0.011072	BL
5	0	Baseline	RB	1	1	0	0.011072	BL
6	1	Cal 0	C	1	1	-600	0.007624	
7	2	Cal 1	C	1	1	34013	0.206565	
8	3	Cal 2	C	1	1	67199	0.397237	
9	4	Cal 3	C	1	1	167177	0.971930	
10	5	Cal 4	C	1	1	869979	5.005573	
11	0	Blank	U	1	1	-8741	-0.022044	LO
5	0	Baseline	RB	1	1	1	0.011072	BL
13	6	ICV	U	1	1	172293	1.001335	
14	1	ICB	U	1	1	-1599	0.001879	
5	0	Baseline	RB	1	1	0	0.011072	BL
16	31	23382WER6.25	U	10	1	136472	7.954517	
17	32	23382WER12.5	U	10	1	244697	14.174784	
18	33	23382WER25	U	10	1	541306	31.222546	
19	34	23382WER50	U	10	1	1013865	58.383110	
20	35	WERAMM612/19	U	10	1	93363	5.476804	
21	36	WERAMM1212/19	U	10	1	221055	12.816123	
22	37	WERAMM2512/19	U	10	1	493262	28.461210	
23	38	WERAMM5012/19	U	10	1	824392	47.493076	
24	39	23395PW	U	1	1	877533	5.054751	
25	5	CCV	U	1	1	864465	4.979649	Sediment
26	1	CCB	U	1	1	-6814	-0.028094	LO Porewater
5	0	Baseline	RB	1	1	0	0.011072	BL Total
28	41	23402PW	U	1	1	148984	0.867368	
29	42	23403PW	U	1	1	23575	0.146569	Ammonia-N
30	43	23404PW	U	1	1	6210	0.046766	(mg/L)
31	44	23405PW	U	1	1	7403	0.053622	
32	45	23406PW	U	1	1	108943	0.637225	
33	46	23407PW	U	1	1	36324	0.219847	
34	47	23411PW	U	1	1	261156	1.512082	
35	48	23412PW	U	1	1	265669	1.538012	
36	49	23395HA012/22	U	1	1	131967	0.768984	
37	50	23401HA0	U	1	1	-3282	-0.007789	LO Overlying
38	5	CCV	U	1	1	871623	5.020772	water on
39	1	CCB	U	1	1	-7037	-0.029371	LO Day 0
5	0	Baseline	RB	1	1	0	0.011072	BL (Test Start)
41	51	23404HA0	U	1	1	-2130	-0.001169	LO
42	52	23405HA0	U	1	1	-2449	-0.003004	LO Total
43	53	23406HA0	U	1	1	5637	0.043470	
44	54	23411HA0	U	1	1	25263	0.156273	Ammonia-N
45	55	23412HA0	U	1	1	25249	0.156191	(mg/L)
46	56	23413HA0	U	1	1	106713	0.624441	
47	57	23418HA0	U	1	1	-2664	-0.004241	LO
48	58	23395LV012/30	U	1	1	212691	1.233523	
49	59	23401LV012/31	U	1	1	-3910	-0.011403	LO Overlying
50	60	23402LV012/30	U	1	1	65652	0.388408	Water
51	5	CCV	U	1	1	867691	4.998171	Lumbricul.
52	1	CCB	U	1	1	-7336	-0.031092	LO
5	0	Baseline	RB	1	1	0	0.011072	BL Day 0
54	61	23403LV012/30	U	1	1	4453	0.036666	

Peak	Dup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
55	62	234041V012/31	U	1	1	-155	0.010182	Overlying
56	63	234051V012/31	U	1	1	-841	0.007961	water
57	64	234061V012/30	U	1	1	39269	0.236773	Lumbriculus
58	65	234071V012/31	U	1	1	2423	0.[illegible]	
59	66	234111V012/30	U	1	1	59204	0.381349	Day 0
60	67	234121V012/30	U	1	1	63493	0.375942	
61	68	234141V012/31	U	1	1	1635	0.020469	
B	69	234231V012/31	RB	1	1	0	0.011072	BL
63	5	CCV	U	1	1	874149	5.035287	
64	1	CCB	U	1	1	-6924	-0.028725	LO
B	0	Baseline	RB	1	1	0	0.011072	BL

Peak Table: Ammonia

Total Ammonia (mg/L)

File name: A:\013003A.RST
Date: January 30, 2003
Operator: JJG

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
1	6	Sync	SYNC	1	1	170072	1.008511	
2	0	CarryOver	CO	1	1	2278	0.006534	
3	0	CarryOver	CO	1	1	309	-0.005228	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
B	0	Baseline	RB	1	1	0	-0.007071	BL
6	1	Cal 0	C	1	1	-119	-0.007779	LO
7	2	Cal 1	C	1	1	37302	0.215675	
8	3	Cal 2	C	1	1	68477	0.401837	
9	4	Cal 3	C	1	1	168252	0.997640	
10	5	Cal 4	C	1	1	838449	4.999698	
11	0	Blank	U	1	1	-4081	-0.031439	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
13	6	ICV	U	1	1	167900	0.995538	
14	1	ICB	U	1	1	-785	-0.011759	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
16	31	23395HA27-1/18	U	1	1	6401	0.031150	
17	32	23401HA27-1/18	U	1	1	214400	1.273211	
18	33	23404HA27-1/18	U	1	1	-9902	-0.066202	LO
19	34	23405HA27-1/18	U	1	1	-10313	-0.068653	LO
20	35	23406HA27-1/18	U	1	1	-10846	-0.071839	LO
21	36	23411HA27-1/18	U	1	1	-5316	-0.038813	LO
22	37	23412HA27-1/18	U	1	1	-3989	-0.030892	LO
23	38	23413HA27-1/18	U	1	1	-2073	-0.019450	LO
24	39	23418HA27-1/18	U	1	1	2957	0.010588	
25	40	23395LV27-1/26	U	1	1	21486	0.121234	
26	5	CCV	U	1	1	858176	5.117498	
27	1	CCB	U	1	1	-4141	-0.031799	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
29	41	23401LV27-1/27	U	1	1	-20979	-0.131748	LO
30	42	23402LV27-1/26	U	1	1	-16057	-0.102952	LO
31	43	23403LV27-1/26	U	1	1	-12750	-0.083207	LO
32	44	23404LV27-1/27	U	1	1	-15264	-0.098220	LO
33	45	23405LV27-1/27	U	1	1	-13383	-0.086989	LO
34	46	23406LV27-1/26	U	1	1	-8868	-0.060025	LO
35	47	23407LV27-1/27	U	1	1	-10254	-0.068305	LO
36	48	23411LV27-1/26	U	1	1	111132	0.656550	
37	49	23412LV27-1/26	U	1	1	14527	0.079674	
38	50	23414LV27-1/26	U	1	1	-3967	-0.030761	LO
39	5	CCV	U	1	1	854397	5.094934	
40	1	CCB	U	1	1	-6778	-0.047533	LO
B	0	Baseline	RB	1	1	1	-0.007071	BL
42	51	23423LV27-1/27	U	1	1	268	-0.005486	LO
43	5	CCV	U	1	1	861472	5.137180	
44	1	CCB	U	1	1	-5279	-0.038592	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL

Overlying water

Lumbriculus

Day 27

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
22.2	22.8	21	21.1	20.8	24.3	16:15:11	12/30/2002
23.5	23.3	22.8	22.4	24.2	24.4	17:15:11	12/30/2002
23	23.5	22.7	22.2	24.3	24.5	18:15:11	12/30/2002
23	23.7	22.7	22.2	23.6	23.6	19:15:11	12/30/2002
23.1	23.4	22.5	22.3	23.4	23.5	20:15:11	12/30/2002
22.9	23.5	22.8	22.3	24	24.1	21:15:11	12/30/2002
22.9	23.6	22.6	22.2	23.2	23.3	22:15:11	12/30/2002
23.1	23.3	22.9	22.3	24	24.1	23:15:11	12/30/2002
22.9	23.7	23	22.3	23.6	23.6	0:15:11	12/31/2002
22.2	22.8	22	21.9	23	23.1	1:15:11	12/31/2002
23	23.5	22.9	22.1	23.8	24	2:15:11	12/31/2002
23.1	23.5	23	22.4	23.3	23.5	3:15:11	12/31/2002
23	23.6	22.6	22.3	23.8	23.8	4:15:11	12/31/2002
23	23.6	22.7	22.3	23.9	24	5:15:11	12/31/2002
23	23.4	23	22.2	23.6	23.7	6:15:11	12/31/2002
23	23.7	22.7	22.4	23.8	24.1	7:15:11	12/31/2002
22.8	23.4	22.7	22.4	23.7	23.9	8:15:11	12/31/2002
23.2	23.7	22.6	22.4	23.8	23.9	9:15:11	12/31/2002
22.9	23.7	22.8	22.4	23.7	23.7	10:15:11	12/31/2002
23.1	23.5	23.2	22.2	23.2	23.2	11:15:11	12/31/2002
23	23.9	22.8	22.5	22.2	22.3	12:15:11	12/31/2002
23.1	23.5	23.1	22.9	22.7	22.9	13:15:11	12/31/2002
22.5	23.1	22.7	22.5	22.3	22.4	14:15:11	12/31/2002
23.3	23.8	23	22.7	22.5	22.6	15:15:11	12/31/2002
23	23.8	23.3	22.6	22.1	22.1	16:15:11	12/31/2002
23.1	23.6	23	22.7	22.1	22.2	17:15:11	12/31/2002
23	24	23.1	22.6	22.1	22.1	18:15:11	12/31/2002
23.4	23.6	23	22.5	22.6	22.5	19:15:11	12/31/2002
23.2	24	23.2	22.5	22.3	22.3	20:15:11	12/31/2002
23.5	23.6	22.9	22.3	22.6	22.3	21:15:11	12/31/2002
23.2	24	23	22.4	22.2	22.3	22:15:11	12/31/2002
23.3	23.5	23.6	22.4	22.9	22.5	23:15:11	12/31/2002
23	23.9	22.8	22.4	22.2	22.3	0:15:11	1/1/2003
22.2	23.1	22.6	22.1	22.1	22	1:15:11	1/1/2003
23.2	23.6	23	22.6	22.4	22.2	2:15:11	1/1/2003
23	23.7	23.1	22.3	22.3	22.4	3:15:11	1/1/2003
23.2	23.7	22.9	22.5	22.7	22.6	4:15:11	1/1/2003
22.9	23.6	23.1	22.6	22.2	22.2	5:15:11	1/1/2003
23.2	23.7	23.3	22.4	22.5	22.5	6:15:11	1/1/2003
22.9	23.7	22.7	22.5	22.7	22.4	7:15:11	1/1/2003
23.3	23.8	22.8	22.5	22.3	22.3	8:15:11	1/1/2003
22.9	23.6	23.2	22.4	22.8	22.5	9:15:11	1/1/2003
23.3	23.8	23.3	22.2	22.2	22.2	10:15:11	1/1/2003
22.8	23.6	23	22.2	22.4	22.3	11:15:11	1/1/2003
23.2	23.9	22.8	22.2	22.4	22.6	12:15:11	1/1/2003
22	22.9	22.1	22	21.7	21.8	13:15:11	1/1/2003
23	23.5	22.9	22.5	22.3	22.4	14:15:11	1/1/2003
23.1	23.8	23.3	22.6	22.7	22.6	15:15:11	1/1/2003
23.1	23.6	23.3	22.5	22.7	22.6	16:15:11	1/1/2003
23.2	23.8	22.7	22.6	22.7	22.7	17:15:11	1/1/2003
23.2	23.6	23	22.6	22.7	22.6	18:15:11	1/1/2003
23.1	23.7	23.3	22.5	22.6	22.7	19:15:11	1/1/2003
23	23.5	22.6	22.5	22.6	22.6	20:15:11	1/1/2003
23	23.8	23	22.6	22.5	22.7	21:15:11	1/1/2003
23.2	23.5	23.2	22.5	22.6	22.6	22:15:11	1/1/2003
22.9	23.8	22.9	22.3	22.4	22.5	23:15:11	1/1/2003
23.1	23.4	22.8	22.4	22.5	22.5	0:15:11	1/2/2003
21.6	23	22	22.1	21.6	22	1:15:11	1/2/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23	23.5	22.9	22.5	22.6	22.6	2:15:11	1/2/2003
22.8	23.7	22.8	22.5	22.3	22.7	3:15:11	1/2/2003
23.2	23.4	22.9	22.5	22.2	22.4	4:15:11	1/2/2003
23	23.8	23.3	22.5	22.6	22.7	5:15:11	1/2/2003
22.9	23.6	22.9	22.3	22.3	22.4	6:15:11	1/2/2003
23.2	23.6	22.8	22.5	22.6	22.6	7:15:11	1/2/2003
22.9	23.7	23.1	22.5	22.2	22.5	8:15:11	1/2/2003
23	23.5	23.2	22.3	22.7	22.7	9:15:11	1/2/2003
23.3	23.9	22.7	22.5	22.5	22.7	10:15:11	1/2/2003
23	23.5	23.1	22.6	22.5	22.4	11:15:11	1/2/2003
22.9	23.8	23.2	22.4	22.7	22.7	12:15:11	1/2/2003
21.6	22.8	21.9	22	21.8	21.8	13:15:11	1/2/2003
22.6	23.8	23	22.5	22.5	22.6	14:15:11	1/2/2003
22.9	23.5	23	22.5	22.2	22.5	15:15:11	1/2/2003
23.1	23.7	23.4	22.5	22.6	22.7	16:15:11	1/2/2003
22.9	23.7	22.8	22.3	22.4	22.6	17:15:11	1/2/2003
23	23.5	22.7	22.6	22.3	22.6	18:15:11	1/2/2003
22.8	23.8	23	22.6	22.5	22.5	19:15:11	1/2/2003
23.1	23.5	23.2	22.6	22.8	22.8	20:15:11	1/2/2003
23	23.8	23.2	22.3	22.5	22.6	21:15:11	1/2/2003
23	23.5	23.2	22.5	22.2	22.5	22:15:11	1/2/2003
23.2	23.8	23	22.3	22.7	22.7	23:15:11	1/2/2003
22.8	23.5	23	22.5	22.4	22.6	0:15:11	1/3/2003
21.7	22.9	22	22.1	21.7	22	1:15:11	1/3/2003
22.7	23.6	22.7	22.4	22.5	22.7	2:15:11	1/3/2003
22.9	23.5	22.9	22.6	22.5	22.6	3:15:11	1/3/2003
23	23.7	23	22.5	22.3	22.6	4:15:11	1/3/2003
22.9	23.6	23.1	22.5	22.3	22.5	5:15:11	1/3/2003
22.8	23.6	23.3	22.4	22.6	22.7	6:15:11	1/3/2003
23.2	23.7	23	22.3	22.5	22.7	7:15:11	1/3/2003
22.9	23.5	22.6	22.4	22.3	22.5	8:15:11	1/3/2003
23.3	23.8	22.9	22.6	22.6	22.7	9:15:11	1/3/2003
22.9	23.6	23.3	22.7	22.2	22.6	10:15:11	1/3/2003
23.3	23.7	23.2	22.5	22.6	22.7	11:15:11	1/3/2003
22.9	23.6	22.6	22.4	22.6	22.8	12:15:11	1/3/2003
21.8	22.9	21.7	22	21.4	22	13:15:11	1/3/2003
22.6	23.7	22.8	22.4	22.3	22.6	14:15:11	1/3/2003
23	23.4	23	22.6	22.6	22.7	15:15:11	1/3/2003
23.1	23.7	22.8	22.6	22.3	22.6	16:15:11	1/3/2003
23	23.8	22.9	22.6	22.2	22.6	17:15:11	1/3/2003
23.1	23.5	23	22.5	22.3	22.6	18:15:11	1/3/2003
23.1	23.8	23.2	22.5	22.7	22.9	19:15:11	1/3/2003
22.8	23.5	23.2	22.5	22.6	22.8	20:15:11	1/3/2003
23.3	23.8	23.1	22.5	22.4	22.7	21:15:11	1/3/2003
22.8	23.6	23.1	22.5	22.4	22.6	22:15:11	1/3/2003
23.1	23.7	23	22.5	22.2	22.7	23:15:11	1/3/2003
22.8	23.7	22.9	22.5	22.6	22.9	0:15:11	1/4/2003
22	22.8	21.8	22	21.3	22.2	1:15:11	1/4/2003
22.9	23.6	22.8	22.5	22.4	22.8	2:15:11	1/4/2003
23	23.7	22.8	22.5	22.2	22.7	3:15:11	1/4/2003
23	23.6	22.8	22.6	22.5	23	4:15:11	1/4/2003
23.1	23.7	22.7	22.5	22.6	23	5:15:11	1/4/2003
23	23.7	22.8	22.5	22.5	22.8	6:15:11	1/4/2003
23.3	23.6	23	22.6	22.3	22.7	7:15:11	1/4/2003
23	23.8	23	22.5	22.3	22.6	8:15:11	1/4/2003
23	23.7	23	22.7	22.2	22.7	9:15:11	1/4/2003
23.2	23.6	23.1	22.6	22.2	22.6	10:15:11	1/4/2003
23.1	23.9	23.1	22.6	22.3	22.8	11:15:11	1/4/2003

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Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23.1	23.6	23	22.6	22.3	22.8	12:15:11	1/4/2003
21.7	23	21.8	22.1	20.9	22.3	13:15:11	1/4/2003
22.6	23.7	22.7	22.5	22.5	23.2	14:15:11	1/4/2003
23.3	23.5	22.8	22.6	22.5	22.8	15:15:11	1/4/2003
23.1	23.8	22.8	22.7	22.3	23	16:15:11	1/4/2003
23.1	23.7	23.1	22.6	22.6	23.2	17:15:11	1/4/2003
23.4	23.8	23	22.6	22.5	22.8	18:15:11	1/4/2003
23	23.5	22.9	22.5	22.4	23.1	19:15:11	1/4/2003
23	24	22.7	22.5	22.7	23.2	20:15:11	1/4/2003
23.1	23.3	22.6	22.3	22.6	22.9	21:15:11	1/4/2003
22.9	24	22.8	22.4	22.5	22.9	22:15:11	1/4/2003
23.2	23.5	22.8	22.3	22.6	23.4	23:15:11	1/4/2003
23.1	23.8	23.1	22.5	22.6	23	0:15:11	1/5/2003
21.8	23.1	21.8	22.1	21.3	22.9	1:15:11	1/5/2003
22.7	23.7	22.7	22.5	22.7	23.1	2:15:11	1/5/2003
23.2	23.6	22.8	22.3	22.5	23.4	3:15:11	1/5/2003
22.9	23.8	23.2	22.5	22.5	23	4:15:11	1/5/2003
23.3	23.4	23.1	22.7	22.5	23.4	5:15:11	1/5/2003
23.1	24	23	22.7	22.7	23.2	6:15:11	1/5/2003
23	23.5	22.9	22.5	22.5	22.8	7:15:11	1/5/2003
23.1	23.8	22.6	22.4	22.4	23.1	8:15:11	1/5/2003
22.9	23.5	23.1	22.4	22.6	23.2	9:15:11	1/5/2003
23.2	23.8	22.8	22.5	22.4	22.8	10:15:11	1/5/2003
22.9	23.5	22.8	22.3	22.4	23.3	11:15:11	1/5/2003
23.2	23.9	23	22.6	22.6	23.3	12:15:11	1/5/2003
21.9	23.1	21.7	22.1	20.9	22.7	13:15:11	1/5/2003
22.8	23.5	23.1	22.5	22.5	23.2	14:15:11	1/5/2003
23.4	23.8	22.8	22.5	22.5	22.8	15:15:11	1/5/2003
23.2	23.4	23	22.5	22.2	23	16:15:11	1/5/2003
23	23.9	23	22.6	22.6	23.3	17:15:11	1/5/2003
23.3	23.5	22.6	22.6	22.6	23.2	18:15:11	1/5/2003
23.2	23.8	22.9	22.5	22.6	23	19:15:11	1/5/2003
23	23.6	22.9	22.6	22.5	22.8	20:15:11	1/5/2003
23.2	23.7	22.6	22.5	22.3	23.2	21:15:11	1/5/2003
23	23.5	23.1	22.6	22.6	23.1	22:15:11	1/5/2003
22.8	23.8	22.6	22.4	22.5	22.7	23:15:11	1/5/2003
23.3	23.4	22.8	22.6	22.3	23.2	0:15:11	1/6/2003
21.7	23.1	21.7	22.1	20.7	22.6	1:15:11	1/6/2003
22.8	23.5	22.9	22.6	22.2	22.6	2:15:11	1/6/2003
23.2	23.7	22.7	22.5	22.4	23.1	3:15:11	1/6/2003
22.8	23.4	22.8	22.5	22.3	22.9	4:15:11	1/6/2003
23.3	24	23	22.6	22.5	23.2	5:15:11	1/6/2003
23.1	23.5	22.7	22.5	22.5	22.7	6:15:11	1/6/2003
22.8	24	23	22.5	22.3	23	7:15:11	1/6/2003
23.2	23.5	22.7	22.6	22.6	23.1	8:15:11	1/6/2003
22.8	23.9	22.8	22.5	22.6	22.8	9:15:11	1/6/2003
23.1	23	23.1	22.6	22.3	22.5	10:15:11	1/6/2003
23.3	23.1	22.8	22.6	22.2	23.2	11:15:11	1/6/2003
23.1	23.1	23.1	22.5	22.3	23.3	12:15:11	1/6/2003
22	22.7	21.9	22.2	20.7	22.7	13:15:11	1/6/2003
22.8	23.1	22.8	22.5	22.1	22.5	14:15:11	1/6/2003
23.3	23.3	22.6	22.4	22.1	23	15:15:11	1/6/2003
23.2	23.2	22.8	22.5	22.2	23.2	16:15:11	1/6/2003
23	23.1	22.8	22.6	22.4	23.1	17:15:11	1/6/2003
23.1	23.5	22.9	22.5	22.5	23.1	18:15:11	1/6/2003
23.4	23.1	22.8	22.6	22.4	23.1	19:15:11	1/6/2003
23.5	23.3	22.9	22.6	22.3	23	20:15:11	1/6/2003
23.2	23.3	22.6	22.4	22.5	22.8	21:15:11	1/6/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
22.9	23.1	22.6	22.3	22.4	22.6	22:15:11	1/6/2003
23	23.3	22.7	22.3	22.1	22.7	23:15:11	1/6/2003
23.5	23.1	22.7	22.3	22.2	22.8	0:15:11	1/7/2003
22	22.7	21.5	22	20.5	22.5	1:15:11	1/7/2003
22.7	22.9	22.5	22.3	22.1	22.3	2:15:11	1/7/2003
23.3	23.3	22.5	22.3	22	22.1	3:15:11	1/7/2003
23.2	23.1	22.5	22.4	21.9	22.8	4:15:11	1/7/2003
22.7	23.2	22.6	22.4	22.2	22.5	5:15:11	1/7/2003
23.2	23.2	23	22.5	22	22.7	6:15:11	1/7/2003
23.3	23.3	23.1	22.3	22.3	22.8	7:15:11	1/7/2003
23	23.1	22.6	22.3	22.2	22.4	8:15:11	1/7/2003
23	23.1	22.6	22.5	22	22.2	9:15:11	1/7/2003
23.2	23.2	22.7	22.3	22.3	22.4	10:15:11	1/7/2003
23.4	23.3	23	22.4	22.1	22.2	11:15:11	1/7/2003
23.1	23.2	22.7	22.4	22	22.1	12:15:11	1/7/2003
21.6	22.7	22.3	22.1	21.3	21.8	13:15:11	1/7/2003
22.6	23	22.8	22.3	21.8	22	14:15:11	1/7/2003
23.1	23.3	23	22.3	22.1	22.4	15:15:11	1/7/2003
23.3	23.3	22.6	22.5	22.2	22.2	16:15:11	1/7/2003
23.1	23.2	23.1	22.5	22	22.2	17:15:11	1/7/2003
23	23.5	22.8	22.5	22	22.1	18:15:11	1/7/2003
23.1	23.1	23	22.4	22	22.1	19:15:11	1/7/2003
23.2	23.4	22.9	22.3	21.9	22	20:15:11	1/7/2003
23.2	23	23	22.3	22	22	21:15:11	1/7/2003
23	23.5	22.7	22.3	22	22.1	22:15:11	1/7/2003
23	23.1	22.6	22.3	21.8	22	23:15:11	1/7/2003
23.1	23.2	22.7	22.2	21.8	22.5	0:15:11	1/8/2003
21.7	22.7	21.8	22.1	20.7	21.6	1:15:11	1/8/2003
22.6	23.2	22.6	22.3	21.8	22.1	2:15:11	1/8/2003
22.9	23.1	22.6	22.3	21.9	22.1	3:15:11	1/8/2003
23.1	23.4	23.1	22.3	21.8	22.3	4:15:11	1/8/2003
23.2	22.9	23	22.5	21.8	22.1	5:15:11	1/8/2003
23.1	23.3	22.7	22.5	21.8	22	6:15:11	1/8/2003
22.8	23.2	22.9	22.4	21.8	22.2	7:15:11	1/8/2003
23	23.2	23.1	22.4	21.8	22.5	8:15:11	1/8/2003
23.3	23.6	22.9	22.6	22	22.6	9:15:11	1/8/2003
22.9	23.1	22.8	22.5	22	22.6	10:15:11	1/8/2003
23	23.3	22.8	22.5	21.8	22.4	11:15:11	1/8/2003
23.1	23.4	22.6	22.4	21.8	22	12:15:11	1/8/2003
22	22.7	21.9	22	20.7	22	13:15:11	1/8/2003
22.7	23.3	22.7	22.3	21.7	22.4	14:15:11	1/8/2003
23.1	23	23	22.5	22	22.5	15:15:11	1/8/2003
23.2	23.3	22.8	22.5	22	22.5	16:15:11	1/8/2003
23.3	23.5	22.7	22.6	21.8	22.6	17:15:11	1/8/2003
23.1	23.3	22.6	22.6	22.2	22.5	18:15:11	1/8/2003
23.2	23.1	22.8	22.5	22.1	22.6	19:15:11	1/8/2003
22.9	23.6	22.7	22.5	22.1	22.3	20:15:11	1/8/2003
23	23.3	22.8	22.3	22.1	22.3	21:15:11	1/8/2003
23.3	23.1	23.1	22.5	22.3	22.3	22:15:11	1/8/2003
23	23.3	22.8	22.3	22.1	22.2	23:15:11	1/8/2003
23	23.5	22.6	22.3	22.2	22.2	0:15:11	1/9/2003
21.7	22.8	21.7	22.5	20.7	22	1:15:11	1/9/2003
22.6	23.1	22.7	22.5	22	22.2	2:15:11	1/9/2003
22.9	23.1	22.6	22.4	22	22.6	3:15:11	1/9/2003
23.1	23.1	22.7	22.4	22.2	22.5	4:15:11	1/9/2003
23.1	23.1	22.6	22.5	22.2	22.4	5:15:11	1/9/2003
23.3	23.2	22.6	22.3	22.2	22.3	6:15:11	1/9/2003
23.2	23.2	22.8	22.6	22.2	22.2	7:15:11	1/9/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23	23.1	22.7	22.5	22.2	22.2	8:15:11	1/9/2003
22.8	23.2	22.6	22.2	22.1	22.1	9:15:11	1/9/2003
22.8	22.9	22.5	22.3	22.1	22.2	10:15:11	1/9/2003
23.1	23.1	22.6	22.3	22.1	22.5	11:15:11	1/9/2003
23.1	23.2	22.5	22.2	22.1	22.5	12:15:11	1/9/2003
21.8	22.6	21.4	22.2	20.5	22.1	13:15:11	1/9/2003
22.6	22.7	22.5	22.2	22	22.5	14:15:11	1/9/2003
22.7	22.9	22.7	22.1	22.1	22.1	15:15:11	1/9/2003
23	22.8	22.5	22.1	22	22.6	16:15:11	1/9/2003
23.3	22.8	22.5	22.1	22.2	22.4	17:15:11	1/9/2003
23.1	22.8	22.6	22.1	22.1	22.2	18:15:11	1/9/2003
23.2	22.8	22.7	22.2	22	22.6	19:15:11	1/9/2003
23	22.7	22.5	22	22.2	22.5	20:15:11	1/9/2003
22.7	22.7	22.6	22.2	22.1	22.3	21:15:11	1/9/2003
22.7	22.7	22.7	22.5	22	22.3	22:15:11	1/9/2003
22.8	22.5	22.4	22.6	22.2	22.4	23:15:11	1/9/2003
23	22.4	22.4	22.6	22	22.1	0:15:11	1/10/2003
21.7	22.2	21	22.6	20.3	22	1:15:11	1/10/2003
22.7	22.3	22.2	22.7	22	22.1	2:15:11	1/10/2003
22.7	22.4	22.5	22.7	22.1	22.3	3:15:11	1/10/2003
22.8	22.2	22.4	22.7	22	22.5	4:15:11	1/10/2003
23.1	22.3	22.5	23	22	22.2	5:15:11	1/10/2003
23.1	22.3	22.4	23.2	22.1	22.2	6:15:11	1/10/2003
23	22.3	22.3	23	21.8	22.5	7:15:11	1/10/2003
23.1	22.7	22.4	22.6	22.2	22.2	8:15:11	1/10/2003
22.7	22.7	22.5	22.9	22	22.5	9:15:11	1/10/2003
22.8	23.1	22.4	23.2	22.2	22.2	10:15:11	1/10/2003
23.1	23	22.6	22.9	22	22.6	11:15:11	1/10/2003
23.2	23	22.5	23.2	22.1	22.1	12:15:11	1/10/2003
21.6	23	20.7	23	20	22	13:15:11	1/10/2003
22.6	23.3	22.2	22.8	22	22.2	14:15:11	1/10/2003
22.8	23.6	22.2	22.9	22	22.5	15:15:11	1/10/2003
22.8	24	22.2	23.2	22	22.1	16:15:11	1/10/2003
22.8	23.3	22.1	23.3	22	22.6	17:15:11	1/10/2003
22.9	24.1	22.2	22.8	22	22.2	18:15:11	1/10/2003
23	23.3	22.1	23.1	22.1	22.2	19:15:11	1/10/2003
23.1	24.1	22.3	23.1	21.9	22.6	20:15:11	1/10/2003
23.2	23.6	22.2	23	22.1	22.4	21:15:11	1/10/2003
23	24.1	22.3	22.6	22.1	22.2	22:15:11	1/10/2003
22.7	23.3	22.1	22.8	21.8	22.5	23:15:11	1/10/2003
22.8	23.7	22	22.9	22.1	22.3	0:15:11	1/11/2003
21.6	23.6	20.5	23	20	22	1:15:11	1/11/2003
22.8	23.5	21.8	22.8	21.7	22.1	2:15:11	1/11/2003
23	23.2	21.8	22.8	21.8	22.2	3:15:11	1/11/2003
23	22.9	22.1	22.7	22	22.1	4:15:11	1/11/2003
22.8	22.8	22.2	22.8	21.9	22.3	5:15:11	1/11/2003
22.8	22.8	22	22.9	21.8	22.5	6:15:11	1/11/2003
23	22.8	22	22.9	21.7	22.3	7:15:11	1/11/2003
23.1	22.8	22	23	21.9	22.1	8:15:11	1/11/2003
23.2	22.9	22	23	21.8	22.5	9:15:11	1/11/2003
23.1	23	21.9	23.1	21.8	22	10:15:11	1/11/2003
22.8	22.9	21.8	22.9	21.8	22.5	11:15:11	1/11/2003
22.8	22.9	22.1	22.8	22.1	22.4	12:15:11	1/11/2003
21.6	22.7	20.5	22.7	19.8	22.4	13:15:11	1/11/2003
23	23	21.6	23	21.6	22.3	14:15:11	1/11/2003
23.1	23.1	21.7	22.8	21.7	22.6	15:15:11	1/11/2003
23.2	23.1	21.8	22.9	21.8	22.7	16:15:11	1/11/2003
23.1	23.1	21.7	22.8	21.8	22.1	17:15:11	1/11/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23.2	23	21.7	22.8	22	22.4	18:15:11	1/11/2003
23	23	21.7	23.2	21.8	22.8	19:15:11	1/11/2003
22.9	22.9	22	23.1	21.9	22.4	20:15:11	1/11/2003
22.8	23	21.8	23.2	21.8	22.1	21:15:11	1/11/2003
23	23.1	21.7	23.2	21.7	23.2	22:15:11	1/11/2003
22.9	23.3	21.5	23.2	21.6	22.7	23:15:11	1/11/2003
22.9	23.2	21.8	23.1	21.6	22.2	0:15:11	1/12/2003
21.7	22.8	20.7	23.1	20.2	23.3	1:15:11	1/12/2003
23.1	23.1	21.8	22.8	21.5	23.5	2:15:11	1/12/2003
23.2	23	21.8	22.8	21.6	22.7	3:15:11	1/12/2003
23.4	23.1	21.7	23.1	21.5	23.6	4:15:11	1/12/2003
23.5	23.2	21.6	23.1	21.4	23	5:15:11	1/12/2003
23.4	23.4	21.6	23.3	21.4	22.8	6:15:11	1/12/2003
23.4	23.5	21.7	23.1	21.1	23.2	7:15:11	1/12/2003
23.4	23.5	21.7	23	21.2	22.8	8:15:11	1/12/2003
23.3	23.2	21.6	22.7	21.1	23.2	9:15:11	1/12/2003
23.4	23.3	22.3	22.7	21	23.2	10:15:11	1/12/2003
23.3	23.5	22.3	22.7	20.9	23	11:15:11	1/12/2003
23.3	23.3	22.3	22.8	20.8	23.7	12:15:11	1/12/2003
22	23.1	21.7	22.7	21.6	21.7	13:15:11	1/12/2003
22.7	23.6	22	22.5	22.3	22.2	14:15:11	1/12/2003
22.8	23.3	22.1	22.5	22.4	22.2	15:15:11	1/12/2003
22.9	23.5	22.1	22.5	22.5	22.3	16:15:11	1/12/2003
23.1	23.7	22.1	22.5	22.3	22.2	17:15:11	1/12/2003
23	23.4	22.2	22.4	22.5	22.3	18:15:11	1/12/2003
23.2	23.5	22.1	22.3	22.3	22.2	19:15:11	1/12/2003
23.1	23.7	22	21.7	22.4	22.2	20:15:11	1/12/2003
23.3	23.3	21.9	21.3	22.3	22.2	21:15:11	1/12/2003
23.5	24	21.9	21	22.3	22.2	22:15:11	1/12/2003
23.5	23.5	21.8	21	22.5	22.2	23:15:11	1/12/2003
23.2	23.5	21.6	20.8	22.2	22.1	0:15:11	1/13/2003
21.8	23.2	20.2	21.4	21.3	21.7	1:15:11	1/13/2003
23.3	23.6	21.3	21	22.2	22.1	2:15:11	1/13/2003
23.2	23.7	21.5	21	22.2	22.1	3:15:11	1/13/2003
23.3	23.3	21.6	21	22.4	22.1	4:15:11	1/13/2003
23.2	23.9	21.5	20.9	22.2	22.1	5:15:11	1/13/2003
23.3	23.3	21.5	21	22.4	22.2	6:15:11	1/13/2003
23.1	23.8	21.5	20.7	22.3	22.1	7:15:11	1/13/2003
23.1	23.7	21.4	20.7	22.2	22.1	8:15:11	1/13/2003
23.2	23.2	21.4	20.7	22.3	22.2	9:15:11	1/13/2003
23.1	23.8	21.5	22.8	22.2	22.1	10:15:11	1/13/2003
23.1	24	22.5	23.6	22.4	22.1	11:15:11	1/13/2003
23.2	23.7	22.5	23.3	22.6	22.2	12:15:11	1/13/2003
22.1	23.2	22.2	22.9	21.6	21.7	13:15:11	1/13/2003
23.2	24	22.6	22.8	22.2	22	14:15:11	1/13/2003
23.1	23.7	22.6	22.7	22.5	22.1	15:15:11	1/13/2003
23.3	23.3	22.7	22.7	22.4	22.1	16:15:11	1/13/2003
23.4	23.7	22.7	22.7	22.5	22.3	17:15:11	1/13/2003
23.2	23.7	22.7	22.6	22.4	22.2	18:15:11	1/13/2003
23.1	23.1	22.6	22.6	22.3	22.2	19:15:11	1/13/2003
23.1	23.6	22.5	22.7	22.3	22.1	20:15:11	1/13/2003
22.9	23.2	22.5	22.8	22.2	22	21:15:11	1/13/2003
23.1	23.5	22.6	22.9	22.4	22	22:15:11	1/13/2003
23	23.2	22.6	22.9	22.6	22	23:15:11	1/13/2003
22.9	23.5	22.7	22.7	22.6	22	0:15:11	1/14/2003
21.8	23.5	22	22.7	21.9	21.7	1:15:11	1/14/2003
23	23.2	22.5	22.7	22.3	21.7	2:15:11	1/14/2003
22.8	23.3	22.6	22.7	22	22	3:15:11	1/14/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23	23	22.6	22.5	22.7	22.2	4:15:11	1/14/2003
22.9	23.1	22.5	22.7	22.2	22.4	5:15:11	1/14/2003
23.1	23.3	22.5	22.8	21.8	22.1	6:15:11	1/14/2003
23.1	23.1	22.6	22.6	22.4	22.5	7:15:11	1/14/2003
23	23.5	22.3	22.8	22.3	23	8:15:11	1/14/2003
23.1	23	22.5	22.7	22.3	23	9:15:11	1/14/2003
23.5	23.5	22.3	23	22.3	23.6	10:15:11	1/14/2003
23.6	23.1	22.3	23	22.3	23.5	11:15:11	1/14/2003
23.5	23.3	22	22.4	21.2	23.7	12:15:11	1/14/2003
21.8	23	21.4	22.5	20.4	23	13:15:11	1/14/2003
23	23.3	21.6	22.2	21	23.6	14:15:11	1/14/2003
23.1	23.1	21.7	22.3	21.1	23.6	15:15:11	1/14/2003
23	23.5	21.9	22.2	21.3	23.7	16:15:11	1/14/2003
23	23.1	21.7	22.3	21.3	23.6	17:15:11	1/14/2003
23	23.6	21.8	22.3	21.5	23.5	18:15:11	1/14/2003
23	23.2	21.6	22.2	21.4	23.6	19:15:11	1/14/2003
23.1	23.4	21.6	22.1	21.3	23.3	20:15:11	1/14/2003
23.2	23.3	21.3	22.1	21.3	23.3	21:15:11	1/14/2003
23.4	23.3	21.1	21.9	21.2	23.5	22:15:11	1/14/2003
23.5	23.1	20.6	21.7	21.2	23.7	23:15:11	1/14/2003
23.5	23.5	20	21.5	21.1	23.8	0:15:11	1/15/2003
22.2	23	19.9	21.5	20.6	23.2	1:15:11	1/15/2003
22.8	23.4	19.8	20.8	21.2	23.6	2:15:11	1/15/2003
23	23.2	19.6	20.7	21.1	23.7	3:15:11	1/15/2003
23.1	23.3	19.5	20.6	21.2	23.5	4:15:11	1/15/2003
23.3	23.3	19.5	20.5	21.2	23.5	5:15:11	1/15/2003
23.5	23.2	19.3	20.4	21.1	23.8	6:15:11	1/15/2003
23.2	23.3	19.3	20.2	21.1	23.7	7:15:11	1/15/2003
23.1	23.3	19.3	20.2	21.1	23.8	8:15:11	1/15/2003
22.9	23.2	19.2	20.2	21.2	23.7	9:15:11	1/15/2003
23	23.4	23.1	22.8	22	23	10:15:11	1/15/2003
23	23	24.3	24	23	22.5	11:15:11	1/15/2003
23.2	23.6	24	23.9	22.6	22.5	12:15:11	1/15/2003
21.8	23.1	22.6	23.3	21.9	22	13:15:11	1/15/2003
22.7	23.5	24.1	23.9	22.6	22.6	14:15:11	1/15/2003
22.9	23.4	24.3	24.1	22.2	22.3	15:15:11	1/15/2003
22.8	23.6	24.6	24	22.8	22.7	16:15:11	1/15/2003
23	23.6	24.5	24.2	22.6	22.5	17:15:11	1/15/2003
23.3	23.1	23.7	23.7	22.6	22.5	18:15:11	1/15/2003
23.3	22.8	23.5	23.4	22.5	22.4	19:15:11	1/15/2003
23.5	22.8	24.1	23.5	22.3	22.2	20:15:11	1/15/2003
23.6	23	24.1	23.6	23	22.5	21:15:11	1/15/2003
23.2	23.1	23.7	23.5	22.6	22.5	22:15:11	1/15/2003
22.8	23.1	23.7	23.5	22.2	22.2	23:15:11	1/15/2003
22.8	22.8	23.6	23.3	22.8	22.6	0:15:11	1/16/2003
22.1	22.5	22.8	23.1	22.1	22	1:15:11	1/16/2003
22.8	23.1	23.8	23.5	23	22.6	2:15:11	1/16/2003
22.9	22.8	23.7	23.5	22.5	22.5	3:15:11	1/16/2003
23.4	22.8	23.6	23.4	22.5	22.3	4:15:11	1/16/2003
23.4	23	24	23.4	22.7	22.7	5:15:11	1/16/2003
23.3	23.3	24	23.5	22.4	22.4	6:15:11	1/16/2003
22.9	22.8	23.7	23.5	22.8	22.3	7:15:11	1/16/2003
22.9	23.2	23.8	23.6	22.7	22.6	8:15:11	1/16/2003
23	23.1	23.7	23.4	22.3	22.3	9:15:11	1/16/2003
23.4	22.8	24	23.5	22.5	22.3	9:37:35	1/16/2003
23.5	22.8	23.8	23.6	22.5	22.5	9:39:57	1/16/2003
23.1	23.3	23.7	23.5	22.6	22.3	10:39:57	1/16/2003
23.1	22.9	23.7	23.3	22.8	22.6	11:39:57	1/16/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
22.8	23.2	23.8	23.5	22.6	22.6	12:39:57	1/16/2003
22.7	23.2	24	23.4	22.3	22.1	13:39:57	1/16/2003
23.3	23.2	24.2	23.6	22.7	22.6	14:39:57	1/16/2003
23.5	23.4	23.7	23.5	22.4	22.4	15:39:57	1/16/2003
23.2	23.2	23.6	23.4	22.4	22.3	16:39:57	1/16/2003
23.2	23.1	23.7	23.6	22.3	22.3	17:39:57	1/16/2003
23.2	23.5	24	23.8	22.3	22.3	18:39:57	1/16/2003
23	22.8	24.2	23.7	22.7	22.3	19:39:57	1/16/2003
22.8	23.3	24.1	23.6	22.7	22.6	20:39:57	1/16/2003
23.1	23.1	24	23.5	22.5	22.5	21:39:57	1/16/2003
23.5	23.1	23.7	23.4	22.5	22.3	22:39:57	1/16/2003
23.3	23.3	23.8	23.6	23.1	22.5	23:39:57	1/16/2003
23	22.9	24.2	23.6	22.4	22.5	0:39:57	1/17/2003
23	23.1	24.1	23.6	22.5	22.2	1:39:57	1/17/2003
23.4	23	24.1	23.5	22.6	22.5	2:39:57	1/17/2003
23	23.3	24	23.6	22.4	22.2	3:39:57	1/17/2003
22.8	22.9	24.2	23.6	23.1	22.6	4:39:57	1/17/2003
23	23.1	24	23.4	22.5	22.5	5:39:57	1/17/2003
23.3	23.2	24.1	23.5	22.3	22.3	6:39:57	1/17/2003
23.4	22.8	24	23.5	23.1	22.6	7:39:57	1/17/2003
23.6	23.3	23.9	23.5	22.6	22.5	8:39:57	1/17/2003
23.4	23.3	23.6	23.5	22.3	22.3	9:39:57	1/17/2003
23.3	22.8	23.8	23.4	22.8	22.3	10:39:57	1/17/2003
23.1	23.4	23.8	23.7	22.8	22.8	11:39:57	1/17/2003
23	23.3	24	23.5	22.6	22.6	12:39:57	1/17/2003
22.8	23.6	24	23.3	22.2	22.3	13:39:57	1/17/2003
23.4	23.2	24.2	23.5	23	22.5	14:39:57	1/17/2003
23.3	23.2	24.2	23.5	22.8	22.6	15:39:57	1/17/2003
23.1	23.2	24.3	23.6	22.6	22.5	16:39:57	1/17/2003
23.1	23.2	24.3	23.5	22.6	22.5	17:39:57	1/17/2003
23	23.4	24.3	23.5	22.5	22.5	18:39:57	1/17/2003
23.1	23.4	24.3	23.5	22.5	22.5	19:39:57	1/17/2003
23.5	23.3	24	23.3	22.4	22.3	20:39:57	1/17/2003
23.6	23.3	23.7	23.3	22.4	22.2	21:39:57	1/17/2003
23.4	23.2	24.1	23.5	23	22.4	22:39:57	1/17/2003
23.2	22.9	24.3	23.5	22.5	22.4	23:39:57	1/17/2003
23.2	22.5	24.2	23.5	22.4	22.3	0:39:57	1/18/2003
22.9	22.3	24.1	23.3	22.3	22.3	1:39:57	1/18/2003
23.3	22.6	24.3	23.4	23	22.5	2:39:57	1/18/2003
23.2	22.5	24.2	23.4	22.6	22.5	3:39:57	1/18/2003
22.8	22.6	24.2	23.3	22.2	22.2	4:39:57	1/18/2003
23.5	23.1	24	23.3	22.8	22.7	5:39:57	1/18/2003
23.2	22.8	23.9	23.3	22.4	22.3	6:39:57	1/18/2003
23	23.3	24	23.3	22.9	22.5	7:39:57	1/18/2003
22.8	23	23.8	23.2	22.6	22.5	8:39:57	1/18/2003
23.2	23.1	23.7	23.3	22.4	22.4	9:39:57	1/18/2003
23.3	23.1	23.8	23.2	22.6	22.2	10:39:57	1/18/2003
23.3	23.3	23.7	23.1	22.7	22.7	11:39:57	1/18/2003
22.8	23.2	23.7	23.1	22.4	22.4	12:39:57	1/18/2003
22.6	23.2	23.8	23	22.6	22.5	13:39:57	1/18/2003
23.1	23.6	23.8	23.2	22.5	22.2	14:39:57	1/18/2003
23.1	23.5	24	23.3	22.6	22.5	15:39:57	1/18/2003
22.9	23.5	24.1	23.3	22.4	22.4	16:39:57	1/18/2003
23.1	23.4	24	23.3	22.7	22.4	17:39:57	1/18/2003
23.5	23.3	23.9	23.3	22.8	22.6	18:39:57	1/18/2003
23.1	23.3	23.9	23.3	22.5	22.3	19:39:57	1/18/2003
22.8	23.4	24	23.3	22.4	22.2	20:39:57	1/18/2003
23	23.3	23.8	23.2	23	22.7	21:39:57	1/18/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23.2	23.2	23.8	23.2	22.4	22.3	22:39:57	1/18/2003
23.3	23.2	24	23.2	22.5	22.2	23:39:57	1/18/2003
23.1	23.3	23.9	23.2	22.6	22.5	0:39:57	1/19/2003
22.7	23.9	23.8	23.2	22.3	22.2	1:39:57	1/19/2003
23.2	24	24.1	23.3	22.6	22.5	2:39:57	1/19/2003
23	23.6	24.2	23.5	22.4	22.3	3:39:57	1/19/2003
22.8	23.6	24.2	23.5	22.6	22.5	4:39:57	1/19/2003
23.3	23.5	24.2	23.5	22.2	22.2	5:39:57	1/19/2003
23.1	23.3	24.2	23.5	22.7	22.6	6:39:57	1/19/2003
22.7	23.2	24.1	23.6	22.4	22.3	7:39:57	1/19/2003
23.3	23.3	24	23.6	22.4	22.2	8:39:57	1/19/2003
23.2	23.4	23.6	23.3	22.9	22.6	9:39:57	1/19/2003
22.9	23.5	23.5	22.7	22.5	22.5	10:39:57	1/19/2003
22.8	23.4	23.1	22.7	22.4	22.3	11:39:57	1/19/2003
23.2	23.6	23.1	22.7	22.4	22.2	12:39:57	1/19/2003
22.5	23.8	23.5	22.7	22.7	22.3	13:39:57	1/19/2003
23.2	23.6	23.2	22.7	22.9	22.6	14:39:57	1/19/2003
23.3	23.7	23.3	22.7	22.7	22.3	15:25:18	1/19/2003
23.1	23.6	23.5	22.7	23	22.5	15:28:33	1/19/2003
23.1	23.4	23.5	22.8	22.7	22.6	15:30:47	1/19/2003
23	23.5	23.6	22.8	22.8	22.6	15:32:53	1/19/2003
23.3	23.4	23.7	23	22.5	22.5	16:03:41	1/19/2003
23.1	23.2	23.7	22.9	22.3	22.3	17:03:41	1/19/2003
22.9	23.2	23.7	22.8	22.7	22.4	18:03:41	1/19/2003
23.2	23.1	23.5	22.8	23	22.7	19:03:41	1/19/2003
23.5	23.1	23.7	22.8	22.7	22.5	20:03:41	1/19/2003
22.9	23.2	23.3	22.7	22.3	22.3	21:03:41	1/19/2003
23	23.1	23.2	22.7	22.4	22.2	22:03:41	1/19/2003
23.4	22.9	23.3	22.6	22.8	22.6	23:03:41	1/19/2003
23.1	22.9	23.5	22.6	22.4	22.3	0:03:41	1/20/2003
22.5	23	23	22.7	22	22	1:03:41	1/20/2003
22.7	23.1	23.3	22.7	22.3	22.3	2:03:41	1/20/2003
22.9	23.2	23.4	22.8	22.8	22.5	3:03:41	1/20/2003
23.3	23.5	23.1	22.7	22.5	22.5	4:03:41	1/20/2003
22.8	23.1	23.1	22.7	22.3	22.2	5:03:41	1/20/2003
23	23.3	22.9	22.6	22.7	22.3	6:03:41	1/20/2003
23	23.1	22.9	22.6	22.6	22.6	7:03:41	1/20/2003
23	23.3	23	22.7	22.5	22.4	8:03:41	1/20/2003
23.4	23.5	23	22.7	22.2	22.1	9:03:41	1/20/2003
22.9	23.7	23.1	22.7	23	22.6	10:03:41	1/20/2003
23	23.1	23.1	22.7	22.8	22.5	11:03:41	1/20/2003
23.3	23	23.1	22.7	22.6	22.5	12:03:41	1/20/2003
22.5	23.6	22.7	22.7	22	22.2	13:03:41	1/20/2003
22.7	23.6	23.2	22.7	22.6	22.5	14:03:41	1/20/2003
22.8	23.2	23.3	22.7	22.3	22.2	15:03:41	1/20/2003
22.8	23.3	23.3	22.6	22.3	22.2	15:31:37	1/20/2003
22.9	23.4	23	22.7	22.9	22.5	16:31:37	1/20/2003
23.5	23.8	23.3	23	22.9	22.6	17:31:37	1/20/2003
23.2	23.2	23.2	22.9	22.8	22.6	18:31:37	1/20/2003
22.7	23.4	23.3	22.8	22.5	22.5	19:31:37	1/20/2003
23.3	23.8	23.3	23	22.3	22.3	20:31:37	1/20/2003
22.8	23.1	23.5	22.8	22.5	22.2	21:31:37	1/20/2003
23.1	23.7	23.6	22.9	22.8	22.6	22:31:37	1/20/2003
23	23.6	23.7	22.8	22.6	22.6	23:31:37	1/20/2003
22.8	23.4	23.4	22.8	22.4	22.3	0:31:37	1/21/2003
22.2	23.3	23.1	22.5	22.5	22.5	1:31:37	1/21/2003
23	23.7	23.6	22.7	22.6	22.3	2:31:37	1/21/2003
22.7	24	23.5	22.8	22.6	22.5	3:31:37	1/21/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
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Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23	23.1	23.5	22.8	22.2	22.1	4:31:37	1/21/2003
22.8	23.7	23.8	22.8	22.7	22.6	5:31:37	1/21/2003
23.1	24.2	23.3	22.7	22.2	22.3	6:31:37	1/21/2003
23	23.8	23.7	22.8	22.7	22.6	7:31:37	1/21/2003
23.2	23.3	23.7	22.8	22.3	22.3	8:31:37	1/21/2003
22.8	23.3	23.8	22.8	23	22.6	9:31:37	1/21/2003
23.2	23.9	23.6	22.7	22.5	22.3	10:31:37	1/21/2003
22.8	24.4	23.3	22.7	22.7	22.3	11:31:37	1/21/2003
23.2	23.5	23.3	22.7	22.8	22.5	12:31:37	1/21/2003
22	23.6	23.1	22.3	22.7	22.4	13:31:37	1/21/2003
22.8	23.4	23	22.7	22.1	22.2	14:31:37	1/21/2003
23.3	23.8	23.2	22.8	22.7	22.6	15:31:37	1/21/2003
23.1	24.2	23.3	23	22.4	22.4	16:31:37	1/21/2003
23	23.3	23.3	22.8	22.5	22.4	17:31:37	1/21/2003
23.3	23.9	23.3	23	22.8	22.7	18:31:37	1/21/2003
23.2	23.3	23.6	23	22.7	22.6	19:31:37	1/21/2003
22.8	24.1	23.6	22.9	22.3	22.4	20:31:37	1/21/2003
23.3	23.6	23	22.8	22.2	22.2	21:31:37	1/21/2003
23	23.6	23.2	22.8	22.5	22.2	22:31:37	1/21/2003
22.8	23.8	23.2	22.9	22.8	22.6	23:31:37	1/21/2003
23.5	23.3	23.5	23	22.6	22.5	0:31:37	1/22/2003
22.6	23.6	23.4	22.6	22.4	22.4	1:31:37	1/22/2003
23.1	23.9	23.6	22.8	22.6	22.4	2:31:37	1/22/2003
22.9	23.5	23.3	22.8	22.7	22.7	3:31:37	1/22/2003
23.3	23.8	23.1	22.8	22.4	22.4	4:31:37	1/22/2003
22.9	23.4	23.5	23	22.5	22.3	5:31:37	1/22/2003
23.1	23.9	23.7	23	22.7	22.6	6:31:37	1/22/2003
23	23.3	23.5	22.8	22.3	22.2	7:31:37	1/22/2003
23.1	23.8	23.6	22.9	22.8	22.6	8:31:37	1/22/2003
23.2	23.5	23.6	22.9	22.6	22.6	9:31:37	1/22/2003
22.8	23.6	23.4	22.8	22.3	22.3	10:31:37	1/22/2003
23.2	23.6	23.1	22.6	22.8	22.5	11:31:37	1/22/2003
23	23.5	23.1	22.8	22.6	22.5	12:31:37	1/22/2003
22	23.2	23.2	22.5	22.7	22.5	13:31:37	1/22/2003
23.1	23.3	23	22.7	22.4	22.2	14:31:37	1/22/2003
23	23.7	23.2	22.7	22.6	22.6	15:31:37	1/22/2003
23.1	23.2	23.1	22.8	22.4	22.3	16:31:37	1/22/2003
23.3	23.9	23.1	22.7	22.8	22.6	17:31:37	1/22/2003
23	23.3	23.2	23	22.8	22.7	18:31:37	1/22/2003
23	23.8	23.6	23	22.5	22.6	19:31:37	1/22/2003
23.3	23.5	23.6	23.1	22.3	22.4	20:31:37	1/22/2003
23.1	23.6	23.6	23	22.5	22.3	21:31:37	1/22/2003
23	23.5	23.6	23	23	22.6	22:31:37	1/22/2003
23.2	23.2	23.8	23.1	22.8	22.6	23:31:37	1/22/2003
23	23.7	23.5	22.8	22.3	22.4	0:31:37	1/23/2003
22.3	23.2	23.4	22.7	22.3	22.5	1:31:37	1/23/2003
23.2	23.5	23.6	22.9	22.7	22.4	2:31:37	1/23/2003
22.8	23.6	23.6	23	22.8	22.7	3:31:37	1/23/2003
23.2	23.5	23.4	22.9	22.3	22.3	4:31:37	1/23/2003
23	23.5	23.4	23	22.7	22.6	5:31:37	1/23/2003
23.2	23.5	23.2	22.9	22.7	22.6	6:31:37	1/23/2003
23.4	23.7	23.3	22.9	22.4	22.3	7:31:37	1/23/2003
22.9	23.2	23.2	22.8	22.3	22.3	8:31:37	1/23/2003
23.2	23.8	23.1	22.8	22.8	22.6	9:31:37	1/23/2003
23.4	23	23.3	22.9	22.7	22.6	10:31:37	1/23/2003
23.1	23.5	23.3	22.9	22.6	22.5	11:31:37	1/23/2003
23.1	23.3	23.3	22.8	22.3	22.2	12:31:37	1/23/2003
21.9	22.9	23.1	22.5	22.6	22.6	13:31:37	1/23/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23	23.2	23.2	22.7	22.2	22.3	14:31:37	1/23/2003
22.8	23.5	23.5	22.8	22.9	22.6	15:31:37	1/23/2003
23.1	23.6	23.5	23	22.7	22.6	16:31:37	1/23/2003
23.3	23.2	23.3	22.9	22.3	22.4	17:31:37	1/23/2003
23	23.8	23.5	22.8	22.5	22.3	18:31:37	1/23/2003
23	23.1	23.6	22.9	22.5	22.3	19:31:37	1/23/2003
23.1	23.6	23.1	22.8	22.8	22.7	20:31:37	1/23/2003
22.8	23.4	23.2	22.8	22.6	22.5	21:31:37	1/23/2003
23.2	23.5	23.7	22.9	22.3	22.3	22:31:37	1/23/2003
23.1	23.7	23.4	22.8	22.6	22.4	23:31:37	1/23/2003
22.8	23.5	23.6	22.8	22.7	22.7	0:31:37	1/24/2003
22.4	23.5	23.3	22.7	22.5	22.5	1:31:37	1/24/2003
23.1	23.7	23.5	22.9	22.5	22.3	2:31:37	1/24/2003
23.1	23.4	23.5	23	22.7	22.6	3:31:37	1/24/2003
23	23.5	23.5	22.9	22.4	22.4	4:31:37	1/24/2003
23.3	23.3	23.2	22.9	22.5	22.3	5:31:37	1/24/2003
23	23.6	23.1	22.8	22.9	22.7	6:31:37	1/24/2003
23.1	23.2	23	22.7	22.5	22.5	7:31:37	1/24/2003
23.2	23.6	23.2	22.7	22.2	22.3	8:31:37	1/24/2003
22.9	23.3	23.2	22.7	22.5	22.3	9:31:37	1/24/2003
23.1	23.5	23.1	22.8	22.8	22.7	10:31:37	1/24/2003
23.2	23.5	23.1	22.8	22.6	22.6	11:31:37	1/24/2003
22.9	23.5	23.1	22.8	22.6	22.5	12:31:37	1/24/2003
22.1	23.1	23.2	22.5	22.7	22.6	13:31:37	1/24/2003
23	23.1	23	22.8	22.2	22.3	14:31:37	1/24/2003
22.8	23.6	23.3	23	22.7	22.5	15:31:37	1/24/2003
23.2	23.6	23.7	23	22.8	22.7	16:31:37	1/24/2003
23	23.1	23.5	22.9	22.9	22.7	17:31:37	1/24/2003
23.1	23.7	23.4	22.9	22.6	22.5	18:31:37	1/24/2003
23.4	23.3	23.3	23	22.4	22.3	19:31:37	1/24/2003
22.8	23.2	23.5	22.8	22.5	22.2	20:31:37	1/24/2003
23.1	23.7	23.3	22.8	22.8	22.6	21:31:37	1/24/2003
22.8	23.1	23.4	22.8	22.4	22.3	22:31:37	1/24/2003
22.8	23.4	23.2	22.7	22.3	22.2	23:31:37	1/24/2003
23.2	23.4	23.2	22.7	23	22.6	0:31:37	1/25/2003
22.3	23	23.1	22.3	22.8	22.4	1:31:37	1/25/2003
23.1	23.1	23.5	22.7	22.2	22.2	2:31:37	1/25/2003
22.7	23.5	23.3	22.6	22.7	22.6	3:31:37	1/25/2003
22.8	23.5	23.5	22.7	22.2	22.2	4:31:37	1/25/2003
23.1	23.1	23.6	22.7	22.8	22.7	5:31:37	1/25/2003
22.7	23.8	23.6	22.8	22.3	22.3	6:31:37	1/25/2003
23.2	23.3	23.6	22.8	22.6	22.5	7:31:37	1/25/2003
23	23.8	23.4	22.8	22.4	22.5	8:31:37	1/25/2003
22.7	23.5	23.1	22.6	22.1	22.2	9:31:37	1/25/2003
23.3	23.5	23.3	22.7	22.7	22.5	10:31:37	1/25/2003
23	24	23.6	22.9	22.7	22.5	11:31:37	1/25/2003
23	23.7	23.6	23	22.5	22.5	12:31:37	1/25/2003
22	23.6	23.3	22.7	22.6	22.5	13:31:37	1/25/2003
22.9	23.7	23	22.7	22.6	22.5	14:31:37	1/25/2003
23.3	23.7	23	22.7	22.2	22.2	15:31:37	1/25/2003
23.2	23.9	23.1	22.9	22.3	22.3	16:31:37	1/25/2003
22.9	23.8	23.1	22.8	22.3	22.3	17:31:37	1/25/2003
23.3	23.3	23.4	22.9	22.4	22.3	18:31:37	1/25/2003
23.1	23.9	23	22.7	22.3	22.2	19:31:37	1/25/2003
23	23.4	23.1	22.8	22.2	22.3	20:31:37	1/25/2003
23.3	23.5	23.2	23	22.4	22.3	21:31:37	1/25/2003
22.9	23.7	23.2	22.8	22.2	22.3	22:31:37	1/25/2003
23.1	23.1	23.1	22.7	22.3	22.2	23:31:37	1/25/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date
23.1	23.6	23	22.8	22.2	22.2	0:31:37	1/26/2003
22.5	23.5	23.5	22.7	22.5	22.5	1:31:37	1/26/2003
23.1	23.6	23.5	23	22.3	22.3	2:31:37	1/26/2003
22.9	23.8	23.6	22.8	22.6	22.5	3:31:37	1/26/2003
23.2	23.3	23.6	22.9	22.8	22.5	4:31:37	1/26/2003
23	23.1	23.5	22.8	22.9	22.6	5:31:37	1/26/2003
23.2	23.8	23.3	22.9	23	22.5	6:31:37	1/26/2003
23.2	23.6	23.6	22.8	22.8	22.4	7:31:37	1/26/2003
23	23.2	23.7	23	22.2	22.3	8:31:37	1/26/2003
23	23.6	23.7	23	22.4	22.3	9:31:37	1/26/2003
23.3	23.8	23.4	22.8	22.4	22.3	10:31:37	1/26/2003
23.5	23.2	23.4	22.8	22.6	22.5	11:31:37	1/26/2003
23.2	23.7	23.5	22.8	22.7	22.7	12:31:37	1/26/2003
22.6	23.5	23.1	22.8	22.9	22.7	13:31:37	1/26/2003
23.1	23.6	23.6	22.9	22.6	22.6	14:31:37	1/26/2003
22.8	23.7	23.5	23	22.7	22.7	15:31:37	1/26/2003
23.2	23.2	23.3	23	22.8	22.7	16:31:37	1/26/2003
23.3	23.4	23.5	23	23	22.8	17:31:37	1/26/2003
23.1	23.7	23.5	23	23	22.5	18:31:37	1/26/2003
23	23.1	23.7	23	22.4	22.3	19:31:37	1/26/2003
23.4	23.5	23.6	23	22.3	22.3	20:31:37	1/26/2003
22.8	23.5	23.1	22.8	22.2	22.3	21:31:37	1/26/2003
23.3	23.2	23.3	22.8	22.4	22.4	22:31:37	1/26/2003
22.8	23.5	23.3	22.8	22.3	22.3	23:31:37	1/26/2003
23.1	23	23.2	22.8	22.2	22.2	0:31:37	1/27/2003
22.6	23.1	23.6	22.8	22.6	22.5	1:31:37	1/27/2003
23.2	23.4	23.7	23	22.3	22.3	2:31:37	1/27/2003
22.7	23.6	23.2	22.9	22.3	22.3	3:31:37	1/27/2003
23.3	23.4	23.2	22.8	22.3	22.2	4:31:37	1/27/2003
23	23.4	23.2	22.8	22.8	22.5	5:31:37	1/27/2003
22.9	23.7	23.2	22.7	23	22.7	6:31:37	1/27/2003
23.2	23.2	23.2	22.8	22.9	22.7	7:31:37	1/27/2003
22.8	23.5	23.1	22.9	22.7	22.7	8:31:37	1/27/2003
23	23.1	23.1	22.6	22.5	22.2	9:31:37	1/27/2003
23.6	23.3	23.1	22.6	22	22	10:31:37	1/27/2003
23.6	23.3	23.3	22.9	21.9	21.8	11:31:37	1/27/2003
23.6	23.6	23.4	22.9	21.8	21.5	12:31:37	1/27/2003
21.6	22.3	22.7	22.2	22	21.6	13:31:37	1/27/2003
22.5	23.3	23.5	22.8	22	22.1	14:31:37	1/27/2003
22.8	23.5	23.6	22.8	22.3	22.1	15:31:37	1/27/2003
22.8	23.7	23.4	22.9	22	22	16:31:37	1/27/2003
22.9	23.3	23.6	23	22.4	22.2	17:31:37	1/27/2003
22.7	23.2	23.6	22.9	22.1	22	18:31:37	1/27/2003
22.9	23	23.8	22.9	22.3	22.2	19:31:37	1/27/2003
22.5	23	23.5	22.8	22.2	22	20:31:37	1/27/2003
22.8	23.1	23.2	22.7	22	22	21:31:37	1/27/2003
22.6	22.9	23.1	22.7	22.2	22	22:31:37	1/27/2003
22.5	23.3	23.4	22.7	22.1	22	23:31:37	1/27/2003
22.5	23.3	23.4	22.7	21.7	21.8	0:31:37	1/28/2003
22	22.5	23.1	22.4	22.1	21.8	1:31:37	1/28/2003
22.5	23.2	23.2	22.6	21.8	21.8	2:31:37	1/28/2003
22.7	22.9	23.2	22.7	22	22	3:31:37	1/28/2003
22.8	22.9	23.2	22.7	22.2	22	4:31:37	1/28/2003
22.5	23.1	23.3	22.7	21.8	21.8	5:31:37	1/28/2003
22.8	23.1	23.3	22.7	22	21.8	6:31:37	1/28/2003
22.6	23.1	23.2	22.7	22.1	22	7:31:37	1/28/2003
22.6	23.2	23.5	22.8	21.9	21.8	8:31:37	1/28/2003

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Lumbriculus variegatus 28-day bioaccumulation (Probes 13, 14, 15, 16, 17, 18)
Test Dates: December 30, 2002 - January 28, 2003

Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18	Time	Date

	Probe 13	Probe 14	Probe 15	Probe 16	Probe 17	Probe 18
Low (°C):	21.6	22.2	19.2	20.2	19.8	21.5
High (°C):	23.6	24.4	24.6	24.2	24.3	24.5
Average (°C):	23.0	23.4	22.9	22.7	22.3	22.5

Sediment Preparation for *Lumbriculus variegautus* Bioaccumulation Test

Client: Sanborn, Head & Associates	Project: 02070, Blackburn Union	SDG: 6669

	Sample Number	Sediment Visual Characterization	Sieving / homogenization	Sediment loaded per test replicate (g, nominal)
☆	23395 TR-3/12-16-02	very moist brown mud with large organic matter (leaves + sticks)	12/24/02 JW	KR 12/29/02 1,000.00g ÷ 500g 14:30
—	23401 Sed RN-4/12-18-02	sandy mud, rocks	12/28/02 JG	J 12/30/02 ≈1500g (1L) 13:15
☆	23402 LP-09/12-18-02	moist, dark brown cohesive mud, with some organic, rocks.	12/27/02 JG	KR 12/29/02 15:00
☆	23403 LP-06/12-18-02	moist, dark mud, cohesive, some organic and rocks.	12/27/02 JG	KR 12/29/02 15:30
—	23404 NR-8/12-18-02	sand, rocks	12/28/02 JG	~~KR 12/29~~ 12/30/02 13:30
—	23405 NR-7/12-18-02	sand, rocks	12/28/02 JG	J 12/30/02 ≈1500g 13:45
☆	23406 LP-01/12-18-02	dark, moist mud, cohesive, with moderate organics.	12/27/02 JG	KR 12/29/02 15:45
—	23407 NR-5/12-18-02	sand and mud some organics	12/28/02 JG	J 12/30/02 ≈1300g 14:10
☆	23411 Sed Nwd-1/12-17-02	very moist, soft brown mud with leaves and other organic matter	12/24/02 JW	KR 12/29/02 15:50
☆	23412 OW-801/12-17-02	sandy mud with sticks and leaves, very moist	12/24/02 JW	KR 12/29/02 16:00
☆	23414 Control Lv	Formulated sediment	--	KR 12/29/02 16:30

Reps C Approx (insufficient sed for 100

23423

Date sediments prepared and loaded into test chambers: Initials: ≈1 L 12/30/02 J

Reviewer: [signature] Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

Main Identity

From: "Liz Porta" <eporta@whgrp.com>
To: "Phil Downey" <pdowney@aquatecb.com>
Cc: "Nikki Delude Roy" <nroy@sanbornhead.com>; "Susan Chapnick" <s.chapnick@attbi.com>
Sent: Tuesday, December 24, 2002 11:08 AM
Attach: Elizabeth Porta.vcf
Subject: Blackburn Site - Preliminary TOC results

Hi Phil,

I hope this helps you some. Let me know if you have any questions.

SedNwd-1:	3.9%	23411	A
SedNwd-2:	0.99%		
SedNwd-3:	4.8%		
OW-408:	3.2%	23412?	A
SedNwd-4:	7.6%		
SedNwd-5:	2.7%		
SedNwd-6:	6.0%		
SedNwd-7:	6.4%		
SedNwd-8:	12.7%		
SedNwd-9:	12.3%		
SedNwd-10:	5.7%		
TR-3:	1.05%	23395	A
OW-409:	1.4%	23402	A
LP-09:	6.9%	OK → mw	
LP-06:	9.5%	23403	A
LP-01:	5.8%	23406	A
NR-8:	0.67%	23404	B
NR-7:	0.35%	23405	B
NR-5:	1.06%	23407	B
SedRN-4:	0.22% T	23401	B

Liz Porta

O-W 401 ? — OK

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: December 29, 2002 Project: 02070 – *Lv 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs			✓	✓	✓	✓	✓

Noon delivery cycle

• splitter boxes filling?			✓	✓	✓	✓	✓
• syringes filling?			✓	✓	✓	✓	✓
• needles flowing?			✓	✓	✓	✓	✓
• drainage to waste ok?			✓	✓	✓	✓	✓
• empty waste buckets?			✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓

Test monitoring

• test temperature ok?			AM ✓ PM ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
• Probe assignments: 18 - CART 1, CART 4 - 13, 17 - CART 1, 14 - CART 3, 15 - CART 2, 16 - CART 2							
• D.O. ok?	✗	✓	* ✓	✓	✓	✓	✓
• check for floating organisms		✓	✓	✓	✓	✓	✓
• feeding completed?	NA	NA	NA	NA	NA	NA	NA

Additional activities

Prior to midnight fill reservoirs		✓	✓	✓	✓	✓	✓
Check sediment water supply		✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes		✓	✓	✓	✓	✓	✓

Corrective Action / Comments		Organisms located for Group A 15:20-16:30	Cart #2 - turned up heater *Some group A D.O.'s were low.				
Initials/Date	JW 12/30	12/30 JW	12/31/03 JG	JG 1/1/03	JW 1/2/03	JG 1/3/03	JG 1/4/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: J Date 02/17/03 Lv28dpkg

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 5, 2002 Project: 02070 – *Lv 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓

Noon delivery cycle

• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓

Test monitoring

• test temperature ok? • Probe assignments: Cart 1 - 17, 18 Cart 2 - 15, 16 Cart 3 - 14 Cart 4 - 13	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
• D.O. ok?	✓	✓	✓	✓	✓	✓	✓
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	NA	NA	NA	NA	NA	NA	NA

Additional activities

Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓

Corrective Action / Comments							
Initials/Date	JW 1/5/03	JW 1/6/03	JW 1/7	JW 1/8/03	JW 1/9	JG 1/10/03	JG 1/11/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: [illegible] Date 2/12/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 12, 2002 Project: 02070 – *Lv 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Test monitoring							
• test temperature ok? • Probe assignments:	✓✓ ①	(*) ✓✓	✓✓	(2) ✓ (3) ✓	✓✓	✓✓	✓✓
• D.O. ok?	✓	✓	✓	✓	✓	✓	✓
• check for floating organisms	✓	✓	✓	✓	✓	✓	
• feeding completed?	NA	NA	NA	NA	NA	NA	NA
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments	① Probes 15, 17 reading low, Temp. of test = 22.1 OK ②	(*) Cart 2 reading low. Circulator clogged.		(2) Cart 2 reading low new circ added and heat turn up			
Initials/Date	JW 1/12/03	JW 1/13	JG KR 1/14/03	JG KR 1/15/03	KR JG 1/16/03	JG 1/17/03	JG 1/18/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments: (2) Circulator had stopped working. Mix of cart temp 22.3°C front of cart too cold JW 1/12/03

(3) Cart 2 reading too high turned heater down JW 1/15/03

Reviewer: O Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 19, 2002 Project: 02070 – *Lv 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Test monitoring							
• test temperature ok?	(1) ✓ ✓						
• Probe assignments:		✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
• D.O. ok?	✓	✓	✓	✓	✓	✓	✓
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	NA	NA	NA	NA	NA	NA	NA
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments	(1) Cat 3 turned down						
Initials/Date	KK JW 1/19/03	JW 1/20/03	JG 1/21/03	JW 1/22/03	JW 1/23/03	JG 1/24/03	JG 1/25/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: S Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 26, 2002 Project: 02070 – *Lv 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓					
Noon delivery cycle							
• splitter boxes filling?	✓	✓					
• syringes filling?	✓	✓					
• needles flowing?	✓	✓					
• drainage to waste ok?	✓	✓					
• empty waste buckets?	✓ ✓	✓ ✓	✓				
Test monitoring							
• test temperature ok? • Probe assignments:	✓ ✓	✓ ✓	✓				
• D.O. ok?	✓	✓					
• check for floating organisms	✓	✓					
• feeding completed?	NA	NA	NA	NA	NA	NA	NA
Additional activities							
Prior to midnight fill reservoirs	✓	✓					
Check sediment water supply	✓	✓					
Check delivery tubing to splitter boxes	✓	✓					
Corrective Action / Comments		Group A ended.	0830 Group B removed from system Ended				
Initials/Date	JW 1/26/03	JW 1/27/03	J 1/28/03				

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: J Date 2/17/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Lv28dpkg

Preparation of Formulated Control Sediment
for
Freshwater Sediment Toxicity Tests

Procedure based on EPA/600/R-99/064

Batch No. 12/16/02 Prepared by: jww / KR

Ingredient	Amount (g)	Percent composition
Fine sand	3850	
Medium sand (washed)	1925	77
Kaolinite clay	1275	17
Alpha-cellulose	375	5
CaCO3	75	1
Total	7500	100

Store well-mixed and dry in a sealed Rubbermaid box. Label by batch number.

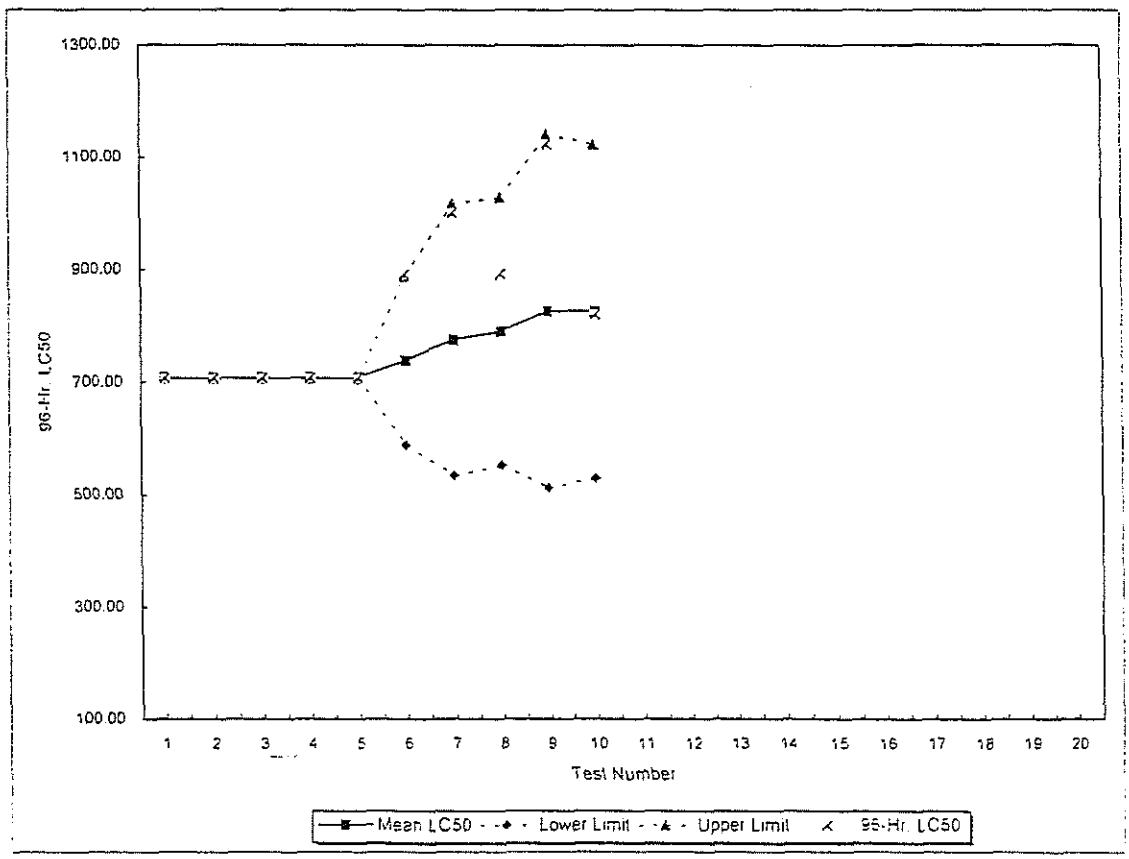
Sample Number: 23214
23423

Standard Reference Toxicant Control Charts

Sanborn, Head & Associates, Inc.

Reference Toxicant Control Chart
Lumbriculus variegatus
in Potassium chloride (mg/L)

Test Number	Test Date	Organism Age (Days)	96-Hr. LC50	Mean LC50	Lower Limit	Upper Limit	Organism Source
1	08/11/00	Adult	707.107	707.11			Aquatic Research Organisms
2	08/14/00	Adult	707.107	707.11	707.11	707.11	Aquatic Research Organisms
3	08/14/00	Adult	707.107	707.11	707.11	707.11	Aquatic Research Organisms
4	08/15/00	Adult	707.107	707.11	707.11	707.11	Aquatic Research Organisms
5	08/15/00	Adult	707.107	707.11	707.11	707.11	Aquatic Research Organisms
6	10/19/01	Adult	890.899	737.74	587.67	887.80	Aquatic Research Organisms
7	10/30/01	Adult	1000.000	775.20	534.23	1016.18	Aquatic Research Organisms
8	11/01/01	Adult	890.899	789.67	552.04	1027.29	Aquatic Research Organisms
9	08/24/02	Adult	1122.460	826.64	512.59	1140.70	Aquatic Research Organisms
10	01/01/03	Adult	820.335	826.01	529.89	1122.13	Aquatic Research Organisms
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							



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Appendix C-2
Sediment Toxicity Laboratory Report

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Ms. Nicole Delude Roy, P.G.
Sanborn, Head & Associates, Inc.
6 Gavins Falls Road
Concord, NH 03301

Dear Ms. Roy:

Enclosed please find one bound and one unbound copies of the reports and data packages for the *Hyalella azteca* 28-day survival and growth whole sediment toxicity tests and the *Lumbriculus variegates* 28-day bioaccumulation whole sediment tests for the Blackburn Union Privileges Superfund Site Ecological Analyses and Support.

If you have any questions, please call Dr. Philip C. Downey or me.

Sincerely,

John Williams
Manager, Environmental Toxicology

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Toxicity Summary Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 02070
SDG 6669
Site: Blackburn Union

Method: 100.4HA28 Species: *Hyalella azteca*

Sample ID	Sample Name	Control Group	Mean Proportion Surviving	Mean Weight Growth (mg)
023395	TR-3/12-16-02	B	0.91	0.563
023401	Sed RN-4/12-18-02	B	0.84	0.397
023404	NR-8/12-18-02	B	0.94	0.401
023405	NR-7/12-18-02	B	0.84	0.466
023406	LP-01/12-18-02	B	0.85	0.324
023411	Sed Nwd-1/12-17-02	B	0.91	0.263 *
023412	OW-801/12-17-02	B	0.83	0.296
023413	Formulated sediment	A	0.88	0.194
023418	Natural sediment control	B	0.88	0.355

* Indicates a statistically significant reduction ($P<0.05$) in the response relative to the response in the corresponding control sample group.

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0100	
2	23406	0.0016	6.3515

(p-value = 0.0262)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.2500	0.5600	0.3538
2	23406	8	0.2800	0.3900	0.3238

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0100	0.0998	0.0353	28.2256
2	23406	0.0016	0.0396	0.0140	12.2374

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0036	0.0036	0.6240
Within (Error)	14	0.0808	0.0058	
Total	15	0.0844		

(p-value = 0.4428)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23406	0.3238	0.3238	0.7899	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.2214)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23406	0.3238	0.3238	0.7899	

Unequal Var: t critical value = 1.8331 (1 Tailed, alpha = 0.05, df = 9)
(p-value = 0.2249)

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23406	8	0.0669	18.9	0.0300

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23406	8	0.0696	19.7	0.0300

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.3400	0.3400
1	Natural Contr B	2	0.3300	0.3300
1	Natural Contr B	3	0.2500	0.2500
1	Natural Contr B	4	0.3300	0.3300
1	Natural Contr B	5	0.4300	0.4300
1	Natural Contr B	6	0.2600	0.2600
1	Natural Contr B	7	0.3300	0.3300
1	Natural Contr B	8	0.5600	0.5600
2	23411	1	0.3100	0.3100
2	23411	2	0.1300	0.1300
2	23411	3	0.3000	0.3000
2	23411	4	0.2800	0.2800
2	23411	5	0.2300	0.2300
2	23411	6	0.1800	0.1800
2	23411	7	0.3800	0.3800
2	23411	8	0.2900	0.2900

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.1137
W = 0.9578

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0100	
2	23411	0.0063	1.5879

(p-value = 0.5567)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.2500	0.5600	0.3538
2	23411	8	0.1300	0.3800	0.2625

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0100	0.0998	0.0353	28.2256
2	23411	0.0063	0.0792	0.0280	30.1857

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0333	0.0333	4.0997
Within (Error)	14	0.1137	0.0081	
Total	15	0.1470		

(p-value = 0.0624)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23411	0.2625	0.2625	2.0248	*

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.0312)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23411	0.2625	0.2625	2.0248	*

Unequal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.0320)

Title: Hyalella azteca 28-d growth: Control B vs. 23411
File: 23411hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23411	8	0.0794	22.4	0.0912

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23411	8	0.0798	22.6	0.0912

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.3400	0.3400
1	Natural Contr B	2	0.3300	0.3300
1	Natural Contr B	3	0.2500	0.2500
1	Natural Contr B	4	0.3300	0.3300
1	Natural Contr B	5	0.4300	0.4300
1	Natural Contr B	6	0.2600	0.2600
1	Natural Contr B	7	0.3300	0.3300
1	Natural Contr B	8	0.5600	0.5600
2	23412	1	0.3100	0.3100
2	23412	2	0.2900	0.2900
2	23412	3	0.3000	0.3000
2	23412	4	0.3100	0.3100
2	23412	5	0.2500	0.2500
2	23412	6	0.3700	0.3700
2	23412	7	0.2200	0.2200
2	23412	8	0.3300	0.3300

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.0847
W = 0.9026

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0100	
2	23412	0.0021	4.6681

(p-value = 0.0596)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.2500	0.5600	0.3538
2	23412	8	0.2200	0.3700	0.2975

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0100	0.0998	0.0353	28.2256
2	23412	0.0021	0.0462	0.0163	15.5340

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0127	0.0127	2.0910
Within (Error)	14	0.0847	0.0061	
Total	15	0.0974		

(p-value = 0.1702)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23412	0.2975	0.2975	1.4460	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.0851)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	Natural Contr B	0.3538	0.3538		
2	23412	0.2975	0.2975	1.4460	

Unequal Var: t critical value = 1.8125 (1 Tailed, alpha = 0.05, df = 10)
(p-value = 0.0894)

Title: Hyalella azteca 28-d growth: Control B vs. 23412
File: 23412hag Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23412	8	0.0685	19.4	0.0562

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23412	8	0.0705	19.9	0.0562

Amphipod (*Hyalella azteca*) Day 28 Survival and Dry Weight Data

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6669
	Test Start: 12/22/02	Test End: 1/19/03

Sample	Repl.	# Alive	Init.	Repick #	Repick Init.	Total Surv	# Weighed	L Pan Wt.	Pan Wt. & Amphipod F Wt.
23395	A	9	JW	—	—	9	9	38.79	42.88
	B	9+1 Dead	KR	—	—	9	9	37.57	42.57
TR-3/12-	C	8	KR	—	—	8	8	40.08	46.20
16-02	D	10	JW	—	—	10	10	42.38	48.34
	E	9	JW	—	—	9	9	34.86	39.95
	F	10	KR	—	—	10	10	41.72	48.32
	G	9	KR	—	—	9	9	38.79	43.26
	H	9	JW	—	—	9	9	38.89	42.56
23401	A	7+1 dead	JW	0	JW	7	7	44.09	47.24
	B	9	KR	—	—	9	9	37.57	40.09
Sed RN-	C (1)	10	KR	—	—	10	10	40.29	44.66
4/12-18-	D	8	JW	0	KR	8	8	42.75	46.3~~69~~
02	E	~~0~~	KR	0	JW	~~0~~	0	41.38	— JW
	F	7+1 (dead)	KR	0	JW	7	7	44.68	47.67
	G	10	JW	—	—	10	10 JG	~~4~~35.98	39.60
	H	8	JW	—	—	8	8	41.46	44.40
23404	A	10	KR	—	—	10	10	42.24	45.94
	B	9	JW	—	—	9	9	37.69	42.14
NR-8/12	C	9	KR	—	—	9	9	39.55	42.99
-18-02	D	9	JW	—	—	9	9	43.07	47.24
	E	~~0~~	KR	0	JW	0	0	40.52	—
	F	10	JW	—	—	10	10	39.72	43.22
	G	10	KR	—	—	10	10	40.08	43.34
	H	9	JW	—	—	9	9	40.99	44.79
23405	A	9	KR	—	—	9	9	38.26	42.00
	B	JW ~~9~~ 8	JW	—	—	8	8	41.03	44.39
NR-7/12	C	9	KR	—	—	9	9	42.61	46.56
-18-02	D	7	KR	0	JW	7	7	38.70	42.32
	E	8	JW	0	KR	8	8	45.06	49.01
	F	7	JW	0	JW	7	7	40.01	43.64
	G	10	KR	—	—	10	10	43.53	48.41
	H	9	KR	—	—	9	9	40.50	44.46
23406	A	6+1 dead	JW	0	JW	6	6	40.86	42.56
	B	10	JW	—	—	10	10	38.00	4~~8~~ JW 1.69
LP-	C	10	KR	—	—	10	10	41.04	43.83
01/12-18	D	8	JW	0	JW	8	8	38.81	41.97
-02	E	9	KR	—	—	9	9	46.39	49.23
	F	10	JW	—	—	10	10	41.05	44.05
	G	10	KR	—	—	10	10	39.09	42.39
	H	5	KR	0	—	5	5	39.30	40.91
Date / Time in/out of oven. oven temp. initials / date:							JW 1/19/03	JG 1/18/03	JW 1/20/03
Balance QC (20 mg wt):								19.98	19.99

① ♀ neonates observed JW 1/19/03

Final: 19.99 19.99 JW 1/20/03

Ha28dpkg

Reviewer: [signature] Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Into Oven 46°C 1/19/03 16:45 JW

Out of Oven 14.30 JW 1/20/03

Amphipod (*Hyalella azteca*) Day 28 Survival and Dry Weight Data

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6669
	Test Start: 12/22/02	Test End: 1/19/03

Sample	Repl.	# Alive	Init.	Repick #	Repick Init.	Total Surv	# Weighed	Pan Wt.	Pan Wt. & Amphipod Wt.
23411	A	10	JW	—	—	10	10	41.28	~~42.06~~ JW 44.35
	B	10	JW	—	—	10	10	42.97	44.32
Sed	C	8	JW	—	—	8	8	40.25	42.67
Nwd-	D	9	KR	—	—	9	9	39.69	42.17
1/12-17-	E	10	JW	—	—	10	10	41.38	43.64
02	F	9	KR	—	—	9	9	39.32	40.95
	G	8	J	—		8	8	39.57	42.61
	H	9	JW	—	—	9	9	44.03	46.68
23412	A	9	JW	—	—	9	9	45.21	47.99
	B	7	KR	0	—	7	7	36.98	38.99
OW-	C	8	KR	—	—	8	8	41.16	43.54
801/12-	D	7	J	—	—	7	7	38.88	41.04
17-02	E	10	J	—	—	10	10	42.59	45.06
	F	7	J	—	—	7	7	44.69	JW 47.31
	G	10	J	—	—	10	10	40.29	42.48
	H	8	KR	—	—	8	8	39.77	42.38
23413	A	10	KR	—	—	10	10	40.28	42.06
	B	7	J	~~0~~ 0	J	7	7	39.39	40.93
Control	C	8	J	0	J	8	8	38.88	40.66
Ha	D	10	JW	—	—	10	10	42.29	43.81
	E	7	KR	0	KR	7	7	39.14	40.98
	F	9	J	—	—	9	9	42.37	43.85
	G	10	JW	—	—	10	10	41.62	43.46
	H	9	J	—	—	9	9	40.03	41.57
23418	A	8	KR	—	—	8	8	44.94	47.68
	B	10	~~0~~ J	—	—	10	10	41.13	44.41
Natural	C	9	J	—	—	9	9	39.15	41.41
Sediment	D	10	KR	—	—	10	10	46.27	49.57
	E	9	J	—	—	9	9	39.67	43.52
	F	9	KR	—	—	9	9	40.90	43.27
	G	7	J	0	J	7	7	40.41	42.73
	H	8	KR	0	KR	8	8	39.78	44.29
	A								
	B								
	C								
	D								
	E								
	F								
	G								
	H								
Date / Time in/out of oven, oven temp. , initials / date:							JW 1/19/03	JG 1/18/03	JW 1/20/03
Balance QC (20 mg wt):								19.98	19.99

Final: 19.98 19.99

Reviewer: J Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

Hyalella azteca Initial Dry Weight

Project: Sanborn, Head & Associates, Inc., 02070	
Culture ID: Ha 121302	Age: 9 d

Replicate	Number of Organisms weighed	Initial Pan Weight (mg)	Final Pan Weight (mg)	Average Dry Weight (mg)
1	10	47.07	47.25	0.018
2	10	45.48	~~46~~ JW 45.72	0.024
3	10	44.01	44.23	0.022
4	10	47.11	47.28	0.017
	Balance QC:	20 mg = 19.95	20 mg = 19.95	
		Date/Time In oven/Init.	Date/Time In oven/Init.	
		JW 12/22/02 11:10	12/23/02 16:30 JW	
		Oven Temp: 80 °C	Oven Temp: 80 °C	

Reviewer [signature] Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

Aquatic Research Organisms

DATA SHEET

I. Organism History

Species: Hyalella azteca

Source: Lab reared ✓ Hatchery reared ____ Field collected ____

Hatch date 12/13/02 Receipt date ____

Lot number 121302HA Strain ARO

Brood Origination USFWS MO

II. Water Quality

Temperature 24 °C Salinity — ppt DO 7.1

pH 7.2 Hardness ≈150 ppm

III. Culture Conditions

System: FW static renewal

Diet: Flake Food ✓ Phytoplankton ____ Trout Chow ✓

Brine Shrimp ____ Rotifers ____ Other ____

Prophylactic Treatments: ____

Comments: ____

IV. Shipping Information

Client: AQUATEC VT # of Organisms: 800+

Carrier: FED EX Date Shipped: 12/20/02

Biologist: Stan Sentske

2/22/02 JW
Temp 21.8°C
pH 7.7
DO 7.1
Cond. 820
50% H_2O Change
Fed yct/sel.
Tetrafin ✓

1 - 800 - 927 - 1650

PO Box 1271 • One Lafayette Road • Hampton, NH 03842 • (603) 926-1650

Rec'd
12-21-02
Temp = 18.8°C
pH = 7.4
D.O. = 8.6

Cond. = 1009
Normal
Fed/H_2O change

Amphipod (*Hyalella azteca*) 28-day Chronic Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6675

Day of Analysis

Sample	Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
23395	pH	8.2	8.0	8.0			7.8			7.8		7.6		7.7			7.6		7.6		7.6	
	DO	7.0	7.0	7.5			7.3			7.6		7.1		6.7			6.4		6.2		7.4	
	Cond	434	—	—			339			—		—		342			—		367			
23401	pH	7.5	7.6	7.6			7.6			7.6		7.7		7.6			7.5		7.6		7.5	
	DO	7.7	8.2	8.3			7.6			8.3		8.0		7.5			6.8		6.8		7.8	
	Cond	339	—	—			295			—		—		315			—		335			
23404	pH	7.5	7.5	7.5			7.5			7.6		7.5		7.5			7.5		7.5		7.5	
	DO	7.6	8.1	8.1			7.8			8.3		7.2		7.4			6.9		6.5		7.4	
	Cond	338	—	—			292			—		—		315			—		330			
23405	pH	7.4	7.5	7.4			7.5			7.6		7.6		7.4			7.5		7.5		7.5	
	DO	7.4	8.0	7.9			8.0			8.4		7.6		7.2			6.7		6.7		7.2	
	Cond	308	—	—			297			—		—		313			—		334			
23406	pH	7.3	7.5	7.4			7.5			7.5		7.7		7.5			7.7		7.6		7.4	
	DO	7.1	8.0	8.5			7.9			8.3		7.4		6.9			6.3		6.1		7.1	
	Cond	330	—	—			290			—		—		307			—		337			
2002 2003	I / D	12/22 JW	12/23 JW	12/24 JW	12/25	12/26	12/27 JG	12/28	12/29	12/30 JW	12/31	1/1 JG	1/2	1/3 JG	1/4	1/5	1/6 JW	1/7	1/8 JW	1/9	1/10 JG	1/11

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0 and 27 Measure DO and pH three times weekly, conductivity once weekly. Temperature is monitored continuously and at least daily in each water bath by manual measurement.

Date / time of test start: 12/22/02 11:30 Initials: KR/JW

Review: J Date: 1/21/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Ctchronicpkg

Amphipod (*Hyalella azteca*) 28-day Chronic Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6675

Day of Analysis

Sample	Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
23411	pH	7.2	7.3	7.4			7.4			7.6		7.6		7.5			7.4		7.4		7.1	
	DO	5.9	6.6	7.0			6.6			6.7		7.8		6.1			5.1		4.8		5.8	
	Cond	367	—	—			288			—		—		332			—		340			
23412	pH	7.1	7.3	7.3			7.4			7.6		7.5		7.3			7.3		7.2		7.0	
	DO	5.8	6.9	7.2			7.2			7.2		8.0		6.0			5.4		5.0		5.5	
	Cond	377	—	—			305			—		—		304			—		332			
23413	pH	7.0	7.2	7.3			7.3			7.4		7.5		7.4			7.4		7.4		7.2	
	DO	8.2	7.8	8.3			8.2			8.3		8.0		7.6			6.9		6.8		7.4	
	Cond	421	—	—			349			—		—		354			—		357			
23418	pH	7.2	7.4	7.5			7.5			7.5		7.6		7.5			7.5		7.4		7.3	
	DO	7.9	7.9	8.3			8.3			8.6		7.7		7.1			6.8		6.3		7.4	
	Cond	314	—	—			291			—		—		315			—		337			
	pH																					
	DO																					
	Cond																					
2002 2003	I / D	12/22 JW	12/23 JW	12/24 JW	12/25	12/26	12/27 JG	12/28	12/29	12/30 JW	12/31	1/1 JG	1/2	1/3 JG	1/4	1/5	1/6 JW	1/7	1/8 JW	1/9	1/10 JG	1/11

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0 and 27 Measure DO and pH three times weekly, conductivity once weekly. Temperature is monitored continuously and at least daily in each water bath by manual measurement.

Review: [signature] Date: 1/21/03

Aquatec Biological Sciences, Inc. Williston, Vermont

Clchronicpkg

Amphipod (*Hyalella azteca*) 28-day Chronic Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6675

Day of Analysis

Sample	Parameter	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
23395	pH		7.7		7.7		7.7	7.5														
	DO		6.8		7.7		7.3	7.0														
	Cond		—		-		323	321														
23401	pH		7.5		7.5		7.5	7.5														
	DO		7.1		7.5		7.6	7.2														
	Cond		—		—		309	305														
23404	pH		7.5		7.5		7.4	7.5														
	DO		7.1		7.4		7.4	7.2														
	Cond		—		—		309	306														
23405	pH		7.4		7.4		7.3	7.4														
	DO		6.9		7.2		7.1	6.8														
	Cond		—		—		308	307														
23406	pH		7.4		7.4		7.3	7.4														
	DO		6.8		7.0		7.0	6.9														
	Cond		—		—		282	299														
2003	I / D	1/12	1/13 JW	1/14	1/15 JG	1/16	1/17 JG	1/18 JG	1/19													

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0 and 27 Measure DO and pH three times weekly, conductivity once weekly. Temperature is monitored continuously and at least daily in each water bath by manual measurement.

Review: J Date: 1/21/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Ctchronicpkg

Amphipod (*Hyalella azteca*) 28-day Chronic Test, Overlying Water Environmental Monitoring

Client: Sanborn, Head & Associates, Inc.	Project: 02070	SDG: 6675

Day of Analysis

Sample	Parameter	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
23411	pH		7.2		7.2		7.1	7.2														
	DO		5.4		6.2		6.0	5.6														
	Cond		—		—		299	300														
23412	pH		7.2		7.1		7.0	7.1														
	DO		5.4		5.5		5.2	5.0														
	Cond		—		—		303	303														
223413	pH		7.3		7.3		7.3	7.4														
	DO		7.2		7.3		7.7	7.2														
	Cond		—		—		327	325														
23418	pH		7.5		7.4		7.4	7.5														
	DO		7.3		7.4		7.9	7.0														
	Cond		—		—		306	309														
	pH																					
	DO																					
	Cond																					
2003	I / D	1/12	1/13 JW	1/14	1/15 JG	1/16	1/17 JG	1/18 JG	1/19													

Comments: Measure total water quality (pH, DO, conductivity, ammonia, alkalinity, hardness) on Days 0 and 27 Measure DO and pH three times weekly, conductivity once weekly. Temperature is monitored continuously and at least daily in each water bath by manual measurement.

Review: [signature] Date: 1/21/03

Aquatec Biological Sciences, Inc. Willison, Vermont

Ctchronicpkg

Alkalinity and Hardness Worksheet

				Alkalinity						Hardness					
Sample Identifier	LIMS Identifier	Sub ID Code	Sampling Date	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Alkalinity	Sample Volume	Initial Titrant (ml)	Final Titrant (ml)	Analyst	Analysis Date	Hardness
23395	TR-3/12-16-02	H.a. Day 0	12/22/02	25	36	39.1	TW	1/2/03	124.0	50	5.2	9.8	JG	12/31/02	92.0
23395	TR-3/12-16-02	H.a. Day 27	1/18/03	25	10.9	12.8	TW	1/22/03	76.0	50	5.2	9.7	JG	1/21/03	90.0
23401	Sed RN-4/12-18-02	H.a. Day 0	12/22/02	25	39.1	40.7	TW	1/2/03	64.0	50	9.8	14.8	JG	12/31/02	100.0
23401	Sed RN-4/12-18-02	H.a. Day 27	1/18/03	25	12.8	14.5	TW	1/22/03	68.0	50	9.7	14.4	JG	1/21/03	94.0
23404	NR-8/12-18-02	H.a. Day 0	12/22/02	25	40.7	42.2	TW	1/2/03	60.0	50	14.8	19.9	JG	12/31/02	102.0
23404	NR-8/12-18-02	H.a. Day 27	1/18/03	25	14.5	16.1	TW	1/22/03	64.0	50	14.4	19.1	JG	1/21/03	94.0
23405	NR-7/12-18-02	H.a. Day 0	12/22/02	25	42.2	43.7	TW	1/2/03	60.0	50	19.9	24.9	JG	12/31/02	100.0
23405	NR-7/12-18-02	H.a. Day 27	1/18/03	25	16.1	17.9	TW	1/22/03	72.0	50	19.1	23.8	JG	1/21/03	94.0
23406	LP-01/12-18-02	H.a. Day 0	12/22/02	25	43.7	45.1	TW	1/2/03	56.0	50	24.9	29.5	JG	12/31/02	92.0
23406	LP-01/12-18-02	H.a. Day 27	1/18/03	25	18	19.6	TW	1/22/03	64.0	50	23.8	28.3	JG	1/21/03	90.0
23411	Sed Nwd-1/12-17-0	H.a. Day 0	12/22/02	25	45.1	46.7	TW	1/2/03	64.0	50	29.5	34.8	JG	12/31/02	106.0
23411	Sed Nwd-1/12-17-0	H.a. Day 27	1/18/03	25	19.6	21.1	TW	1/22/03	60.0	50	28.3	32.9	JG	1/21/03	92.0
23412	OW-801/12-17-02	H.a. Day 0	12/22/02	25	0.1	1.6	TW	1/2/03	60.0	50	34.8	36	JG	12/31/02	24.0
23412	OW-801/12-17-02	H.a. Day 27	1/18/03	25	21.1	22.7	TW	1/22/03	64.0	50	32.9	37.5	JG	1/21/03	92.0
23413	Formulated sedime	H.a. Day 0	12/22/02	25	1.6	4.6	TW	1/2/03	120.0	50	40	47.6	JG	12/31/02	152.0
23413	Formulated sedime	H.a. Day 27	1/18/03	25	22.7	24.6	TW	1/22/03	76.0	50	37.5	42.6	JG	1/21/03	102.0
23418	Natural sediment C	H.a. Day 0	12/22/02	25	4.6	6.3	TW	1/2/03	68.0	50	0	5	JG	12/31/02	100.0
23418	Natural sediment C	H.a. Day 27	1/18/03	25	24.6	26.4	TW	1/22/03	72.0	50	42.6	47.3	JG	1/21/03	94.0

Peak Table: Ammonia

Total Ammonia (mg/L)
Porewater
Day 0 - Hyalella.

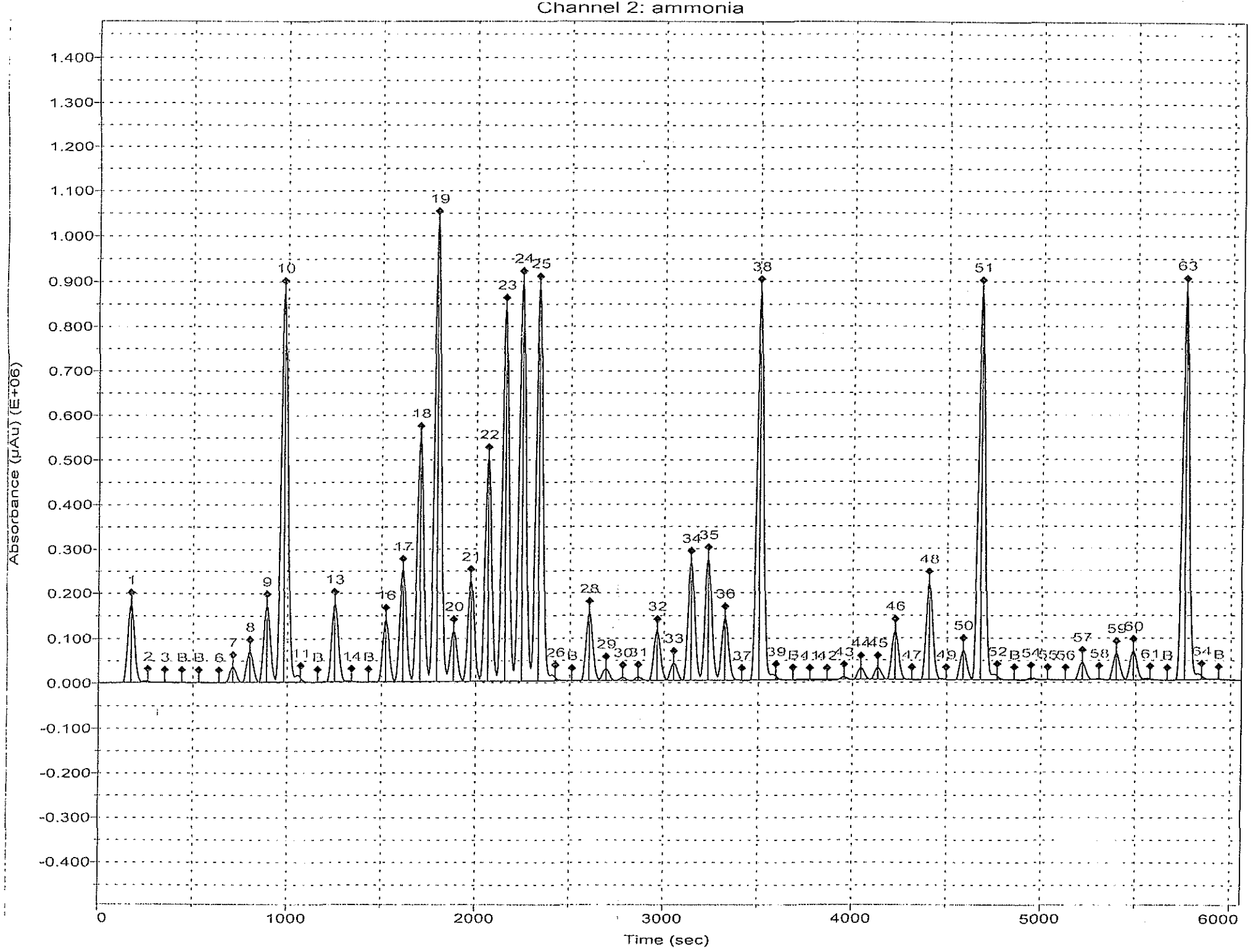
File name: A:\010703B.RST
Date: January 07, 2003
Operator: JJG

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
1	6	Sync	SYNC	1	1	172579	1.002977	
2	0	CarryOver	CO	1	1	2924	0.027876	
3	0	CarryOver	CO	1	1	534	0.014142	
B	0	Baseline	RB	1	1	0	0.011072	BL
B	0	Baseline	RB	1	1	0	0.011072	BL
6	1	Cal 0	C	1	1	-600	0.007624	
7	2	Cal 1	C	1	1	34013	0.206565	
8	3	Cal 2	C	1	1	67188	0.397237	
9	4	Cal 3	C	1	1	167177	0.971930	
10	5	Cal 4	C	1	1	868979	5.005573	
11	0	Blank	U	1	1	-5761	-0.022044	LO
B	0	Baseline	RB	1	1	0	0.011072	BL
13	6	ICV	U	1	1	172293	1.001335	
14	1	ICB	U	1	1	-1599	0.001879	
B	0	Baseline	RB	1	1	0	0.011072	BL
16	31	23382WER6.25	U	10	1	136472	7.954517	
17	32	23382WER12.5	U	10	1	244697	14.174784	
18	33	23382WER25	U	10	1	541306	31.222546	
19	34	23382WER50	U	10	1	1013865	58.383110	
20	35	WERAMM612/19	U	10	1	93363	5.476804	
21	36	WERAMM1212/19	U	10	1	221058	12.816123	
22	37	WERAMM2512/19	U	10	1	493262	28.461210	
23	38	WERAMM5012/19	U	10	1	824392	47.493076	
24	39	23395PW	U	1	1	877535	5.054751	
25	5	CCV	U	1	1	864468	4.979649	
26	1	CCB	U	1	1	-6814	-0.028094	LO
B	0	Baseline	RB	1	1	0	0.011072	BL
28	41	23402PW	U	1	1	148984	0.867368	
29	42	23403PW	U	1	1	23575	0.146569	
30	43	23404PW	U	1	1	6210	0.046766	
31	44	23405PW	U	1	1	7403	0.053622	
32	45	23406PW	U	1	1	108943	0.637225	
33	46	23407PW	U	1	1	36324	0.219847	
34	47	23411PW	U	1	1	261156	1.512082	
35	48	23412PW	U	1	1	265668	1.538012	
36	49	23395HA012/22	U	1	1	131867	0.768984	
37	50	23401HA0	U	1	1	-3282	-0.007789	LO
38	5	CCV	U	1	1	871623	5.020772	
39	1	CCB	U	1	1	-7037	-0.029371	LO
B	0	Baseline	RB	1	1	0	0.011072	BL
41	51	23404HA0	U	1	1	-2130	-0.001169	LO
42	52	23405HA0	U	1	1	-2449	-0.003004	LO
43	53	23406HA0	U	1	1	5637	0.043470	
44	54	23411HA0	U	1	1	25263	0.156273	
45	55	23412HA0	U	1	1	25249	0.156191	
46	56	23413HA0	U	1	1	106719	0.624441	
47	57	23418HA0	U	1	1	-2664	-0.004241	LO
48	58	233951V012/30	U	1	1	212691	1.233523	
49	59	234011V012/31	U	1	1	-3910	-0.011403	LO
50	60	234021LV012/30	U	1	1	65652	0.388408	
51	5	CCV	U	1	1	867691	4.998171	
52	1	CCB	U	1	1	-7336	-0.031092	LO
B	0	Baseline	RB	1	1	0	0.011072	BL
54	61	23403LV012/30	U	1	1	4453	0.036666	

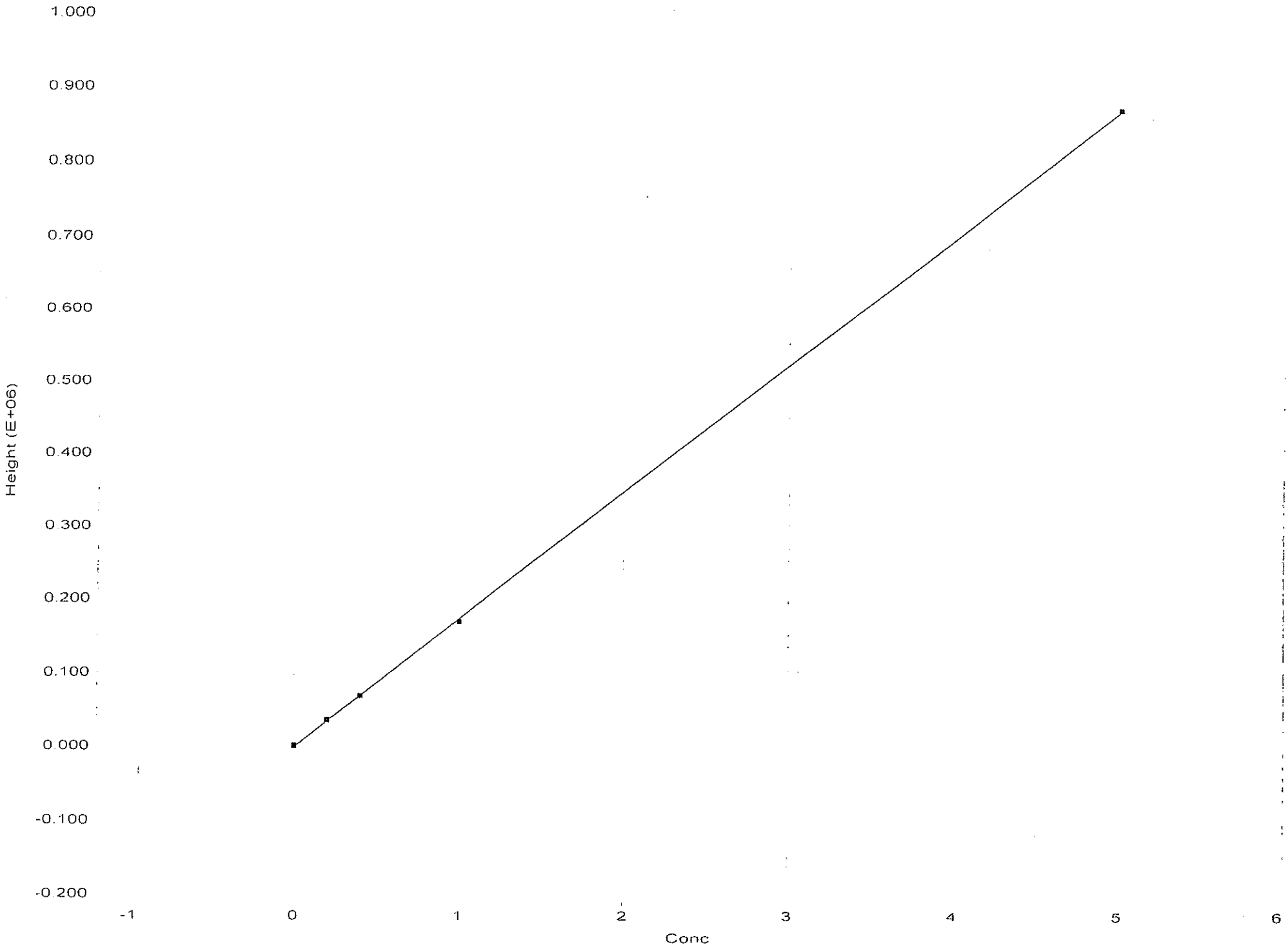
Sediment Porewater Total Ammonia-N (mg/L)

Overlying water on Day 0 (Test Start) Total Ammonia-N (mg/L)

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
55	62	23404LV012/31	U	1	1	-155	0.010182	
56	63	23405LV012/31	U	1	1	-541	0.007961	
57	64	23406LV012/30	U	1	1	39269	0.236773	
58	65	23407LV012/31	U	1	1	2426	0.025017	
59	66	23411LV012/30	U	1	1	59204	0.351348	
60	67	23412LV012/30	U	1	1	63483	0.375942	
61	68	23414LV012/30	U	1	1	1635	0.020468	
B	69	23423LV012/31	RB	1	1	0	0.011072	BL
63	5	CCV	U	1	1	874149	5.035287	
64	1	CCB	U	1	1	-6924	-0.028725	LO
B	0	Baseline	RB	1	1	0	0.011072	BL


Channel 2: ammonia
Absorbance (µAu) (E+06)
Time (sec)
1.400
1.300
1.200
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
0
1000
2000
3000
4000
5000
6000

ammonia: Calibration, Peak 6-65



ammonia: calibration, peak 6-65

File name: A:\010703B.RST
Date: January 07, 2003
Operator: JJG

Name	Conc	Height
* Cal 0	0.0000	-600
* Cal 1	0.2000	34013
* Cal 2	0.4000	67188
* Cal 3	1.0000	167177
* Cal 4	5.0000	868979

Calib Coef:
y=bx+a
a: (intercept) -1.9264e+03
b: 1.7399e+05

Corr Coef: 0.999972

Carryover: 1.69%

No Drift Peaks

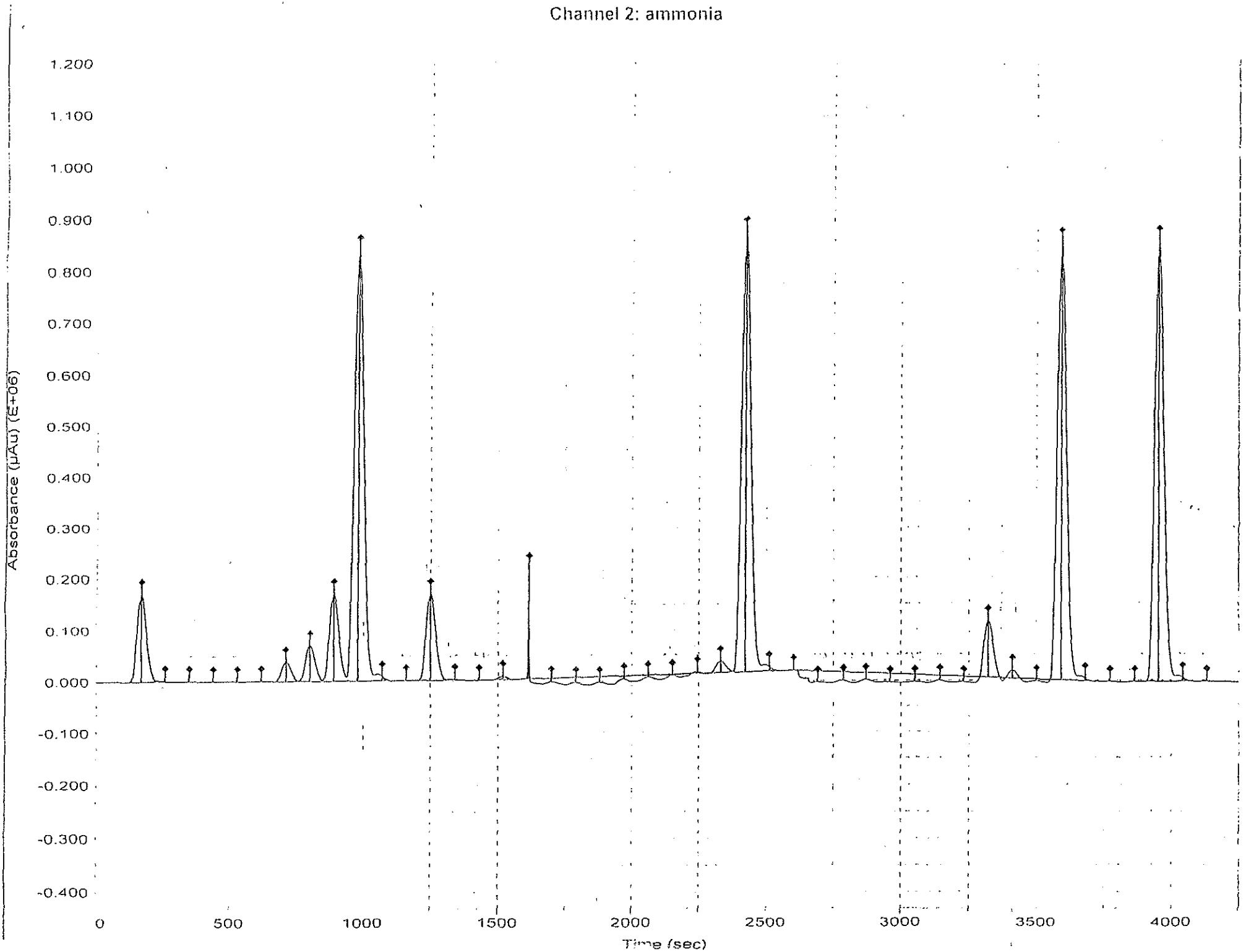
Peak Table: ammonia

1012L Ammonia (mg/L)

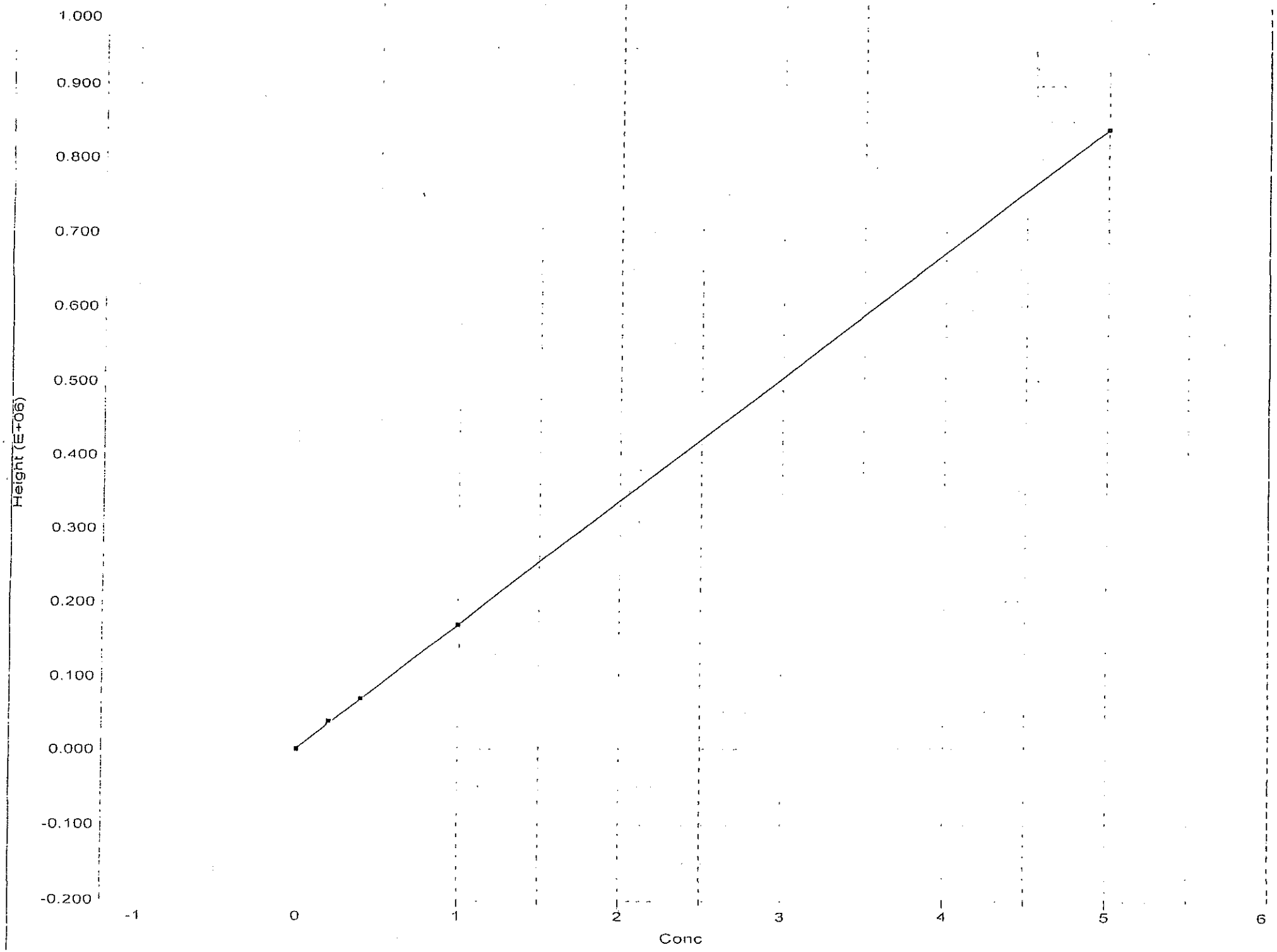
File name: A:\013003A.RST
Date: January 30, 2003
Operator: JJG

Peak	Cup	Name	Type	Dil	Wt	Height	Calc. (mg/L)	Flags
1	6	Sync	SYNC	1	1	170072	1.008511	
2	0	CarryOver	CO	1	1	2278	0.006534	
3	0	CarryOver	CO	1	1	309	-0.005228	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
B	0	Baseline	RB	1	1	0	-0.007071	BL
6	1	Cal 0	C	1	1	-119	-0.007779	LO
7	2	Cal 1	C	1	1	37302	0.215675	
8	3	Cal 2	C	1	1	68477	0.401837	
9	4	Cal 3	C	1	1	168252	0.997640	
10	5	Cal 4	C	1	1	838449	4.999698	
11	0	Blank	U	1	1	-4081	-0.031439	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
13	6	ICV	U	1	1	167900	0.995538	
14	1	ICB	U	1	1	-785	-0.011759	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
16	31	23395HA27-1/18	U	1	1	6401	0.031150	
17	32	23401HA27-1/18	U	1	1	214400	1.273211	
18	33	23404HA27-1/18	U	1	1	-9902	-0.066202	LO
19	34	23405HA27-1/18	U	1	1	-10313	-0.068653	LO
20	35	23406HA27-1/18	U	1	1	-10846	-0.071839	LO
21	36	23411HA27-1/18	U	1	1	-5316	-0.038813	LO
22	37	23412HA27-1/18	U	1	1	-3989	-0.030892	LO
23	38	23413HA27-1/18	U	1	1	-2073	-0.019450	LO
24	39	23418HA27-1/18	U	1	1	2957	0.010588	
25	40	23395LV27-1/26	U	1	1	21486	0.121234	
26	5	CCV	U	1	1	858176	5.117498	
27	1	CCB	U	1	1	-4141	-0.031799	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
29	41	23401LV27-1/27	U	1	1	-20879	-0.131748	LO
30	42	23402LV27-1/26	U	1	1	-16057	-0.102952	LO
31	43	23403LV27-1/26	U	1	1	-12750	-0.083207	LO
32	44	23404LV27-1/27	U	1	1	-15264	-0.098220	LO
33	45	23405LV27-1/27	U	1	1	-13383	-0.086989	LO
34	46	23406LV27-1/26	U	1	1	-8868	-0.060025	LO
35	47	23407LV27-1/27	U	1	1	-10254	-0.068305	LO
36	48	23411LV27-1/26	U	1	1	111132	0.656550	
37	49	23412LV27-1/26	U	1	1	14527	0.079674	
38	50	23414LV27-1/26	U	1	1	-3967	-0.030761	LO
39	5	CCV	U	1	1	854397	5.094934	
40	1	CCB	U	1	1	-6776	-0.047533	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL
42	51	23423LV27-1/27	U	1	1	265	-0.005486	LO
43	5	CCV	U	1	1	861472	5.137180	
44	1	CCB	U	1	1	-6279	-0.038592	LO
B	0	Baseline	RB	1	1	0	-0.007071	BL

Overlying water on Day 27


Channel 2: ammonia
Absorbance (µAu) (E+06)
1.200
1.100
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
0
500
1000
1500
2000
2500
3000
3500
4000
Time (sec)

ammonia: Calibration, Peak 6-45



File name: A:\013003A.RST
Date: January 30, 2003
Operator: JJG

Name	Conc	Height
* Cal 0	0.0000	-119
* Cal 1	0.2000	37302
* Cal 2	0.4000	68477
* Cal 3	1.0000	168252
* Cal 4	5.0000	838449

Calib Coef:
y=bx+a
a: (intercept) 1.1842e+03
b: 1.6746e+05

Corr Coef: 0.999990

Carryover: 1.34%

No Drift Peaks

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22	20.5	13:05:10	12/22/02
22.4	21.6	14:05:10	12/22/02
22.5	21.9	15:05:10	12/22/02
22.6	23.6	16:05:10	12/22/02
22.6	23.4	17:05:10	12/22/02
22.6	22.3	18:05:10	12/22/02
22.4	22.9	19:05:10	12/22/02
22.5	22.8	20:05:10	12/22/02
22.4	22.5	21:05:10	12/22/02
22.4	23	22:05:10	12/22/02
22.5	22.2	23:05:10	12/22/02
22.2	23	0:05:10	12/23/02
22.1	22.2	1:05:10	12/23/02
22.2	23.1	2:05:10	12/23/02
22.3	22.1	3:05:10	12/23/02
22.5	23.5	4:05:10	12/23/02
22.3	22.1	5:05:10	12/23/02
22.5	23.5	6:05:10	12/23/02
22.5	22.1	7:05:10	12/23/02
22.3	23.3	8:05:10	12/23/02
22.4	22.2	9:05:10	12/23/02
22.6	23	10:05:10	12/23/02
22.5	22.3	11:05:10	12/23/02
22.5	23.1	12:05:10	12/23/02
22.2	22.2	13:05:10	12/23/02
22.4	23.1	14:05:10	12/23/02
22.5	22.4	15:05:10	12/23/02
22.6	23.2	16:05:10	12/23/02
22.6	22.3	17:05:10	12/23/02
22.4	23	18:05:10	12/23/02
22.2	22.3	19:02:14	12/23/02
22.2	22.9	20:02:14	12/23/02
22	22.1	21:02:14	12/23/02
22	23.1	22:02:14	12/23/02
22	22	23:02:14	12/23/02
21.9	23	0:02:14	12/24/02
21.5	22.2	1:02:14	12/24/02
21.7	23	2:02:14	12/24/02
21.9	22.2	3:02:14	12/24/02
21.8	22.5	4:02:14	12/24/02
21.9	22.5	5:02:14	12/24/02
21.8	22.3	6:02:14	12/24/02

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
21.8	22.8	7:02:14	12/24/02
21.9	22	8:02:14	12/24/02
22	23.2	9:02:14	12/24/02
22.3	22.2	10:02:14	12/24/02
22.6	22.5	11:02:14	12/24/02
22.7	22.7	12:02:14	12/24/02
22.3	21.9	13:02:14	12/24/02
22.7	23.3	14:02:14	12/24/02
23	22.1	15:02:14	12/24/02
22.8	23	16:02:14	12/24/02
22.6	22.1	17:02:14	12/24/02
22.8	22.6	18:02:14	12/24/02
22.7	22.7	19:02:14	12/24/02
22.7	22	20:02:14	12/24/02
22.7	23	21:02:14	12/24/02
22.6	22.2	22:02:14	12/24/02
22.6	22.2	23:02:14	12/24/02
22.6	22.7	0:02:14	12/25/02
22	22.2	1:02:14	12/25/02
22.2	22.1	2:02:14	12/25/02
22.3	23	3:02:14	12/25/02
22.5	22.2	4:02:14	12/25/02
22.5	22.3	5:02:14	12/25/02
22.5	22.8	6:02:14	12/25/02
22.4	21.9	7:02:14	12/25/02
22.5	22.5	8:02:14	12/25/02
22.6	22.5	9:02:14	12/25/02
22.5	21.9	10:02:14	12/25/02
22.6	23	11:02:14	12/25/02
22.7	22.2	12:02:14	12/25/02
22	21.8	13:02:14	12/25/02
22.4	23.1	14:02:14	12/25/02
22.5	22.7	15:02:14	12/25/02
22.5	22.7	16:02:14	12/25/02
22.6	23.5	17:02:14	12/25/02
22.7	22.6	18:02:14	12/25/02
22.6	22.7	19:02:14	12/25/02
22.6	23.2	20:02:14	12/25/02
22.5	22.6	21:02:14	12/25/02
22.6	22.8	22:02:14	12/25/02
22.5	23.3	23:02:14	12/25/02
22.6	22.5	0:02:14	12/26/02

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
21.7	23.1	1:02:14	12/26/02
22.1	22.5	2:02:14	12/26/02
22.3	23	3:02:14	12/26/02
22.4	23.2	4:02:14	12/26/02
22.3	22.5	5:02:14	12/26/02
22.5	23.5	6:02:14	12/26/02
22.4	22.8	7:02:14	12/26/02
22.4	22.6	8:02:14	12/26/02
22.5	23.3	9:02:14	12/26/02
22.5	22.6	10:02:14	12/26/02
22.5	22.7	11:02:14	12/26/02
22.6	23.1	12:02:14	12/26/02
21.8	22.5	13:02:14	12/26/02
22.4	22.8	14:02:14	12/26/02
22.5	23.2	15:02:14	12/26/02
22.7	22.5	16:02:14	12/26/02
22.8	23	17:02:14	12/26/02
22.7	23	18:02:14	12/26/02
22.7	22.7	19:02:14	12/26/02
22.6	22.7	20:02:14	12/26/02
22.7	23.4	21:02:14	12/26/02
22.6	22.6	22:02:14	12/26/02
22.6	22.7	23:02:14	12/26/02
22.6	23.3	0:02:14	12/27/02
21.8	22.3	1:02:14	12/27/02
22.2	23.3	2:02:14	12/27/02
22.4	22.8	3:02:14	12/27/02
22.4	22.6	4:02:14	12/27/02
22.5	23.3	5:02:14	12/27/02
22.5	22.8	6:02:14	12/27/02
22.5	23.2	7:02:14	12/27/02
22.4	23.1	8:02:14	12/27/02
22.3	22.8	9:02:14	12/27/02
22.3	23.7	10:02:14	12/27/02
22.4	23.6	10:11:57	12/27/02
22.8	22.8	11:11:57	12/27/02
22.6	22.5	12:11:57	12/27/02
22.1	23.2	13:11:57	12/27/02
22.2	22.4	14:11:57	12/27/02
22.4	23.1	15:11:57	12/27/02
22.6	23.3	16:11:57	12/27/02
22.7	22.7	17:11:57	12/27/02

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.8	23	18:11:57	12/27/02
22.7	23.5	19:11:57	12/27/02
22.7	22.7	20:11:57	12/27/02
22.7	23.1	21:11:57	12/27/02
22.6	23.3	22:11:57	12/27/02
22.6	22.6	23:11:57	12/27/02
22.6	22.9	0:11:57	12/28/02
22	22.7	1:11:57	12/28/02
22.3	22.6	2:11:57	12/28/02
22.5	23.1	3:11:57	12/28/02
22.3	23.4	4:11:57	12/28/02
22.5	22.7	5:11:57	12/28/02
22.6	22.9	6:11:57	12/28/02
22.5	23.4	7:11:57	12/28/02
22.7	22.8	8:11:57	12/28/02
22.6	23.2	9:11:57	12/28/02
22.7	23.4	10:11:57	12/28/02
22.7	22.7	11:11:57	12/28/02
22.8	22.9	12:11:57	12/28/02
22.2	22.6	13:11:57	12/28/02
22.6	22.7	14:11:57	12/28/02
22.7	23.4	15:11:57	12/28/02
22.9	22.8	16:11:57	12/28/02
22.9	22.9	17:11:57	12/28/02
22.7	23.4	18:11:57	12/28/02
22.7	22.8	19:11:57	12/28/02
22.8	23.1	20:11:57	12/28/02
22.9	23.5	21:11:57	12/28/02
22.8	22.6	22:11:57	12/28/02
22.7	23.2	23:11:57	12/28/02
22.8	23.2	0:11:57	12/29/02
22.1	22.3	1:11:57	12/29/02
22.5	22.6	2:11:57	12/29/02
22.6	23.1	3:11:57	12/29/02
22.7	23.3	4:11:57	12/29/02
22.7	22.6	5:11:57	12/29/02
22.7	22.8	6:11:57	12/29/02
22.8	23.1	7:11:57	12/29/02
22.7	23.2	8:11:57	12/29/02
22.8	22.7	9:11:57	12/29/02
22.7	22.8	10:11:57	12/29/02
22.8	22.8	11:11:57	12/29/02

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
23	23.4	12:11:57	12/29/02
22.3	22.1	13:11:57	12/29/02
22.6	23.2	14:11:57	12/29/02
23	23.3	15:11:57	12/29/02
23.2	22.9	16:11:57	12/29/02
23	23.4	17:11:57	12/29/02
22.9	22.7	18:11:57	12/29/02
22.8	23.1	19:11:57	12/29/02
22.8	23.2	20:11:57	12/29/02
22.8	22.6	21:11:57	12/29/02
22.8	23.3	22:11:57	12/29/02
22.7	23.1	23:11:57	12/29/02
22.7	22.8	0:11:57	12/30/02
22.1	22.5	1:11:57	12/30/02
22.3	22.9	2:11:57	12/30/02
22.5	23.4	3:11:57	12/30/02
22.5	22.6	4:11:57	12/30/02
22.6	23.4	5:11:57	12/30/02
22.6	22.8	6:11:57	12/30/02
22.5	22.8	7:11:57	12/30/02
22.4	23.3	8:11:57	12/30/02
22.5	22.6	9:11:57	12/30/02
22.4	23.3	10:11:57	12/30/02
22.2	22.9	11:11:57	12/30/02
22.2	22.8	12:11:57	12/30/02
21.6	22	13:11:57	12/30/02
22	23	14:11:57	12/30/02
22.3	23.1	15:11:57	12/30/02
22.6	22.6	16:11:57	12/30/02
22.7	23.4	17:11:57	12/30/02
22.7	22.8	18:11:57	12/30/02
22.5	23	19:11:57	12/30/02
22.5	23.2	20:11:57	12/30/02
22.5	22.6	21:11:57	12/30/02
22.5	23.4	22:11:57	12/30/02
22.4	22.8	23:11:57	12/30/02
22.4	23	0:11:57	12/31/02
21.8	22.5	1:11:57	12/31/02
22.1	23	2:11:57	12/31/02
22.2	23.3	3:11:57	12/31/02
22.5	22.7	4:11:57	12/31/02
22.5	23.5	5:11:57	12/31/02

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.5	22.7	6:11:57	12/31/02
22.6	23.4	7:11:57	12/31/02
22.6	22.9	8:11:57	12/31/02
22.7	22.9	9:11:57	12/31/02
22.8	23.2	10:11:57	12/31/02
23	22.8	11:11:57	12/31/02
23.1	23.6	12:11:57	12/31/02
22.3	21.6	13:11:57	12/31/02
22.8	23.3	14:11:57	12/31/02
23.1	22.8	15:11:57	12/31/02
23	23.3	16:11:57	12/31/02
23	23.7	17:11:57	12/31/02
23	22.8	18:11:57	12/31/02
23.1	23.3	19:11:57	12/31/02
23.2	22.9	20:11:57	12/31/02
23.2	23.2	21:11:57	12/31/02
23.2	23.3	22:11:57	12/31/02
23.2	22.8	23:11:57	12/31/02
23.2	23.6	0:11:57	1/1/03
22.6	22.6	1:11:57	1/1/03
23	23.5	2:11:57	1/1/03
23	22.8	3:11:57	1/1/03
23.1	23.1	4:11:57	1/1/03
23.1	23.4	5:11:57	1/1/03
23.1	22.7	6:11:57	1/1/03
23.1	23.3	7:11:57	1/1/03
23.1	23	8:11:57	1/1/03
23.1	22.8	9:11:57	1/1/03
23	23	10:11:57	1/1/03
23	22.6	11:11:57	1/1/03
23	23.2	12:11:57	1/1/03
22.3	21.8	13:11:57	1/1/03
22.6	23.3	14:11:57	1/1/03
22.7	22.9	15:11:57	1/1/03
22.8	23.2	16:11:57	1/1/03
23	23.3	17:11:57	1/1/03
23	22.8	18:11:57	1/1/03
22.9	23.4	19:11:57	1/1/03
22.8	22.7	20:11:57	1/1/03
22.8	22.9	21:11:57	1/1/03
22.8	23.4	22:11:57	1/1/03
22.7	22.6	23:11:57	1/1/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.7	23	0:11:57	1/2/03
22.1	22.5	1:11:57	1/2/03
22.3	23.1	2:11:57	1/2/03
22.5	23.1	3:11:57	1/2/03
22.5	22.6	4:11:57	1/2/03
22.5	23.1	5:11:57	1/2/03
22.5	23.1	6:11:57	1/2/03
22.5	22.6	7:11:57	1/2/03
22.6	22.7	8:11:57	1/2/03
22.6	23.2	9:11:57	1/2/03
22.6	22.7	10:11:57	1/2/03
22.5	23	11:11:57	1/2/03
22.6	23.1	12:11:57	1/2/03
21.8	21.3	13:11:57	1/2/03
22.3	23.2	14:11:57	1/2/03
22.2	22.9	15:11:57	1/2/03
22.3	22.6	16:11:57	1/2/03
22.4	22.7	17:11:57	1/2/03
22.5	23.1	18:11:57	1/2/03
22.6	22.9	19:11:57	1/2/03
22.6	22.6	20:11:57	1/2/03
22.6	23.3	21:11:57	1/2/03
22.6	22.8	22:11:57	1/2/03
22.5	22.9	23:11:57	1/2/03
22.5	23.1	0:11:57	1/3/03
22	22	1:11:57	1/3/03
22.3	23.2	2:11:57	1/3/03
22.5	23	3:11:57	1/3/03
22.6	23	4:11:57	1/3/03
22.5	23.2	5:11:57	1/3/03
22.7	22.7	6:11:57	1/3/03
22.6	23.1	7:11:57	1/3/03
22.6	23	8:11:57	1/3/03
22.6	22.7	9:11:57	1/3/03
22.6	23.5	10:11:57	1/3/03
22.7	22.7	11:11:57	1/3/03
22.6	23.2	12:11:57	1/3/03
21.9	21.5	13:11:57	1/3/03
22.2	23	14:11:57	1/3/03
22.4	23.1	15:11:57	1/3/03
22.5	22.6	16:11:57	1/3/03
22.6	23.2	17:11:57	1/3/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.5	23.1	18:11:57	1/3/03
22.5	22.6	19:11:57	1/3/03
22.7	23	20:11:57	1/3/03
22.6	23.3	21:11:57	1/3/03
22.5	23	22:11:57	1/3/03
22.5	22.6	23:11:57	1/3/03
22.6	22.9	0:11:57	1/4/03
21.8	22.5	1:11:57	1/4/03
22.3	22.6	2:11:57	1/4/03
22.5	23	3:11:57	1/4/03
22.5	23.1	4:11:57	1/4/03
22.5	23	5:11:57	1/4/03
22.6	22.8	6:11:57	1/4/03
22.5	22.7	7:11:57	1/4/03
22.6	22.6	8:11:57	1/4/03
22.7	23.2	9:11:57	1/4/03
22.6	23	10:11:57	1/4/03
22.6	22.6	11:11:57	1/4/03
22.6	22.8	12:11:57	1/4/03
22	21.7	13:11:57	1/4/03
22.4	22.5	14:11:57	1/4/03
22.6	23.1	15:11:57	1/4/03
22.7	23	16:11:57	1/4/03
22.7	22.6	17:11:57	1/4/03
22.7	22.6	18:11:57	1/4/03
22.7	23.2	19:11:57	1/4/03
22.7	23	20:11:57	1/4/03
22.7	22.5	21:11:57	1/4/03
22.7	22.7	22:11:57	1/4/03
22.6	23.1	23:11:57	1/4/03
22.6	23	0:11:57	1/5/03
21.9	22.1	1:11:57	1/5/03
22.3	22.8	2:11:57	1/5/03
22.5	23.3	3:11:57	1/5/03
22.5	22.6	4:11:57	1/5/03
22.6	22.6	5:11:57	1/5/03
22.6	22.9	6:11:57	1/5/03
22.6	23.2	7:11:57	1/5/03
22.7	22.7	8:11:57	1/5/03
22.6	22.5	9:11:57	1/5/03
22.3	22.9	10:11:57	1/5/03
22.6	23.1	11:11:57	1/5/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.6	22.8	12:11:57	1/5/03
21.8	21.6	13:11:57	1/5/03
22.1	23.1	14:11:57	1/5/03
22.2	23.3	15:11:57	1/5/03
22.5	22.7	16:11:57	1/5/03
22.6	22.7	17:11:57	1/5/03
22.4	23.2	18:11:57	1/5/03
22.6	22.9	19:11:57	1/5/03
22.6	22.8	20:11:57	1/5/03
22.6	23.1	21:11:57	1/5/03
22.6	23.1	22:11:57	1/5/03
22.5	22.6	23:11:57	1/5/03
22.4	22.9	0:11:57	1/6/03
21.8	22.7	1:11:57	1/6/03
22.2	22.6	2:11:57	1/6/03
22.3	22.8	3:11:57	1/6/03
22.4	23.3	4:11:57	1/6/03
22.3	22.8	5:11:57	1/6/03
22.5	22.6	6:11:57	1/6/03
22.3	22.7	7:11:57	1/6/03
22.4	23.1	8:11:57	1/6/03
22.4	23.1	9:11:57	1/6/03
22.5	22.8	10:11:57	1/6/03
22.7	22.7	11:11:57	1/6/03
22.7	23.3	12:11:57	1/6/03
22	21.7	13:11:57	1/6/03
22.5	23	14:11:57	1/6/03
22.6	23.2	15:11:57	1/6/03
22.9	22.7	16:11:57	1/6/03
22.8	23.5	17:11:57	1/6/03
23	23	18:11:57	1/6/03
23	23	19:11:57	1/6/03
22.7	23.3	20:11:57	1/6/03
22.6	22.8	21:11:57	1/6/03
22.6	22.9	22:11:57	1/6/03
22.6	23.4	23:11:57	1/6/03
22.5	22.9	0:11:57	1/7/03
21.8	22.1	1:11:57	1/7/03
22.2	23.2	2:11:57	1/7/03
22.3	23.1	3:11:57	1/7/03
22.3	22.6	4:11:57	1/7/03
22.3	23.2	5:11:57	1/7/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.4	22.8	6:11:57	1/7/03
22.5	22.6	7:11:57	1/7/03
22.4	23.3	8:11:57	1/7/03
22.5	22.8	9:11:57	1/7/03
22.7	22.8	10:11:57	1/7/03
22.7	23.3	11:11:57	1/7/03
22.8	22.6	12:11:57	1/7/03
22	22.1	13:11:57	1/7/03
22.5	22.6	14:11:57	1/7/03
22.6	22.9	15:11:57	1/7/03
22.7	23.1	16:11:57	1/7/03
22.6	22.5	17:11:57	1/7/03
22.6	23	18:11:57	1/7/03
22.6	23.1	19:11:57	1/7/03
22.7	22.7	20:11:57	1/7/03
22.6	22.7	21:11:57	1/7/03
22.4	23.3	22:11:57	1/7/03
22.2	22.6	23:11:57	1/7/03
22.2	22.7	0:11:57	1/8/03
21.5	22.6	1:11:57	1/8/03
21.9	22.9	2:11:57	1/8/03
22	23.1	3:11:57	1/8/03
22.1	22.5	4:11:57	1/8/03
22.2	23	5:11:57	1/8/03
22.1	23	6:11:57	1/8/03
22.2	22.8	7:11:57	1/8/03
22.2	23.2	8:11:57	1/8/03
22.2	22.6	9:11:57	1/8/03
22.2	23	10:11:57	1/8/03
22.5	23.1	11:11:57	1/8/03
22.7	22.6	12:11:57	1/8/03
22.1	22.2	13:11:57	1/8/03
22.6	23.2	14:11:57	1/8/03
22.8	22.6	15:11:57	1/8/03
22.8	23.4	16:11:57	1/8/03
22.8	22.7	17:11:57	1/8/03
22.7	23.2	18:11:57	1/8/03
22.7	23	19:11:57	1/8/03
22.5	22.5	20:11:57	1/8/03
22.5	23.3	21:11:57	1/8/03
22.5	22.9	22:11:57	1/8/03
22.3	22.7	23:11:57	1/8/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.3	22.6	0:11:57	1/9/03
21.7	22.4	1:11:57	1/9/03
22.1	22.5	2:11:57	1/9/03
22.1	23	3:11:57	1/9/03
22.1	23.2	4:11:57	1/9/03
22.2	22.6	5:11:57	1/9/03
22.2	23.1	6:11:57	1/9/03
22.1	23	7:11:57	1/9/03
22.2	22.5	8:11:57	1/9/03
22	23.1	9:11:57	1/9/03
22.1	22.8	10:11:57	1/9/03
22.2	22.7	11:11:57	1/9/03
22.1	23.2	12:11:57	1/9/03
21.3	21.2	13:11:57	1/9/03
22.1	23.2	14:11:57	1/9/03
22.4	22.7	15:11:57	1/9/03
22.5	23	16:11:57	1/9/03
22.6	23	17:11:57	1/9/03
22.6	22.7	18:11:57	1/9/03
22.6	23.3	19:11:57	1/9/03
22.6	22.7	20:11:57	1/9/03
22.5	22.7	21:11:57	1/9/03
22.4	23.2	22:11:57	1/9/03
22.3	22.5	23:11:57	1/9/03
22.2	22.7	0:11:57	1/10/03
21.7	22.3	1:11:57	1/10/03
22.1	23	2:11:57	1/10/03
22.1	22.8	3:11:57	1/10/03
22.3	22.3	4:11:57	1/10/03
22.2	23.1	5:11:57	1/10/03
22.2	22.7	6:11:57	1/10/03
22.3	22.6	7:11:57	1/10/03
22.3	23.2	8:11:57	1/10/03
22.3	22.5	9:11:57	1/10/03
22.3	22.9	10:11:57	1/10/03
22.4	23	11:11:57	1/10/03
22.3	22.5	12:11:57	1/10/03
21.4	21.3	13:11:57	1/10/03
21.9	23.1	14:11:57	1/10/03
22.6	22.7	15:11:57	1/10/03
22.5	22.6	16:11:57	1/10/03
22.7	22.7	17:11:57	1/10/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.6	23.1	18:11:57	1/10/03
22.6	22.7	19:11:57	1/10/03
22.5	22.3	20:11:57	1/10/03
22.5	22.7	21:11:57	1/10/03
22.5	23	22:11:57	1/10/03
22.4	22.4	23:11:57	1/10/03
22.4	22.9	0:11:57	1/11/03
21.7	21.7	1:11:57	1/11/03
22.2	22.8	2:11:57	1/11/03
22.3	22.9	3:11:57	1/11/03
22.5	22.5	4:11:57	1/11/03
22.3	23.1	5:11:57	1/11/03
22.2	22.6	6:11:57	1/11/03
22.3	22.5	7:11:57	1/11/03
22.3	23	8:11:57	1/11/03
22.3	22.5	9:11:57	1/11/03
22.3	22.6	10:11:57	1/11/03
22.4	22.9	11:11:57	1/11/03
22.3	22.5	12:11:57	1/11/03
21.5	21.3	13:11:57	1/11/03
21.8	23	14:11:57	1/11/03
22.1	22.8	15:11:57	1/11/03
22.3	23.2	16:11:57	1/11/03
22.4	22.5	17:11:57	1/11/03
22.4	23	18:11:57	1/11/03
22.3	23	19:11:57	1/11/03
22.3	22.5	20:11:57	1/11/03
22.3	23.2	21:11:57	1/11/03
22.3	22.7	22:11:57	1/11/03
22.3	22.6	23:11:57	1/11/03
22.2	23.1	0:11:57	1/12/03
21.6	21.2	1:11:57	1/12/03
22.1	23.2	2:11:57	1/12/03
22.2	22.5	3:11:57	1/12/03
22.2	23	4:11:57	1/12/03
22.3	22.8	5:11:57	1/12/03
22.3	22.6	6:11:57	1/12/03
22.4	23.3	7:11:57	1/12/03
22.4	22.7	8:11:57	1/12/03
22.3	22.7	9:11:57	1/12/03
22.3	23.2	10:11:57	1/12/03
22.3	22.7	11:11:57	1/12/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.5	22.8	12:11:57	1/12/03
21.7	21.8	13:11:57	1/12/03
22.2	23.3	14:11:57	1/12/03
22.3	22.7	15:11:57	1/12/03
22.5	22.6	16:11:57	1/12/03
22.6	23.1	17:11:57	1/12/03
22.6	22.5	18:11:57	1/12/03
22.5	23	19:11:57	1/12/03
22.5	22.9	20:11:57	1/12/03
22.5	22.7	21:11:57	1/12/03
22.4	23.2	22:11:57	1/12/03
22.3	22.6	23:11:57	1/12/03
22.3	22.8	0:11:57	1/13/03
21.7	22.2	1:11:57	1/13/03
22.1	23	2:11:57	1/13/03
22.2	22.9	3:11:57	1/13/03
22.5	22.6	4:11:57	1/13/03
22.6	23.2	5:11:57	1/13/03
22.4	22.7	6:11:57	1/13/03
22.5	22.6	7:11:57	1/13/03
22.5	23.2	8:11:57	1/13/03
22.3	22.6	9:11:57	1/13/03
22.5	22.4	10:11:57	1/13/03
22.5	23	11:11:57	1/13/03
22.5	22.8	12:11:57	1/13/03
21.7	21.3	13:11:57	1/13/03
22	23.3	14:11:57	1/13/03
22.3	22.6	15:11:57	1/13/03
22.3	23.2	16:11:57	1/13/03
22.2	22.9	17:11:57	1/13/03
22.2	22.5	18:11:57	1/13/03
22.2	23	19:11:57	1/13/03
22	22.7	20:11:57	1/13/03
22	22.6	21:11:57	1/13/03
22	23	22:11:57	1/13/03
22	22.7	23:11:57	1/13/03
21.8	22.3	0:11:57	1/14/03
21.2	22.2	1:11:57	1/14/03
21.5	22.3	2:11:57	1/14/03
21.7	23.1	3:11:57	1/14/03
21.8	22.4	4:11:57	1/14/03
21.7	23.1	5:11:57	1/14/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
21.7	22.6	6:11:57	1/14/03
21.6	22.4	7:11:57	1/14/03
21.6	23	8:11:57	1/14/03
21.6	22.4	9:11:57	1/14/03
21.7	23.1	10:11:57	1/14/03
21.8	22.7	11:11:57	1/14/03
22	22.6	12:11:57	1/14/03
21.5	21.3	13:11:57	1/14/03
22.1	23.4	14:11:57	1/14/03
22.5	22.6	15:11:57	1/14/03
22.6	23.2	16:11:57	1/14/03
22.6	22.7	17:11:57	1/14/03
22.7	22.8	18:11:57	1/14/03
22.7	23	19:11:57	1/14/03
22.6	22.4	20:11:57	1/14/03
22.6	22.9	21:11:57	1/14/03
22.5	22.7	22:11:57	1/14/03
22.3	22.3	23:11:57	1/14/03
22.4	23	0:11:57	1/15/03
21.8	21.9	1:11:57	1/15/03
22.1	23.2	2:11:57	1/15/03
22.1	22.5	3:11:57	1/15/03
22.2	23.2	4:11:57	1/15/03
22.3	22.5	5:11:57	1/15/03
22.3	23.2	6:11:57	1/15/03
22.2	22.4	7:11:57	1/15/03
22.3	23	8:11:57	1/15/03
22.2	22.7	9:11:57	1/15/03
22.3	22.5	10:11:57	1/15/03
22.3	23.1	11:11:57	1/15/03
22.4	22.5	12:11:57	1/15/03
21.6	21.3	13:11:57	1/15/03
22.2	23	14:11:57	1/15/03
22.6	23.1	15:11:57	1/15/03
22.6	22.5	16:11:57	1/15/03
22.7	23.2	17:11:57	1/15/03
22.5	22.9	18:11:57	1/15/03
22.6	22.5	19:11:57	1/15/03
22.6	23.1	20:11:57	1/15/03
22.7	22.6	21:11:57	1/15/03
22.7	22.8	22:11:57	1/15/03
22.6	23	23:11:57	1/15/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.5	22.4	0:11:57	1/16/03
21.8	22.3	1:11:57	1/16/03
22.3	22.6	2:11:57	1/16/03
22.5	23.2	3:11:57	1/16/03
22.6	22.4	4:11:57	1/16/03
22.6	23.1	5:11:57	1/16/03
22.7	22.7	6:11:57	1/16/03
22.6	22.5	7:11:57	1/16/03
22.7	23.1	8:11:57	1/16/03
22.5	22.6	9:11:57	1/16/03
22.5	22.8	9:34:25	1/16/03
22.6	23	9:36:28	1/16/03
22.6	22.5	10:36:29	1/16/03
22.6	23	11:36:29	1/16/03
22.8	23	12:36:29	1/16/03
22.3	22.2	13:36:29	1/16/03
22.6	23.3	14:36:29	1/16/03
22.7	22.6	15:36:29	1/16/03
22.8	23.2	16:36:29	1/16/03
22.8	22.8	17:36:29	1/16/03
22.8	22.7	18:36:29	1/16/03
22.9	23.1	19:36:29	1/16/03
22.6	22.7	20:36:29	1/16/03
22.7	22.4	21:36:29	1/16/03
22.6	22.9	22:36:29	1/16/03
22.7	22.8	23:36:29	1/16/03
21.7	21.2	0:36:29	1/17/03
22.1	22.6	1:36:29	1/17/03
22.6	22.6	2:36:29	1/17/03
22.6	22.7	3:36:29	1/17/03
22.6	23.1	4:36:29	1/17/03
22.7	22.5	5:36:29	1/17/03
22.7	22.8	6:36:29	1/17/03
22.6	22.9	7:36:29	1/17/03
22.6	22.3	8:36:29	1/17/03
22.7	23.3	9:36:29	1/17/03
22.7	22.6	10:36:29	1/17/03
22.6	22.8	11:36:29	1/17/03
22.4	23.1	12:36:29	1/17/03
21.8	22.2	13:36:29	1/17/03
22.3	23	14:36:29	1/17/03
22.6	22.9	15:36:29	1/17/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

Probe 25	Probe 26	Time	Date
22.6	22.6	16:36:29	1/17/03
22.6	23.2	17:36:29	1/17/03
22.7	22.7	18:36:29	1/17/03
22.6	22.6	19:36:29	1/17/03
22.5	23.2	20:36:29	1/17/03
22.4	22.7	21:36:29	1/17/03
22.3	22.6	22:36:29	1/17/03
22.3	23	23:36:29	1/17/03
21.4	21.5	0:36:29	1/18/03
22	23	1:36:29	1/18/03
22.1	22.6	2:36:29	1/18/03
22.2	22.8	3:36:29	1/18/03
22.1	22.8	4:36:29	1/18/03
22.2	22.3	5:36:29	1/18/03
22.2	22.8	6:36:29	1/18/03
22.1	22.8	7:36:29	1/18/03
22.2	22.4	8:36:29	1/18/03
22.1	23.1	9:36:29	1/18/03
22.1	22.5	10:36:29	1/18/03
22.3	23	11:36:29	1/18/03
22.4	22.4	12:36:29	1/18/03
21.9	22.5	13:36:29	1/18/03
22.2	22.5	14:36:29	1/18/03
22.5	23	15:36:29	1/18/03
22.5	22.3	16:36:29	1/18/03
22.5	23.1	17:36:29	1/18/03
22.5	22.5	18:36:29	1/18/03
22.6	22.6	19:36:29	1/18/03
22.4	22.8	20:36:29	1/18/03
22.5	22.3	21:36:29	1/18/03
22.4	23	22:36:29	1/18/03
22.3	22.4	23:36:29	1/18/03
21.4	21.4	0:36:29	1/19/03
22	22.3	1:36:29	1/19/03
22.1	22.5	2:36:29	1/19/03
22.4	23	3:36:29	1/19/03
22.4	22.3	4:36:29	1/19/03
22.4	23.1	5:36:29	1/19/03
22.3	22.3	6:36:29	1/19/03
22.3	23	7:36:29	1/19/03
22.5	22.6	8:36:29	1/19/03
22.3	22.8	9:36:29	1/19/03

Toxicity Test Temperature Monitoring
Project: 02070
Sanborn, Head & Associates - Blackburn Union
Hyalella azteca 28-day survival and growth (Probes 25, 26)
Test Dates: December 22, 2002 - January 19, 2003

	Probe 25	Probe 26	Time	Date
Minimum (°C):	21.2	20.5		
Maximum (°C):	23.2	23.7		
Average (°C):	22.4	22.8		

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: December 22, 2002 Project: 02070 – *Ha* 28-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs		✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?		✓	✓	✓	✓	✓	✓
• syringes filling?		✓	✓	✓	✓	✓	✓
• needles flowing?		✓	✓	✓	✓	✓	✓
• drainage to waste ok?		✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓	✓ ✓	✓ ✓	✓ —	✓ ✓	✓ ✓	✓ ✓
Test monitoring							
• test temperature ok?							
• Probe assignments: probe 25 – cart#1 probe 26 – cart#2	✓ ✓ (1)	✓ ✓	(*) ✓ ✓	✓ (6) ✓	✓ ✓	✓ ✓	✓ ✓
• D.O. ok?	✓	✓	✓	—	—	✓	—
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	✓	✓	✓	✓	✓	✓	✓
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓ (3)	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments	(1) probe 26 heater turned up. 06:30		(*) probe 25 heater turned up 07:45	(6) Probe 27 heater turned up @ 13:00			
Initials/Date	KR JW 12/22	JW 12/23	JW 12/24	KR 12/25	KR 12/26	JG 12/27/02	JG 12/28/02

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments: Test Started 12/22/02 11:30 KR

(3) filled w/ 5050

Reviewer: [signature] Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: December 29, 2002 Project: 02070 – *Ha 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Test monitoring							
• test temperature ok?	✓	✓	✓	✓	✓	✓	✓
• Probe assignments:	✓	✓	✓	✓	✓	✓	✓
• D.O. ok?	—	✓	—	✓	✗	✓	—
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	✓	✓	✓	✓	✓	✓	✓
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments							
Initials/Date	XR 12/29/02	JW 12/30/02	JG JW 12/31/02	JG 1/1/03	JW 1/2/03	JG 1/3/03	JG 1/4/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: [signature] Date 1/21/03.

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 5, 2003 Project: 02070 – *Ha* 28-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Test monitoring							
• test temperature ok?							
• Probe assignments:	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
• D.O. ok?	—	✓	—	✓	—	✓	—
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	✓	✓	✓	✓	✓	✓	✓
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments							
Initials/Date	JW 1/5/03	JW 1/6/03	JW 1/7/03	JW 1/8/03	~~JG~~ JW 1/9/03 1/10/03	JG 1/10/03	JG 1/11/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: J Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

DAILY CHECKLIST FOR AUTOMATED DELIVERY SEDIMENT TOXICITY TESTS

Week of: January 12, 2003 Project: 02070 – *Ha 28*-day SDG: 6669

ACTIVITY / DAY	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Prior to noon fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Noon delivery cycle							
• splitter boxes filling?	✓	✓	✓	✓	✓	✓	✓
• syringes filling?	✓	✓	✓	✓	✓	✓	✓
• needles flowing?	✓	✓	✓	✓	✓	✓	✓
• drainage to waste ok?	✓	✓	✓	✓	✓	✓	✓
• empty waste buckets?	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Test monitoring							
• test temperature ok? • Probe assignments:	✓✓	✓✓	✓✓ JG	✓✓	✓✓	✓✓	✓✓
• D.O. ok?	—	✓	✓	✓	—	✓	✓
• check for floating organisms	✓	✓	✓	✓	✓	✓	✓
• feeding completed?	✓	✓	✓	✓	✓	✓	✓
Additional activities							
Prior to midnight fill reservoirs	✓	✓	✓	✓	✓	✓	✓
Check sediment water supply	✓	✓	✓	✓	✓	✓	✓
Check delivery tubing to splitter boxes	✓	✓	✓	✓	✓	✓	✓
Corrective Action / Comments							
Initials/Date	JW 1/12/03	JW 1/13/03	JG 1/14/03	JG 1/15/03	JG 1/16/03	JG 1/17/03	JG 1/18/03

Procedure: All operating systems listed above must be checked on a daily basis when sediment toxicity tests are in progress. Corrective action must be taken whenever appropriate. Document corrective action on this form.

Comments:

Reviewer: [signature] Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

Sediment Characterization

Client: Sanborn, Head & Associates	Project: 02070, Blackburn Union	SDG: 6669

Sample Number	Sediment Visual Characterization	Indigenous organisms observed?	Sieving required?	Homogenized / loaded for toxicity test (Date/Init.)
23395 TR-3/12-16-02	Fine dark mud with leaves & debris	No	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23401 Sed RN-4/12-18-02	Sandy mud with organic debris and rocks	A few small chironomid larvae	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23404 NR-8/12-18-02	Coarse sand with rock, sticks, debris	No	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23405 NR-7/12-18-02	Fine sand, coarse sand, rocks	No	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23406 LP-01/12-18-02	Sandy brown mud with organic debris	No	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23411 Sed Nwd-1/12-17-02	Fine dark mud with leaves & debris	A few small chironomid larvae	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23412 OW-801/12-17-02	Fine dark mud with leaves & debris	A few small chironomid larvae	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23413 Control *Ha*	Formulated sediment	--	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG
23418 Natural Control *Ha*	Natural sediment, Lamoille River, VT Fine sand	No	No for *Hyalella*	For *Hyalella* testing on 12/21/02 JG

Reviewer: [illegible] Date 1/2/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

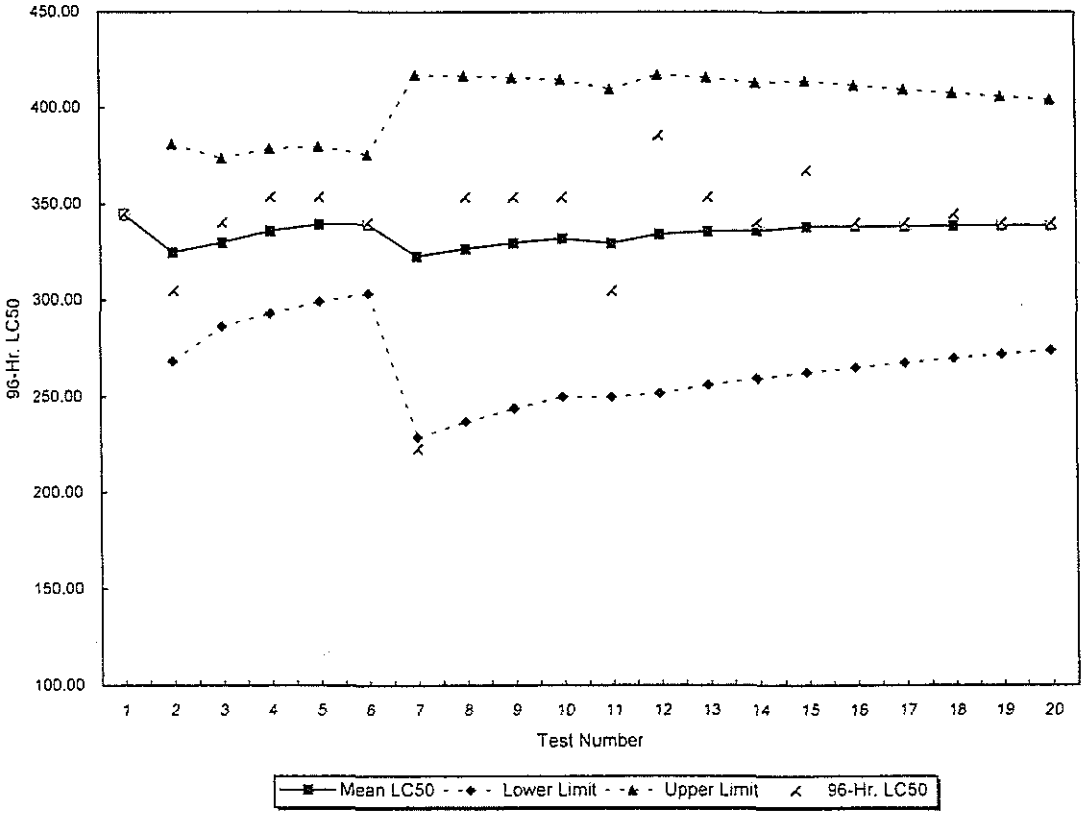
Ha28dpkg

Standard Reference Toxicant Control Charts

Sanborn, Head & Associates, Inc.

Reference Toxicant Control Chart
Hyalella azteca
in Potassium chloride (mg/L)

Test Number	Test Date	Organism Age (Days)	96-Hr. LC50	Mean LC50	Lower Limit	Upper Limit	Organism Source
1	09/21/00	14	344.592	344.59			Aquatic Research Organisms
2	10/31/00	8	304.753	324.67	268.33	381.01	Aquatic Research Organisms
3	11/11/00	9	340.198	329.85	286.16	373.53	Aquatic Research Organisms
4	06/29/01	11&12	353.553	335.77	292.95	378.60	Aquatic Research Organisms
5	07/04/01	12	353.553	339.33	298.97	379.69	Aquatic Research Organisms
6	07/04/01	8	340.198	339.47	303.37	375.58	Aquatic Research Organisms
7	07/07/01	8	222.725	322.80	228.59	417.00	Aquatic Research Organisms
8	09/10/01	11	353.553	326.64	236.75	416.53	Aquatic Research Organisms
9	09/14/01	8	353.553	329.63	243.65	415.61	Aquatic Research Organisms
10	10/15/01	11	353.553	332.02	249.56	414.48	Aquatic Research Organisms
11	10/19/01	7	304.753	329.54	249.61	409.48	Aquatic Research Organisms
12	11/01/01	8	385.553	334.21	251.42	417.01	Aquatic Research Organisms
13	12/06/01	8	353.553	335.70	255.71	415.69	Aquatic Research Organisms
14	07/16/02	11	340.198	336.02	259.13	412.91	Aquatic Research Organisms
15	08/08/02	13	367.434	338.11	262.27	413.96	Aquatic Research Organisms
16	08/09/02	11	340.198	338.25	264.96	411.53	Aquatic Research Organisms
17	08/31/02	12	340.198	338.36	267.40	409.32	Aquatic Research Organisms
18	09/07/02	12	344.592	338.71	269.80	407.61	Aquatic Research Organisms
19	10/28/02	10	340.198	338.78	271.81	405.75	Aquatic Research Organisms
20	12/22/02	9	340.198	338.86	273.67	404.04	Aquatic Research Organisms



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Toxicity Summary Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 02070
SDG 6669
Site: Blackburn Union

Samples Received

Number	Sample Name	Date Time and Collected		Type
023395	TR-3/12-16-02	12/16/02	3:00:00 PM	Sediment
023401	Sed RN-4/12-18-02	12/18/02	3:30:00 PM	Sediment
023402	LP-09/12-18-02	12/18/02	10:45:00 AM	Sediment
023403	LP-06/12-18-02	12/18/02	11:15:00 AM	Sediment
023404	NR-8/12-18-02	12/18/02	1:30:00 PM	Sediment
023405	NR-7/12-18-02	12/18/02	2:00:00 PM	Sediment
023406	LP-01/12-18-02	12/18/02	12:30:00 PM	Sediment
023407	NR-5/12-18-02	12/18/02	2:45:00 PM	Sediment
023411	Sed Nwd-1/12-17-02	12/17/02	10:15:00 AM	Sediment
023412	OW-801/12-17-02	12/17/02	10:15:00 AM	Sediment

Submitted By: _____

Toxicity Detail Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 02070
SDG 6669
Site: Blackburn Union

Sample ID: 023395 Sample Name: TR-3/12-16-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	9	0.90	38.79	42.88	9	0.45
B	10	9	0.90	37.57	42.57	9	0.56
C	10	8	0.80	40.08	46.20	8	0.76
D	10	10	1.00	42.38	48.34	10	0.60
E	10	9	0.90	34.86	39.95	9	0.57
F	10	10	1.00	41.72	48.32	10	0.66
G	10	9	0.90	38.79	43.26	9	0.50
H	10	9	0.90	38.89	42.56	9	0.41
	Mean Survival:		0.91			Mean Growth Weight:	0.563

Sample ID: 023401 Sample Name: Sed RN-4/12-18-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	7	0.70	44.09	47.24	7	0.45
B	10	9	0.90	37.57	40.09	9	0.28
C	10	10	1.00	40.29	44.66	10	0.44
D	10	8	0.80	42.75	46.39	8	0.45
E	10						
F	10	7	0.70	44.68	47.67	7	0.43
G	10	10	1.00	35.98	39.60	10	0.36
H	10	8	0.80	41.46	44.40	8	0.37
	Mean Survival:		0.84			Mean Growth Weight:	0.397

Toxicity Detail Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 020070
SDG 6669
Site: Blackburn Union

Sample ID: 023404 Sample Name: NR-8/12-18-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	10	1.00	42.24	45.94	10	0.37
B	10	9	0.90	37.69	42.14	9	0.49
C	10	9	0.90	39.55	42.99	9	0.38
D	10	9	0.90	43.07	47.24	9	0.46
E	10						
F	10	10	1.00	39.72	43.22	10	0.35
G	10	10	1.00	40.08	43.34	10	0.33
H	10	9	0.90	40.99	44.79	9	0.42
	Mean Survival:		0.94			Mean Growth Weight:	0.401

Sample ID: 023405 Sample Name: NR-7/12-18-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	9	0.90	38.26	42.00	9	0.42
B	10	8	0.80	41.03	44.39	8	0.42
C	10	9	0.90	42.61	46.56	9	0.44
D	10	7	0.70	38.7	42.32	7	0.52
E	10	8	0.80	45.06	49.01	8	0.49
F	10	7	0.70	40.01	43.64	7	0.52
G	10	10	1.00	43.53	48.41	10	0.49
H	10	9	0.90	40.5	44.46	9	0.44
	Mean Survival:		0.84			Mean Growth Weight:	0.466

Toxicity Detail Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 020070
SDG 6669
Site: Blackburn Union

Sample ID: 023406 Sample Name: LP-01/12-18-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	6	0.60	40.86	42.56	6	0.28
B	10	10	1.00	38	41.69	10	0.37
C	10	10	1.00	41.04	43.83	10	0.28
D	10	8	0.80	38.81	41.97	8	0.39
E	10	9	0.90	46.39	49.23	9	0.32
F	10	10	1.00	41.05	44.05	10	0.30
G	10	10	1.00	39.09	42.39	10	0.33
H	10	5	0.50	39.3	40.91	5	0.32
	Mean Survival:		0.85			Mean Growth Weight:	0.324

Sample ID: 023411 Sample Name: Sed Nwd-1/12-17-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	10	1.00	41.28	44.35	10	0.31
B	10	10	1.00	42.97	44.32	10	0.13
C	10	8	0.80	40.25	42.67	8	0.30
D	10	9	0.90	39.69	42.17	9	0.28
E	10	10	1.00	41.38	43.64	10	0.23
F	10	9	0.90	39.32	40.95	9	0.18
G	10	8	0.80	39.57	42.61	8	0.38
H	10	9	0.90	44.03	46.68	9	0.29
	Mean Survival:		0.91			Mean Growth Weight:	0.263

Toxicity Detail Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 02070
SDG 6669
Site: Blackburn Union

Sample ID: 023412 Sample Name: OW-801/12-17-02 Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	9	0.90	45.21	47.99	9	0.31
B	10	7	0.70	36.98	38.99	7	0.29
C	10	8	0.80	41.16	43.54	8	0.30
D	10	7	0.70	38.88	41.04	7	0.31
E	10	10	1.00	42.59	45.06	10	0.25
F	10	7	0.70	44.69	47.31	7	0.37
G	10	10	1.00	40.29	42.48	10	0.22
H	10	8	0.80	39.77	42.38	8	0.33
	Mean Survival:		0.83			Mean Growth Weight:	0.296

Sample ID: 023413 Sample Name: Formulated sediment Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	10	1.00	40.28	42.06	10	0.18
B	10	7	0.70	39.39	40.93	7	0.22
C	10	8	0.80	38.88	40.66	8	0.22
D	10	10	1.00	42.29	43.81	10	0.15
E	10	7	0.70	39.14	40.98	7	0.26
F	10	9	0.90	42.37	43.85	9	0.16
G	10	10	1.00	41.62	43.46	10	0.18
H	10	9	0.90	40.03	41.57	9	0.17
	Mean Survival:		0.88			Mean Growth Weight:	0.194

Toxicity Detail Report

Sanborn, Head & Associates, Inc.
6 Gavins Falls Road

Concord, NH 03301

Date: 2/14/03
Project: 02070
SDG 6669
Site: Blackburn Union

Sample ID: 023418 Sample Name: Natural sediment control Method: 100.4HA28

Replicate	Start Count	Total Surviving	Proportion Surviving	Initial Pan Weight (mg)	Pan and Larval Dried Weight (mg)	Weighed	Mean Replicate Weight (mg)
A	10	8	0.80	44.94	47.68	8	0.34
B	10	10	1.00	41.13	44.41	10	0.33
C	10	9	0.90	39.15	41.41	9	0.25
D	10	10	1.00	46.27	49.57	10	0.33
E	10	9	0.90	39.67	43.52	9	0.43
F	10	9	0.90	40.9	43.27	9	0.26
G	10	7	0.70	40.41	42.73	7	0.33
H	10	8	0.80	39.78	44.29	8	0.56
	Mean Survival:		0.88			Mean Growth Weight:	0.355

Aquatec Biological Sciences

Ecology | Environmental Toxicology | Natural Resource Assessments | Microbiology

Quality Assurance Report

Sanborn, Head & Associates, Inc.		Date:	2/12/03
6 Gavins Falls Road		Project:	02070
		SDG	6669
Concord, NH	03301	Site:	Blackburn Union

Qualifiers and Special Conditions

Two replicates (23401-E and 23404-E) had no recovered organisms at the end of the test. This result varied significantly from the remaining seven replicates of the respective samples. The reason(s) for lack of recovery is unknown but could reflect either predation by organisms in the sediment or laboratory error. These replicates were excluded from the data analyses.

273 Commerce Street, Williston, VT 05495 Tel: 802.860.1638 Fax: 802.658.3189

Supportive Documentation

Chain-Of-Custody

Toxicity Test Methods

Amphipod, Hyalella azteca, 28-day survival and growth

Lumbriculus variegatus Bioaccumulation Test

Standard Reference Toxicant Control Charts

Chain-Of-Custody

Sanborn, Head & Associates, Inc.

Chain-of-Custody Record

Woods Hole — Aquatic Biology (BAC Group)

375 Paramount Drive
Raynham, MA 02767 (BAC)

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION
Name: (Ex) Sunburn Hand Area	Regulatory Protocol:	Carrier: Fed Ex
Address: 6 Commons Falls Rd, Concord, NH 03301	For the State of:	Airbill Number: 831424409681
	Project Name: BWPS	Date Shipped: 12-16-02
	Project Number: 2032	Quote #:
Telephone: 603-229-1900	P.O. #	
Facsimile: 603-229-1919	Sampler Name(s): B. Green, M. Thomas	
Contact Name: M. Ray		

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ice
CONTAINER TYPE	Plastic Bucket
VOLUME	2 gallons

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS
	TR-3/12-16-02	12-16-02	1300	C	Sediment	Sediment Toxicity (Hyella) / Sed. Bioassay (Lumbriculus)	BAG/MBT	1

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12-16-02	1630	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/17/02	10:00	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: SDG-BW 801

Cooler Temp = 0.0°C

We cannot accept verbal changes. Please fax written changes to (508) 822-3288

Chain-of-Custody Record

Woods Hole Group

EH Aquatech Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE ___ OF ___

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION
Name: Sanborn Head & Assoc.	Regulatory Protocol:	Carrier: Fed Ex
Address: 6 Loudon Falls Rd Concord, NH 03301	For the State of:	Airbill Number: 831424404871
	Project Name: BWMS	Date Shipped: 12-18-02
	Project Number: 2032	Quote #:
Telephone: (603) 229-1960	P.O. #	
Facsimile: (603) 229-1919	Sampler Name(s): B. Green + M. Thomas	
Contact Name: M. Roy		

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 L					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	Sed RN-41 12-18-02	12-18-02	1530	—	SED	LUMBRICULUS + HYALELLA	BAG + MBT	2					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole Group Aqua Tech

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE 1 OF 1

COMPANY INFORMATION

Name: Sandy Head Assoc
Address: 6 Grove Falls Rd
Concord NH 03301
Telephone: (603) 229-1900
Facsimile: (603) 229-1919
Contact Name: N. Roy

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BUPS
Project Number: 2032
P.O. #
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: FED EXP
Airbill Number: 831424401911
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	NR-01 12-18-02	12-18-02	1330	C	SED.	LUMBRICULUS + HYALELLA	BAG + MBT	2					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab:
Cooler Temp = 0.0°C

Chain-of-Custody Record

Woods Hole Group

Aquatech Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

PAGE ___ OF ___

COMPANY INFORMATION

Name: Swan Heart Assoc.
Address: 6 Grove Farm Rd
Lincoln, MA 01773
Telephone: (617) 259-1900
Facsimile: (617) 259-1919
Contact Name: M. Rei

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BWPS
Project Number: 2032
P.O. #:
Sampler Name(s): B. Green & M. Thomas

SHIPPING INFORMATION

Carrier: Fed Ex
Airbill Number: 831424404852
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC					
VOLUME	1 L					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	NR-71 12-18-02	12-17-02	1400	—	SED.	LUMBRICULUS + HYALELLA	BAC + MSF						

Relinquished by: (*signature*)	DATE	TIME	Received by: (*signature*)
[signature]	12-17-02	1730	
Relinquished by: (*signature*)	DATE 12/18/02	TIME 10:30	Received by: (*signature*) Karen Downey
Relinquished by: (*signature*)	DATE	TIME	Received for Laboratory by: (*signature*)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp =

Chain-of-Custody Record

Woods Hole Group

Aquatech Bio

375 Paramount Drive
Raynham, MA 02767

TEL: (508) 822-9300
FAX: (508) 822-3288

COMPANY INFORMATION

Name: Sanborn Head & Assoc.
Address: 6 Governors Falls Rd
Concord, NH 03301
Telephone: (603) 224-1900
Facsimile: (603) 224-1919
Contact Name:

COMPANY'S PROJECT INFORMATION

Regulatory Protocol:
For the State of:
Project Name: BWPS
Project Number: 2032
P.O. #:
Sampler Name(s): B. Green + M. Thomas

SHIPPING INFORMATION

Carrier: Fed Ex
Airbill Number: 8314244047874
Date Shipped: 12-18-02
Quote #:

(TAT IS IN BUSINESS DAYS) (IF OTHER NOTE BELOW)
CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE						
CONTAINER TYPE	PLASTIC	PLASTIC	PLASTIC			
VOLUME	2 L	1 L	1/2 L			

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	LP-01 / 12-18-02	12-18-02	1330	G	SED	LUMBRICULUS + HYALELLA	BAG + MBT	1					
	VA-5 / 12-18-02	12-18-02	1445	G	"	LUMBRICULUS	"		1	1			

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
M. B. Thomas	12-18-02	1730	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/19/02	10:30	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: Cooler Temp =

We cannot accept verbal changes - Please Fax written changes to (508) 822-3288

Chain-of-Custody Record

Woods Hole ~~Group~~ Aquatech Bio

~~375 Paramount Drive~~
~~Raynham, MA 02767~~

~~TEL: (508) 822-9300~~
~~FAX: (508) 822-3288~~

PAGE 1 OF 1

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION
Name: Sanborn Head + Assoc.	Regulatory Protocol:	Carrier: Fed Exp
Address: 6 Garvins Falls Rd Concord NH 03301	For the State of:	Airbill Number: 831424409740
	Project Name: BUPS	Date Shipped: 12-17-02
	Project Number: 2032	Quote #:
Telephone: (603) 229-1900	P.O. #	
Facsimile: (603) 229-1919	Sampler Name(s): B. Green + M. Thomas	
Contact Name: N. Roy	(TAT IS IN BUSINESS DAYS) CIRCLE TAT: 10 Day 5 Day 3 Day 48 Hr 24 Hr Other (IF OTHER NOTE BELOW)	

SAMPLE CONTAINERS (NOTE 4)

PRESERVATIVE	ICE					
CONTAINER TYPE	PLASTIC BUCKET					
VOLUME	2 GAL					

WHG LAB #	SAMPLE ID (NOTE 1)	COLLECTION DATE	COLLECTION TIME	COMPOSITE OR GRAB	MATRIX	ANALYSIS/REMARKS (NOTES 2, 3)	SAMPLER(S) INTIALS	NUMBER OF CONTAINERS					
	Sed Nwd-1/ 12-17-02	12-17-02	1015	C/G	SED	LUMBRICULUS + HYALELLA	BAG + MBT	1					
	OW-801/ 12-17-02	12-17-02	1015	C/G	SED	" "	"	1					

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
[signature]	12-17-02	1705	
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/20/02	11:20	Karen Downey
Relinquished by: (signature)	DATE	TIME	Received for Laboratory by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 6 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.; MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.; 40ml/glass/H_2SO_4

Notes to Lab: SDG - BU 801 Cooler Temp = 0.0°C

No tape was on the cooler when we received it from Fedex

Aquatec Biological Sciences
Chain-of-Custody Record

273 Commerce Street
Williston, VT 05495
TEL: (802) 860-1638
FAX: (802) 658-3189

COMPANY INFORMATION	COMPANY'S PROJECT INFORMATION	SHIPPING INFORMATION	VOLUME/CONTAINER TYPE/ PRESERVATIVE (NOTE 4)
Name:	Project Name:	Carrier:	
Address:			
	Project Number:	Airbill Number:	
City/State/Zip:	Sampler Name(s):		
Telephone:	JOHN WILLIAMS	Date Shipped:	
Facsimile:			
Contact Name:	Quote #: ____ Client Code: ____	Hand Delivered: ☐ Yes ☐ No	

SAMPLE IDENTIFICATION (NOTE1)	COLLECTION DATE	COLLECTION TIME	GRAB	COMPOSITE	MATRIX	ANALYSIS/REMARKS (NOTE 2,3)	NUMBER OF CONTAINERS
Lamoille River							
Natural Sediment	12/21/02	15:30	X			Hydrolic Natural	
						sediment control.	

Relinquished by: (signature)	DATE	TIME	Received by: (signature)
	12/21/02	16:15	To Aquatec
Relinquished by: (signature)	DATE	TIME	Received by: (signature)
Relinquished by: (signature)	DATE	TIME	Received by: (signature)

NOTES TO SAMPLER(S): (1) Limit Sample Identification to 30 characters, if possible; (2) Indicate designated Lab Q.C. sample and type (e.g.:MS/MSD/REP) and provide sufficient sample; (3) Field duplicates are separate sample; (4) e.g.: 40 ml/glass/H_2SO_4

Notes to Lab:

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Toxicity Test Methods

Sanborn, Head & Associates, Inc.

Client: Sanborn, Head, & Associates	Project: 02070, Blackburn Union	SDG: 6669

Test Description: Amphipod, *Hyalella azteca*, 28-day survival and growth test for sediments

ASSOCIATED PROTOCOLS: USEPA 2000 *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA/600/R-99/064)

1. Test type:	Whole sediment toxicity (static renewal)
2. Test temperature:	23 ± 1°C
3. Light quality:	Ambient laboratory illumination
4. Photoperiod:	16 hr. light, 8 hr. dark
5. Test chamber:	300 ml glass beaker with screened overflow
6. Sediment / overlying water volumes:	100 / 175 mL
7. Renewal of overlying water:	2 volume exchanges per day
8. Age of test organisms:	9 days at the start of the test
9. No. amphipods / test chamber:	10
10. No. of replicate chambers / sample	8
11. Feeding regime:	1.0 mL YCT daily to each replicate
12. Cleaning:	Overflow screens, replace water delivery tips as needed
13. Aeration:	None, unless dissoved oxygen drops below 2.5 mg/L
14. Overlying water:	1:1 mix of reconstituted water and Lake Champlain water
15. Control sediment:	Control A: Formulated sediment; Control B: Natural sediment (statistical control)
16. Test duration:	28 days
17. Monitoring:	Overlying water chemistry: Daily: temperature Three times weekly: dissolved oxygen, pH Weekly: conductivity Beginning (Day 0) and end of test (Day 27): pH, conductivity, hardness, alkalinity, and ammonia Systems and biological monitoring: Daily.
18. End points:	Day 28: survival and growth (average dry weight)
19. Reference toxicant test:	Potassium chloride 96-h LC50, water only
20. Test acceptability	80% or greater survival in controls
21. Data interpretation:	Hypothesis test statistics (e.g., t-test) to identify significant reductions in responses compared to the control responses. Survival or growth responses quantitatively equal to or greater than the control were assumed to be not significant.

Reviewer: _____ Date 1/21/03

Laboratory: Aquatec Biological Sciences, Inc. Williston, Vermont

Ha28dpkg

Amphipod, Hyalella azteca, 28-day survival and growth

Sanborn, Head & Associates, Inc.

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.8000	1.1071
1	Natural Contr B	2	1.0000	1.4120
1	Natural Contr B	3	0.9000	1.2490
1	Natural Contr B	4	1.0000	1.4120
1	Natural Contr B	5	0.9000	1.2490
1	Natural Contr B	6	0.9000	1.2490
1	Natural Contr B	7	0.7000	0.9912
1	Natural Contr B	8	0.8000 ✓	1.1071
2	23401	1	0.7000	0.9912
2	23401	2	0.9000	1.2490
2	23401	3	1.0000	1.4120
2	23401	4	0.8000	1.1071
2	23401	5	0.7000	0.9912
2	23401	6	1.0000	1.4120
2	23401	7	0.8000 ✓	1.1071

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.3484
W = 0.9225

Critical W = 0.8350 (alpha = 0.01 , N = 15)
W = 0.8810 (alpha = 0.05 , N = 15)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0220	
2	23401	0.0324	1.4717

(p-value = 0.6213)

Critical F = 9.1553 (P=0.01, 6, 7)
5.1186 (P=0.05, 6, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.9912	1.4120	1.2221
2	23401	7	0.9912	1.4120	1.1814

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0220	0.1484	0.0525	12.1402
2	23401	0.0324	0.1800	0.0680	15.2347

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0062	0.0062	0.2307
Within (Error)	13	0.3484	0.0268	
Total	14	0.3546		

(p-value = 0.6390)

Critical F = 9.0738 (alpha = 0.01, df = 1,13)
= 4.6672 (alpha = 0.05, df = 1,13)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS t STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23401	1.1814	0.8429	0.4803	

Equal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.3195)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23401	1.1814	0.8429	0.4737	

Unequal Var: t critical value = 1.7823 (1 Tailed, alpha = 0.05, df = 12)
(p-value = 0.3221)

Title: Hyalella azteca 28-d survival: Control B vs. 23401
File: 23401has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23401	7	0.1121	12.7	0.0321

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23401	7	0.1146	13.0	0.0321

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.8000	1.1071
1	Natural Contr B	2	1.0000	1.4120
1	Natural Contr B	3	0.9000	1.2490
1	Natural Contr B	4	1.0000	1.4120
1	Natural Contr B	5	0.9000	1.2490
1	Natural Contr B	6	0.9000	1.2490
1	Natural Contr B	7	0.7000	0.9912
1	Natural Contr B	8	0.8000	1.1071
2	23405	1	0.9000	1.2490
2	23405	2	0.8000	1.1071
2	23405	3	0.9000	1.2490
2	23405	4	0.7000	0.9912
2	23405	5	0.8000	1.1071
2	23405	6	0.7000	0.9912
2	23405	7	1.0000	1.4120
2	23405	8	0.9000	1.2490

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.3033
W = 0.9572

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0220	
2	23405	0.0213	1.0328

(p-value = 0.9671)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.9912	1.4120	1.2221
2	23405	8	0.9912	1.4120	1.1695

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0220	0.1484	0.0525	12.1402
2	23405	0.0213	0.1460	0.0516	12.4832

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0111	0.0111	0.5111
Within (Error)	14	0.3033	0.0217	
Total	15	0.3143		

(p-value = 0.4864)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS t STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23405	1.1695	0.8375	0.7149	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.2432)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23405	1.1695	0.8375	0.7149	

Unequal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.2432)

Title: Hyalella azteca 28-d survival: Control B vs. 23405
File: 23405has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23405	8	0.0951	10.8	0.0375

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23405	8	0.0951	10.8	0.0375

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.8000	1.1071
1	Natural Contr B	2	1.0000	1.4120
1	Natural Contr B	3	0.9000	1.2490
1	Natural Contr B	4	1.0000	1.4120
1	Natural Contr B	5	0.9000	1.2490
1	Natural Contr B	6	0.9000	1.2490
1	Natural Contr B	7	0.7000	0.9912
1	Natural Contr B	8	0.8000	1.1071
2	23406	1	0.6000	0.8861
2	23406	2	1.0000	1.4120
2	23406	3	1.0000	1.4120
2	23406	4	0.8000	1.1071
2	23406	5	0.9000	1.2490
2	23406	6	1.0000	1.4120
2	23406	7	1.0000	1.4120
2	23406	8	0.5000	0.7854

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.6146
W = 0.8788

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0220	
2	23406	0.0658	2.9891

(p-value = 0.1718)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.9912	1.4120	1.2221
2	23406	8	0.7854	1.4120	1.2095

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0220	0.1484	0.0525	12.1402
2	23406	0.0658	0.2565	0.0907	21.2080

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0006	0.0006	0.0145
Within (Error)	14	0.6146	0.0439	
Total	15	0.6153		

(p-value = 0.9059)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS t STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23406	1.2095	0.8500	0.1204	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.4530)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23406	1.2095	0.8500	0.1204	

Unequal Var: t critical value = 1.7959 (1 Tailed, alpha = 0.05, df = 11)
(p-value = 0.4532)

Title: Hyalella azteca 28-d survival: Control B vs. 23406
File: 23406has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23406	8	0.1416	16.0	0.0250

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23406	8	0.1448	16.4	0.0250

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.8000	1.1071
1	Natural Contr B	2	1.0000	1.4120
1	Natural Contr B	3	0.9000	1.2490
1	Natural Contr B	4	1.0000	1.4120
1	Natural Contr B	5	0.9000	1.2490
1	Natural Contr B	6	0.9000	1.2490
1	Natural Contr B	7	0.7000	0.9912
1	Natural Contr B	8	0.8000	1.1071
2	23412	1	0.9000	1.2490
2	23412	2	0.7000	0.9912
2	23412	3	0.8000	1.1071
2	23412	4	0.7000	0.9912
2	23412	5	1.0000	1.4120
2	23412	6	0.7000	0.9912
2	23412	7	1.0000	1.4120
2	23412	8	0.8000	1.1071

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.3801
W = 0.9252

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	Natural Contr B	0.0220	
2	23412	0.0323	1.4669

(p-value = 0.6257)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Natural Contr B	8	0.9912	1.4120	1.2221
2	23412	8	0.9912	1.4120	1.1576

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Natural Contr B	0.0220	0.1484	0.0525	12.1402
2	23412	0.0323	0.1797	0.0635	15.5226

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0166	0.0166	0.6124
Within (Error)	14	0.3801	0.0272	
Total	15	0.3967		

(p-value = 0.4469)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS t STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23412	1.1576	0.8250	0.7826	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.2235)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	Natural Contr B	1.2221	0.8750		
2	23412	1.1576	0.8250	0.7826	

Unequal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.2235)

Title: Hyalella azteca 28-d survival: Control B vs. 23412
File: 23412has Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23412	8	0.1079	12.2	0.0500

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	Natural Contr B	8			
2	23412	8	0.1079	12.2	0.0500

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Natural Contr B	1	0.3400	0.3400
1	Natural Contr B	2	0.3300	0.3300
1	Natural Contr B	3	0.2500	0.2500
1	Natural Contr B	4	0.3300	0.3300
1	Natural Contr B	5	0.4300	0.4300
1	Natural Contr B	6	0.2600	0.2600
1	Natural Contr B	7	0.3300	0.3300
1	Natural Contr B	8	0.5600	0.5600
2	23406	1	0.2800	0.2800
2	23406	2	0.3700	0.3700
2	23406	3	0.2800	0.2800
2	23406	4	0.3900	0.3900
2	23406	5	0.3200	0.3200
2	23406	6	0.3000	0.3000
2	23406	7	0.3300	0.3300
2	23406	8	0.3200	0.3200

Title: Hyalella azteca 28-d growth: Control B vs. 23406
File: 23406hag Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.0808
W = 0.8732

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Appendix D
Food Chain Models

Table D-1
Food Chain Model for Chronic Exposures
Muskrat Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	0.745	7.45	1.57E+01	1.57E+01	1.15E+01	9.77E+01	0.05	6.96E+00	0.95	0.34	2.48E-01	8.70E+03	0.0014	7.52E-01		0.98	0.00E+00
Barium	0.2	0.1	10.4	14.92	1.69E+00	1.69E+00	4.34E+00	5.83E+01	0.05	1.50E+00	0.95	0.34	8.76E-01	5.01E+01	0.0014	4.04E-02	1.43E-01	0.98	8.34E-02
Cobalt	Bench NA	Bench NA	NA	NA	1.82E-02	1.82E-02	3.30E-02	2.73E-01	0.05	2.04E-02	0.95	0.34	6.18E-01	5.10E+00	0.0014	3.82E-01		0.98	0.00E+00
Iron	Bench NA	Bench NA	NA	NA	4.13E+01	4.13E+01	4.18E+01	6.23E+02	0.05	1.12E+01	0.95	0.34	3.44E-01	1.40E+04	0.0014	4.61E-01	8.22E+00	0.98	1.95E-01
Lead	0.1	0.01	6	60	6.85E-01	6.85E-01	9.04E-01	7.53E+00	0.05	5.56E-01	0.95	0.34	4.49E-01	2.78E+02	0.0014	5.51E-01		0.98	0.00E+00
Manganese	0.3	0.08	63	203	1.69E+01	1.69E+01	4.46E+01	4.66E+01	0.05	4.45E+01	0.95	0.34	8.97E-01	8.91E+02	0.0014	7.16E-02	5.35E-01	0.98	3.10E-02
Nickel	1	0.3	2.03	12.1	3.04E+00	3.04E+00	8.60E+00	7.43E-01	0.05	9.01E+00	0.95	0.34	9.61E-01	8.67E+01	0.0014	3.87E-02		0.98	0.00E+00
Vanadium	0.4	0.04	0.14	1.4	5.10E-02	5.10E-02	6.02E-02	7.33E-01	0.05	2.47E-02	0.95	0.34	4.01E-01	2.25E+01	0.0014	5.99E-01		0.98	0.00E+00
Zinc	0.054	0.03	114.17	228.34	6.12E+00	6.12E+00	1.76E+01	3.77E+01	0.05	1.65E+01	0.95	0.34	9.77E-01	1.03E+02	0.0014	2.30E-02		0.98	0.00E+00
SVOCs																			
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.70E-02	1.70E-02	4.76E-02		0.05	5.01E-02	0.95	0.34	9.52E-01	5.96E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthene	0.0005	0.0003	14	27	6.95E-03	6.95E-03	1.95E-02		0.05	2.05E-02	0.95	0.34	9.52E-01	2.44E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	3.31E-02	3.31E-02	9.27E-02		0.05	9.76E-02	0.95	0.34	9.52E-01	1.16E+00	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	0.0005	Bench NA	38.6	NA	1.94E-02	1.94E-02	5.43E-02		0.05	5.71E-02	0.95	0.34	9.52E-01	6.80E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	4.19E-02	4.19E-02	1.17E-01		0.05	1.23E-01	0.95	0.34	9.52E-01	1.47E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)pyrene	0.1	0.01	0.4	3.9	4.80E-02	4.80E-02	1.34E-01		0.05	1.41E-01	0.95	0.34	9.52E-01	1.68E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	6.47E-02	6.47E-02	1.80E-01		0.05	1.90E-01	0.95	0.34	9.48E-01	2.26E+00	0.0014	4.75E-02	3.19E-04	0.98	4.83E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.57E-02	1.57E-02	4.35E-02		0.05	4.58E-02	0.95	0.34	9.42E-01	5.45E-01	0.0014	4.72E-02	1.78E-04	0.98	1.11E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	4.35E-02	4.35E-02	1.21E-01		0.05	1.28E-01	0.95	0.34	9.48E-01	1.52E+00	0.0014	4.75E-02	1.99E-04	0.98	4.49E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	2.86E-02	2.86E-02	8.18E-02	1.64E+00	0.05		0.95	0.34	9.74E-01	5.45E-01	0.0014	2.60E-02		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.0002	0.00002	7.07	70.7	1.69E-03	1.69E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	1.25E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	3.61E-04	3.61E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.66E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	5.81E-02	5.81E-02	1.62E-01		0.05	1.70E-01	0.95	0.34	9.47E-01	2.03E+00	0.0014	4.75E-02	3.45E-04	0.98	5.82E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	3.77E-03	3.77E-03	1.05E-02		0.05	1.11E-02	0.95	0.34	9.52E-01	1.32E-01	0.0014	4.77E-02		0.98	0.00E+00
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	1.46E-04	1.46E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.07E-01	0.0014	1.00E+00		0.98	0.00E+00
Fluoranthene	0.005	Bench NA	19	NA	9.22E-02	9.22E-02	2.59E-01	1.25E-01	0.05	2.66E-01	0.95	0.34	9.53E-01	3.16E+00	0.0014	4.66E-02		0.98	0.00E+00
Fluorene	0.0005	Bench NA	19	NA	9.46E-03	9.46E-03	2.65E-02		0.05	2.79E-02	0.95	0.34	9.52E-01	3.32E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.85E-02	1.85E-02	5.17E-02		0.05	5.45E-02	0.95	0.34	9.52E-01	6.48E-01	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.003	0.002	5.1	10	1.62E-02	1.62E-02	4.54E-02		0.05	4.78E-02	0.95	0.34	9.52E-01	5.69E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	6.35E-02	6.35E-02	1.78E-01		0.05	1.87E-01	0.95	0.34	9.52E-01	2.23E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.02	2.9	5	1.03E-01	1.03E-01	2.86E-01		0.05	3.01E-01	0.95	0.34	9.47E-01	3.58E+00	0.0014	4.75E-02	6.15E-04	0.98	5.88E-03

Table D-1
Food Chain Model for Chronic Exposures
Muskrat Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food							Sediment			Water		
							Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	0.75	7.45	1.61E+01	1.61E+01	1.26E+01	1.20E+02	0.05	6.96E+00	0.95	0.34	2.66E-01	8.70E+03	0.0014	7.34E-01		0.98	0.00E+00
Barium	0.2	0.1	10.40	14.92	1.75E+00	1.75E+00	4.53E+00	6.20E+01	0.05	1.50E+00	0.95	0.34	8.81E-01	5.01E+01	0.0014	3.90E-02	1.43E-01	0.98	8.04E-02
Cobalt	Bench NA	Bench NA	NA	NA	1.95E-02	1.95E-02	3.69E-02	3.50E-01	0.05	2.04E-02	0.95	0.34	6.44E-01	5.10E+00	0.0014	3.56E-01		0.98	0.00E+00
Iron	Bench NA	Bench NA	NA	NA	4.30E+01	4.30E+01	4.66E+01	7.20E+02	0.05	1.12E+01	0.95	0.34	3.69E-01	1.40E+04	0.0014	4.43E-01	8.22E+00	0.98	1.87E-01
Lead	0.1	0.01	5.71	57.09	7.20E-01	7.20E-01	1.01E+00	9.60E+00	0.05	5.56E-01	0.95	0.34	4.76E-01	2.78E+02	0.0014	5.24E-01		0.98	0.00E+00
Manganese	0.3	0.09	62.79	202.65	1.74E+01	1.74E+01	4.61E+01	7.50E+01	0.05	4.45E+01	0.95	0.34	9.00E-01	8.91E+02	0.0014	6.96E-02	5.35E-01	0.98	3.01E-02
Nickel	1	0.3	2.03	12.1	3.04E+00	3.04E+00	8.61E+00	9.50E-01	0.05	9.01E+00	0.95	0.34	9.61E-01	8.67E+01	0.0014	3.87E-02		0.98	0.00E+00
Vanadium	0.4	0.04	0.14	1.39	5.32E-02	5.32E-02	6.65E-02	8.60E-01	0.05	2.47E-02	0.95	0.34	4.25E-01	2.25E+01	0.0014	5.75E-01		0.98	0.00E+00
Zinc	0.054	0.03	114.17	228.34	6.19E+00	6.19E+00	1.78E+01	4.20E+01	0.05	1.65E+01	0.95	0.34	9.77E-01	1.03E+02	0.0014	2.27E-02		0.98	0.00E+00
SVOCs																			
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.70E-02	1.70E-02	4.76E-02		0.05	5.01E-02	0.95	0.34	9.52E-01	5.96E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthene	0.0005	0.0003	14	27	6.95E-03	6.95E-03	1.95E-02		0.05	2.05E-02	0.95	0.34	9.52E-01	2.44E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	3.31E-02	3.31E-02	9.27E-02		0.05	9.76E-02	0.95	0.34	9.52E-01	1.16E+00	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	0.0005	Bench NA	38.61	NA	1.94E-02	1.94E-02	5.43E-02		0.05	5.71E-02	0.95	0.34	9.52E-01	6.80E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	4.19E-02	4.19E-02	1.17E-01		0.05	1.23E-01	0.95	0.34	9.52E-01	1.47E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)pyrene	0.1	0.01	0.39	3.86	4.80E-02	4.80E-02	1.34E-01		0.05	1.41E-01	0.95	0.34	9.52E-01	1.68E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	6.47E-02	6.47E-02	1.80E-01		0.05	1.90E-01	0.95	0.34	9.48E-01	2.26E+00	0.0014	4.75E-02	3.19E-04	0.98	4.83E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.57E-02	1.57E-02	4.35E-02		0.05	4.58E-02	0.95	0.34	9.42E-01	5.45E-01	0.0014	4.72E-02	1.78E-04	0.98	1.11E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	4.35E-02	4.35E-02	1.21E-01		0.05	1.28E-01	0.95	0.34	9.48E-01	1.52E+00	0.0014	4.75E-02	1.99E-04	0.98	4.49E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	4.83E-02	4.83E-02	1.40E-01	2.80E+00	0.05		0.95	0.34	9.85E-01	5.45E-01	0.0014	1.53E-02		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.0002	0.00002	7.07	70.66	1.69E-03	1.69E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	1.25E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	3.61E-04	3.61E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.66E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	5.81E-02	5.81E-02	1.62E-01		0.05	1.70E-01	0.95	0.34	9.47E-01	2.03E+00	0.0014	4.75E-02	3.45E-04	0.98	5.82E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	3.77E-03	3.77E-03	1.05E-02		0.05	1.11E-02	0.95	0.34	9.52E-01	1.32E-01	0.0014	4.77E-02		0.98	0.00E+00
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	7.21E-05	7.21E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	5.30E-02	0.0014	1.00E+00		0.98	0.00E+00
Fluoranthene	0.005	Bench NA	19	NA	9.21E-02	9.21E-02	2.58E-01	1.20E-01	0.05	2.66E-01	0.95	0.34	9.53E-01	3.16E+00	0.0014	4.67E-02		0.98	0.00E+00
Fluorene	0.0005	Bench NA	19	NA	9.46E-03	9.46E-03	2.65E-02		0.05	2.79E-02	0.95	0.34	9.52E-01	3.32E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.85E-02	1.85E-02	5.17E-02		0.05	5.45E-02	0.95	0.34	9.52E-01	6.48E-01	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.003	0.002	5.07	9.99	1.62E-02	1.62E-02	4.54E-02		0.05	4.78E-02	0.95	0.34	9.52E-01	5.69E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	6.35E-02	6.35E-02	1.78E-01		0.05	1.87E-01	0.95	0.34	9.52E-01	2.23E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.02	2.90	5.02	1.03E-01	1.03E-01	2.86E-01		0.05	3.01E-01	0.95	0.34	9.47E-01	3.58E+00	0.0014	4.75E-02	6.15E-04	0.98	5.88E-03

Notes:
Bench NA=benchmark not available/applicable
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since UCLs could not be calculated for invertebrate concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-2
Food Chain Model for Chronic Exposures
Muskrat Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency			NOAEL	LOAEL	Time and Area		Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	Benchmark Dose mg/kg/d	Benchmark Dose mg/kg/d	Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	0.745	7.45	1.59E+01	1.59E+01	1.24E+01	1.18E+02	0.05	6.88E+00	0.95	0.34	2.65E-01	8.60E+03	0.0014	7.35E-01		0.98	0.00E+00
Barium	0.2	0.2	10.4	14.9	2.31E+00	2.31E+00	5.97E+00	6.13E+01	0.05	3.06E+00	0.95	0.34	8.79E-01	1.02E+02	0.0014	6.00E-02	1.43E-01	0.98	6.08E-02
Beryllium	0.003	Bench NA	0.47	NA	1.19E-03	1.19E-03	1.12E-03		0.05	1.18E-03	0.95	0.34	3.22E-01	5.92E-01	0.0014	6.78E-01		0.98	0.00E+00
Cadmium	0.2	0.02	0.7	6.9	1.40E-01	1.40E-01	3.93E-01	9.77E-02	0.05	4.09E-01	0.95	0.34	9.54E-01	4.76E+00	0.0014	4.61E-02		0.98	0.00E+00
Chromium	0.006	Bench NA	1953	NA	1.22E+01	1.22E+01	3.49E+01	5.57E+00	0.05	3.64E+01	0.95	0.34	9.75E-01	2.25E+02	0.0014	2.51E-02		0.98	0.00E+00
Cobalt	Bench NA	Bench NA	NA	NA	3.79E-02	3.79E-02	6.18E-02	2.93E-01	0.05	4.96E-02	0.95	0.34	5.55E-01	1.24E+01	0.0014	4.45E-01		0.98	0.00E+00
Copper	0.3	0.2	10.9	14.05	3.09E+00	3.09E+00	8.65E+00	4.67E+00	0.05	8.86E+00	0.95	0.34	9.51E-01	1.11E+02	0.0014	4.87E-02		0.98	0.00E+00
Lead	1	0.1	6	60	7.36E+00	7.36E+00	7.67E+00	2.06E+01	0.05	6.98E+00	0.95	0.34	3.54E-01	3.49E+03	0.0014	6.46E-01		0.98	0.00E+00
Manganese	0.2	0.06	63	203	1.25E+01	1.25E+01	3.26E+01	1.01E+01	0.05	3.37E+01	0.95	0.34	8.85E-01	6.75E+02	0.0014	7.34E-02	5.35E-01	0.98	4.19E-02
Mercury	0.002	Bench NA	0.9	NA	1.46E-03	1.46E-03	2.24E-03	1.17E-02	0.05	1.75E-03	0.95	0.34	5.22E-01	5.14E-01	0.0014	4.78E-01		0.98	0.00E+00
Nickel	**4**	0.7	2.03	12.1	8.03E+00	8.03E+00	2.27E+01	2.19E+00	0.05	2.38E+01	0.95	0.34	9.61E-01	2.29E+02	0.0014	3.87E-02		0.98	0.00E+00
Selenium	0.1	0.06	0.1	0.24	1.46E-02	1.46E-02	3.89E-02	5.17E-01	0.05	1.37E-02	0.95	0.34	9.08E-01	9.81E-01	0.0014	9.17E-02		0.98	0.00E+00
Silver	0.03	0.003	1.6	15.9	5.39E-02	5.39E-02	1.55E-01		0.05	1.63E-01	0.95	0.34	9.74E-01	1.02E+00	0.0014	2.56E-02		0.98	0.00E+00
Thallium	0.04	0.004	0.0053	0.053	1.90E-04	1.90E-04	1.36E-04	2.55E-03	0.05	8.45E-06	0.95	0.34	2.43E-01	1.06E-01	0.0014	7.57E-01		0.98	0.00E+00
Vanadium	0.7	0.07	0.14	1.4	9.15E-02	9.15E-02	8.11E-02	6.40E-01	0.05	5.17E-02	0.95	0.34	3.01E-01	4.70E+01	0.0014	6.99E-01		0.98	0.00E+00
Zinc	0.2	0.08	110	230	1.77E+01	1.77E+01	5.07E+01	3.30E+01	0.05	5.16E+01	0.95	0.34	9.75E-01	3.22E+02	0.0014	2.48E-02		0.98	0.00E+00
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	4.16E-04	4.16E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	3.06E-01	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	4.52E-03	4.52E-03	1.26E-02		0.05	1.33E-02	0.95	0.34	9.52E-01	1.58E-01	0.0014	4.77E-02		0.98	0.00E+00
4-Methylphenol	0.0003	0.0001	12.5	32.1	3.17E-03	3.17E-03	8.33E-03	1.67E-01	0.05		0.95	0.34	8.94E-01	2.46E-01	0.0014	1.06E-01		0.98	0.00E+00
Acenaphthene	0.0003	0.0002	14	27	4.24E-03	4.24E-03	1.19E-02		0.05	1.25E-02	0.95	0.34	9.52E-01	1.49E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.94E-02	1.94E-02	5.44E-02		0.05	5.72E-02	0.95	0.34	9.52E-01	6.81E-01	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	0.0006	Bench NA	38.6	NA	2.14E-02	2.14E-02	6.01E-02		0.05	6.32E-02	0.95	0.34	9.52E-01	7.53E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	6.31E-02	6.31E-02	1.77E-01	1.38E-01	0.05	1.79E-01	0.95	0.34	9.54E-01	2.13E+00	0.0014	4.60E-02		0.98	0.00E+00
Benzo(a)pyrene	0.2	0.02	0.4	3.9	6.20E-02	6.20E-02	1.74E-01		0.05	1.83E-01	0.95	0.34	9.52E-01	2.18E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	7.92E-02	7.92E-02	2.21E-01		0.05	2.32E-01	0.95	0.34	9.49E-01	2.77E+00	0.0014	4.75E-02	3.19E-04	0.98	3.95E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.26E-02	1.26E-02	3.49E-02		0.05	3.68E-02	0.95	0.34	9.39E-01	4.38E-01	0.0014	4.71E-02	1.78E-04	0.98	1.38E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	7.41E-02	7.41E-02	2.07E-01		0.05	2.18E-01	0.95	0.34	9.50E-01	2.59E+00	0.0014	4.76E-02	1.99E-04	0.98	2.64E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	1.64E-02	1.64E-02	4.37E-02	8.73E-01	0.05		0.95	0.34	9.07E-01	1.12E+00	0.0014	9.29E-02		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	2.96E-02	2.96E-02	8.67E-02	1.73E+00	0.05		0.95	0.34	9.95E-01	1.07E-01	0.0014	4.91E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.0002	0.00002	7.07	70.7	1.53E-03	1.53E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	1.12E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	2.50E-04	2.50E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.84E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	7.42E-02	7.42E-02	2.07E-01	1.32E-01	0.05	2.11E-01	0.95	0.34	9.49E-01	2.51E+00	0.0014	4.61E-02	3.45E-04	0.98	4.56E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	4.82E-03	4.82E-03	1.35E-02		0.05	1.42E-02	0.95	0.34	9.52E-01	1.69E-01	0.0014	4.77E-02		0.98	0.00E+00
Fluoranthene	0.006	Bench NA	19	NA	1.16E-01	1.16E-01	3.27E-01	1.87E-01	0.05	3.34E-01	0.95	0.34	9.54E-01	3.97E+00	0.0014	4.64E-02		0.98	0.00E+00
Fluorene	0.0004	Bench NA	19	NA	7.58E-03	7.58E-03	2.12E-02		0.05	2.23E-02	0.95	0.34	9.52E-01	2.66E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.52E-02	1.52E-02	4.25E-02		0.05	4.48E-02	0.95	0.34	9.52E-01	5.33E-01	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.002	0.001	5.1	10	1.04E-02	1.04E-02	2.92E-02		0.05	3.08E-02	0.95	0.34	9.52E-01	3.66E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	5.70E-02	5.70E-02	1.60E-01		0.05	1.68E-01	0.95	0.34	9.52E-01	2.00E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.02	2.9	5	1.25E-01	1.25E-01	3.49E-01	2.17E-01	0.05	3.56E-01	0.95	0.34	9.49E-01	4.24E+00	0.0014	4.61E-02	6.15E-04	0.98	4.82E-03
VOCs																			
Acetone	0.00005	0.00001	7.1	36	3.68E-04	3.68E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.71E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbon Disulfide	0.000001	Bench NA	4	NA	5.94E-06	5.94E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	4.37E-03	0.0014	1.00E+00		0.98	0.00E+00
Methyl tert-butyl ether (MTBE)	0.0000004	0.00000004	10.2	102	3.86E-06	3.86E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	2.84E-03	0.0014	1.00E+00		0.98	0.00E+00

Table D-2
Food Chain Model for Chronic Exposures
Muskrat Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	0.75	7.45	1.61E+01	1.61E+01	1.30E+01	1.30E+02	0.05	6.88E+00	0.95	0.34	2.75E-01	8.60E+03	0.0014	7.25E-01		0.98	0.00E+00
Barium	0.2	0.2	10.40	14.92	2.37E+00	2.37E+00	6.16E+00	6.50E+01	0.05	3.06E+00	0.95	0.34	8.82E-01	1.02E+02	0.0014	5.85E-02	1.43E-01	0.98	5.92E-02
Beryllium	0.003	Bench NA	0.47	NA	1.19E-03	1.19E-03	1.12E-03		0.05	1.18E-03	0.95	0.34	3.22E-01	5.92E-01	0.0014	6.78E-01		0.98	0.00E+00
Cadmium	0.2	0.02	0.69	6.88	1.40E-01	1.40E-01	3.93E-01	9.90E-02	0.05	4.09E-01	0.95	0.34	9.54E-01	4.76E+00	0.0014	4.61E-02		0.98	0.00E+00
Chromium	0.006	Bench NA	1953.03	NA	1.22E+01	1.22E+01	3.51E+01	8.70E+00	0.05	3.64E+01	0.95	0.34	9.75E-01	2.25E+02	0.0014	2.50E-02		0.98	0.00E+00
Cobalt	Bench NA	Bench NA	NA	NA	3.86E-02	3.86E-02	6.41E-02	3.40E-01	0.05	4.96E-02	0.95	0.34	5.64E-01	1.24E+01	0.0014	4.36E-01		0.98	0.00E+00
Copper	0.3	0.2	10.85	14.05	3.11E+00	3.11E+00	8.72E+00	6.00E+00	0.05	8.86E+00	0.95	0.34	9.52E-01	1.11E+02	0.0014	4.84E-02		0.98	0.00E+00
Lead	1	0.1	5.71	57.09	7.58E+00	7.58E+00	8.33E+00	3.40E+01	0.05	6.98E+00	0.95	0.34	3.74E-01	3.49E+03	0.0014	6.26E-01		0.98	0.00E+00
Manganese	0.2	0.06	62.79	202.65	1.26E+01	1.26E+01	3.29E+01	1.70E+01	0.05	3.37E+01	0.95	0.34	8.86E-01	6.75E+02	0.0014	7.27E-02	5.35E-01	0.98	4.15E-02
Mercury	0.002	Bench NA	0.93	NA	1.50E-03	1.50E-03	2.36E-03	1.40E-02	0.05	1.75E-03	0.95	0.34	5.34E-01	5.14E-01	0.0014	4.66E-01		0.98	0.00E+00
Nickel	**4**	0.7	2.03	12.1	8.05E+00	8.05E+00	2.28E+01	3.50E+00	0.05	2.38E+01	0.95	0.34	9.61E-01	2.29E+02	0.0014	3.86E-02		0.98	0.00E+00
Selenium	0.1	0.07	0.14	0.24	1.58E-02	1.58E-02	4.25E-02	5.90E-01	0.05	1.37E-02	0.95	0.34	9.16E-01	9.81E-01	0.0014	8.44E-02		0.98	0.00E+00
Silver	0.03	0.003	1.6	15.9	5.39E-02	5.39E-02	1.55E-01		0.05	1.63E-01	0.95	0.34	9.74E-01	1.02E+00	0.0014	2.56E-02		0.98	0.00E+00
Thallium	0.04	0.004	0.01	0.05	2.21E-04	2.21E-04	2.28E-04	4.40E-03	0.05	8.45E-06	0.95	0.34	3.51E-01	1.06E-01	0.0014	6.49E-01		0.98	0.00E+00
Vanadium	0.7	0.07	0.14	1.39	9.47E-02	9.47E-02	9.06E-02	8.30E-01	0.05	5.17E-02	0.95	0.34	3.25E-01	4.70E+01	0.0014	6.75E-01		0.98	0.00E+00
Zinc	0.2	0.08	114.17	228.34	1.77E+01	1.77E+01	5.09E+01	3.80E+01	0.05	5.16E+01	0.95	0.34	9.75E-01	3.22E+02	0.0014	2.47E-02		0.98	0.00E+00
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	4.16E-04	4.16E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	3.06E-01	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	4.52E-03	4.52E-03	1.26E-02		0.05	1.33E-02	0.95	0.34	9.52E-01	1.58E-01	0.0014	4.77E-02		0.98	0.00E+00
4-Methylphenol	0.0003	0.0001	12.5	32.1	3.73E-03	3.73E-03	1.00E-02	2.00E-01	0.05		0.95	0.34	9.10E-01	2.46E-01	0.0014	8.96E-02		0.98	0.00E+00
Acenaphthene	0.0003	0.0002	14	27	4.24E-03	4.24E-03	1.19E-02		0.05	1.25E-02	0.95	0.34	9.52E-01	1.49E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.94E-02	1.94E-02	5.44E-02		0.05	5.72E-02	0.95	0.34	9.52E-01	6.81E-01	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	0.0006	Bench NA	38.61	NA	2.14E-02	2.14E-02	6.01E-02		0.05	6.32E-02	0.95	0.34	9.52E-01	7.53E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	6.31E-02	6.31E-02	1.77E-01	1.40E-01	0.05	1.79E-01	0.95	0.34	9.54E-01	2.13E+00	0.0014	4.59E-02		0.98	0.00E+00
Benzo(a)pyrene	0.2	0.02	0.39	3.86	6.20E-02	6.20E-02	1.74E-01		0.05	1.83E-01	0.95	0.34	9.52E-01	2.18E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	7.92E-02	7.92E-02	2.21E-01		0.05	2.32E-01	0.95	0.34	9.49E-01	2.77E+00	0.0014	4.75E-02	3.19E-04	0.98	3.95E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.26E-02	1.26E-02	3.49E-02		0.05	3.68E-02	0.95	0.34	9.39E-01	4.38E-01	0.0014	4.71E-02	1.78E-04	0.98	1.38E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	7.41E-02	7.41E-02	2.07E-01		0.05	2.18E-01	0.95	0.34	9.50E-01	2.59E+00	0.0014	4.76E-02	1.99E-04	0.98	2.64E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	1.80E-02	1.80E-02	4.85E-02	9.70E-01	0.05		0.95	0.34	9.16E-01	1.12E+00	0.0014	8.44E-02		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	4.09E-02	4.09E-02	1.20E-01	2.40E+00	0.05		0.95	0.34	9.97E-01	1.00E-01	0.0014	3.32E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.0002	0.00002	7.07	70.66	1.53E-03	1.53E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	1.12E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	2.50E-04	2.50E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.84E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	7.42E-02	7.42E-02	2.07E-01	1.30E-01	0.05	2.11E-01	0.95	0.34	9.49E-01	2.51E+00	0.0014	4.61E-02	3.45E-04	0.98	4.56E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	4.82E-03	4.82E-03	1.35E-02		0.05	1.42E-02	0.95	0.34	9.52E-01	1.69E-01	0.0014	4.77E-02		0.98	0.00E+00
Fluoranthene	0.006	Bench NA	19	NA	1.19E-01	1.19E-01	3.33E-01	3.20E-01	0.05	3.34E-01	0.95	0.34	9.54E-01	3.97E+00	0.0014	4.55E-02		0.98	0.00E+00
Fluorene	0.0004	Bench NA	19	NA	7.58E-03	7.58E-03	2.12E-02		0.05	2.23E-02	0.95	0.34	9.52E-01	2.66E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.52E-02	1.52E-02	4.25E-02		0.05	4.48E-02	0.95	0.34	9.52E-01	5.33E-01	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.002	0.001	5.07	9.99	1.04E-02	1.04E-02	2.92E-02		0.05	3.08E-02	0.95	0.34	9.52E-01	3.66E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	5.70E-02	5.70E-02	1.60E-01		0.05	1.68E-01	0.95	0.34	9.52E-01	2.00E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.03	2.90	5.02	1.28E-01	1.28E-01	3.58E-01	3.90E-01	0.05	3.56E-01	0.95	0.34	9.50E-01	4.24E+00	0.0014	4.50E-02	6.15E-04	0.98	4.71E-03
VOCs																			
Acetone	0.00005	0.00001	7.14	35.68	3.68E-04	3.68E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.71E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbon Disulfide	0.000002	Bench NA	4	NA	5.94E-06	5.94E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	4.37E-03	0.0014	1.00E+00		0.98	0.00E+00
Methyl tert-butyl ether (MTBE)	0.0000004	0.00000004	10.2	102	3.67E-06	3.67E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	2.70E-03	0.0014	1.00E+00		0.98	0.00E+00

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
Bench NA=benchmark not available/applicable
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since UCLs could not be calculated for invertebrate concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-3
Food Chain Model for Chronic Exposures
Muskrat Analysis
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**40**	**4**	0.745	7.45	2.88E+01	2.88E+01	2.51E+01	3.20E+02	0.05	9.58E+00	0.95	0.34	2.96E-01	1.20E+04	0.0014	5.65E-01	4.11E+00	0.98	1.40E-01
Barium	0.1	0.07	10.4	14.9	1.02E+00	1.02E+00	2.68E+00	2.50E+01	0.05	1.51E+00	0.95	0.34	8.90E-01	5.03E+01	0.0014	6.67E-02	4.50E-02	0.98	4.30E-02
Beryllium	0.002	Bench NA	0.47	NA	1.10E-03	1.10E-03	1.04E-03		0.05	1.09E-03	0.95	0.34	3.22E-01	5.47E-01	0.0014	6.78E-01		0.98	0.00E+00
Cobalt	Bench NA	Bench NA	NA	NA	2.20E-02	2.20E-02	3.92E-02	3.90E-01	0.05	2.07E-02	0.95	0.34	6.04E-01	5.18E+00	0.0014	3.19E-01	1.72E-03	0.98	7.63E-02
Lead	0.2	0.02	6	60	1.10E+00	1.10E+00	1.23E+00	7.10E+00	0.05	9.24E-01	0.95	0.34	3.80E-01	4.62E+02	0.0014	5.70E-01	5.58E-02	0.98	4.96E-02
Manganese	0.2	0.06	63	203	1.30E+01	1.30E+01	3.50E+01	8.50E+00	0.05	3.64E+01	0.95	0.34	9.16E-01	7.28E+02	0.0014	7.62E-02	1.06E-01	0.98	7.96E-03
Mercury	0.0003	Bench NA	0.9	NA	3.00E-04	3.00E-04	3.94E-04		0.05	4.14E-04	0.95	0.34	4.47E-01	1.22E-01	0.0014	5.53E-01		0.98	0.00E+00
Nickel	0.9	0.1	2.03	12.1	1.74E+00	1.74E+00	4.90E+00	9.70E-01	0.05	5.11E+00	0.95	0.34	9.56E-01	4.91E+01	0.0014	3.83E-02	1.04E-02	0.98	5.85E-03
Selenium	0.08	0.05	0.1	0.24	1.11E-02	1.11E-02	3.05E-02	4.60E-01	0.05	7.89E-03	0.95	0.34	9.31E-01	5.64E-01	0.0014	6.89E-02		0.98	0.00E+00
Thallium	0.05	0.005	0.0053	0.053	2.88E-04	2.88E-04	1.34E-04	2.40E-03	0.05	1.43E-05	0.95	0.34	1.58E-01	1.79E-01	0.0014	8.42E-01		0.98	0.00E+00
Vanadium	1	0.1	0.14	1.4	1.42E-01	1.42E-01	1.10E-01	9.20E-01	0.05	6.77E-02	0.95	0.34	2.64E-01	6.15E+01	0.0014	5.88E-01	2.15E-02	0.98	1.48E-01
Zinc	0.3	0.1	114.17	228.34	3.06E+01	3.06E+01	8.94E+01	2.40E+01	0.05	9.29E+01	0.95	0.34	9.94E-01	9.33E+01	0.0014	4.15E-03	7.12E-02	0.98	2.28E-03
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	1.29E-04	1.29E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	9.50E-02	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	7.86E-03	7.86E-03	2.17E-02		0.05	2.28E-02	0.95	0.34	9.38E-01	2.72E-01	0.0014	4.70E-02	1.17E-04	0.98	1.46E-02
4-Methylphenol	0.00002	0.000007	12.5	32.1	2.11E-04	2.11E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.55E-01	0.0014	1.00E+00		0.98	0.00E+00
Acenaphthene	0.0005	0.0002	14	27	6.64E-03	6.64E-03	1.86E-02		0.05	1.96E-02	0.95	0.34	9.52E-01	2.33E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.70E-02	1.70E-02	4.73E-02		0.05	4.98E-02	0.95	0.34	9.45E-01	5.93E-01	0.0014	4.74E-02	1.38E-04	0.98	7.95E-03
Anthracene	0.0002	Bench NA	38.6	NA	7.18E-03	7.18E-03	2.01E-02		0.05	2.12E-02	0.95	0.34	9.52E-01	2.52E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	2.32E-02	2.32E-02	6.42E-02		0.05	6.76E-02	0.95	0.34	9.43E-01	8.05E-01	0.0014	4.72E-02	2.41E-04	0.98	1.02E-02
Benzo(a)pyrene	0.2	0.02	0.4	3.9	5.98E-02	5.98E-02	1.67E-01		0.05	1.75E-01	0.95	0.34	9.47E-01	2.09E+00	0.0014	4.74E-02	3.67E-04	0.98	6.01E-03
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	3.86E-02	3.86E-02	1.07E-01	1.20E-01	0.05	1.07E-01	0.95	0.34	9.46E-01	1.27E+00	0.0014	4.49E-02	3.54E-04	0.98	9.00E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	9.74E-03	9.74E-03	2.67E-02		0.05	2.81E-02	0.95	0.34	9.32E-01	3.35E-01	0.0014	4.67E-02	2.13E-04	0.98	2.15E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	7.83E-02	7.83E-02	2.19E-01		0.05	2.30E-01	0.95	0.34	9.50E-01	2.74E+00	0.0014	4.76E-02	1.98E-04	0.98	2.48E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	6.70E-03	6.70E-03	1.80E-02	3.60E-01	0.05		0.95	0.34	9.13E-01	4.27E-01	0.0014	8.66E-02		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	8.85E-02	8.85E-02	2.60E-01	5.20E+00	0.05		0.95	0.34	9.99E-01	9.65E-02	0.0014	1.48E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.00005	0.000005	7.07	70.7	3.63E-04	3.63E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.67E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	2.66E-04	2.66E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.95E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	7.59E-02	7.59E-02	2.12E-01	1.20E-01	0.05	2.17E-01	0.95	0.34	9.49E-01	2.58E+00	0.0014	4.62E-02	3.85E-04	0.98	4.98E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	4.50E-03	4.50E-03	1.25E-02		0.05	1.31E-02	0.95	0.34	9.42E-01	1.56E-01	0.0014	4.72E-02	4.85E-05	0.98	1.06E-02
Fluoranthene	0.005	Bench NA	19	NA	9.81E-02	9.81E-02	2.75E-01	1.50E-01	0.05	2.82E-01	0.95	0.34	9.54E-01	3.35E+00	0.0014	4.65E-02		0.98	0.00E+00
Fluorene	0.0005	Bench NA	19	NA	9.03E-03	9.03E-03	2.53E-02		0.05	2.66E-02	0.95	0.34	9.52E-01	3.17E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.12E-02	1.12E-02	3.10E-02		0.05	3.26E-02	0.95	0.34	9.37E-01	3.88E-01	0.0014	4.70E-02	1.78E-04	0.98	1.55E-02
Naphthalene	0.002	0.0009	5.1	10	8.63E-03	8.63E-03	2.42E-02		0.05	2.55E-02	0.95	0.34	9.52E-01	3.03E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	4.96E-02	4.96E-02	1.39E-01		0.05	1.46E-01	0.95	0.34	9.52E-01	1.74E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.02	2.9	5	1.24E-01	1.24E-01	3.45E-01	2.50E-01	0.05	3.50E-01	0.95	0.34	9.49E-01	4.16E+00	0.0014	4.58E-02	6.87E-04	0.98	5.45E-03
VOCs																			
Carbon Disulfide	0.000002	Bench NA	4	NA	8.83E-06	8.83E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	6.49E-03	0.0014	1.00E+00		0.98	0.00E+00

Table D-3
Food Chain Model for Chronic Exposures
Muskrat Analysis
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food							Sediment			Water		
							Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**40**	**4**	0.75	7.45	3.20E+01	3.20E+01	2.51E+01	3.20E+02	0.05	9.58E+00	0.95	0.34	2.67E-01	1.20E+04	0.0014	5.09E-01	7.33E+00	0.98	2.24E-01
Barium	0.2	0.1	10.40	14.92	2.07E+00	2.07E+00	5.33E+00	2.50E+01	0.05	4.29E+00	0.95	0.34	8.74E-01	1.43E+02	0.0014	9.39E-02	6.69E-02	0.98	3.17E-02
Beryllium	0.002	Bench NA	0.47	NA	1.10E-03	1.10E-03	1.04E-03		0.05	1.09E-03	0.95	0.34	3.22E-01	5.47E-01	0.0014	6.78E-01		0.98	0.00E+00
Cobalt	Bench NA	Bench NA	NA	NA	4.21E-02	4.21E-02	6.70E-02	3.90E-01	0.05	5.00E-02	0.95	0.34	5.41E-01	1.25E+01	0.0014	4.03E-01	2.40E-03	0.98	5.58E-02
Lead	0.2	0.02	5.71	57.09	1.12E+00	1.12E+00	1.23E+00	7.10E+00	0.05	9.24E-01	0.95	0.34	3.74E-01	4.62E+02	0.0014	5.61E-01	7.44E-02	0.98	6.51E-02
Manganese	0.7	0.2	62.79	202.65	4.41E+01	4.41E+01	1.19E+02	8.50E+00	0.05	1.25E+02	0.95	0.34	9.20E-01	2.50E+03	0.0014	7.72E-02	1.49E-01	0.98	3.31E-03
Mercury	0.0003	Bench NA	0.93	NA	3.00E-04	3.00E-04	3.94E-04		0.05	4.14E-04	0.95	0.34	4.47E-01	1.22E-01	0.0014	5.53E-01		0.98	0.00E+00
Nickel	0.9	0.1	2.03	12.1	1.75E+00	1.75E+00	4.90E+00	9.70E-01	0.05	5.11E+00	0.95	0.34	9.53E-01	4.91E+01	0.0014	3.82E-02	1.56E-02	0.98	8.74E-03
Selenium	0.08	0.05	0.14	0.24	1.11E-02	1.11E-02	3.05E-02	4.60E-01	0.05	7.89E-03	0.95	0.34	9.31E-01	5.64E-01	0.0014	6.89E-02		0.98	0.00E+00
Thallium	0.05	0.005	0.01	0.05	2.88E-04	2.88E-04	1.34E-04	2.40E-03	0.05	1.43E-05	0.95	0.34	1.58E-01	1.79E-01	0.0014	8.42E-01		0.98	0.00E+00
Vanadium	1	0.1	0.14	1.39	1.57E-01	1.57E-01	1.10E-01	9.20E-01	0.05	6.77E-02	0.95	0.34	2.39E-01	6.15E+01	0.0014	5.33E-01	3.66E-02	0.98	2.28E-01
Zinc	0.3	0.1	114.17	228.34	3.09E+01	3.09E+01	8.94E+01	2.40E+01	0.05	9.29E+01	0.95	0.34	9.85E-01	2.64E+02	0.0014	1.16E-02	9.33E-02	0.98	2.96E-03
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	8.16E-05	8.16E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	6.00E-02	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.31E-02	1.31E-02	3.59E-02		0.05	3.78E-02	0.95	0.34	9.32E-01	4.50E-01	0.0014	4.67E-02	2.90E-04	0.98	2.17E-02
4-Methylphenol	0.00002	0.000007	12.5	32.1	2.11E-04	2.11E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.55E-01	0.0014	1.00E+00		0.98	0.00E+00
Acenaphthene	0.0005	0.0002	14	27	6.64E-03	6.64E-03	1.86E-02		0.05	1.96E-02	0.95	0.34	9.52E-01	2.33E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.71E-02	1.71E-02	4.73E-02		0.05	4.98E-02	0.95	0.34	9.38E-01	5.93E-01	0.0014	4.70E-02	2.70E-04	0.98	1.54E-02
Anthracene	0.0006	Bench NA	38.61	NA	2.22E-02	2.22E-02	6.22E-02		0.05	6.55E-02	0.95	0.34	9.52E-01	7.80E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	7.75E-02	7.75E-02	2.15E-01		0.05	2.27E-01	0.95	0.34	9.45E-01	2.70E+00	0.0014	4.74E-02	6.00E-04	0.98	7.59E-03
Benzo(a)pyrene	0.2	0.02	0.39	3.86	6.03E-02	6.03E-02	1.67E-01		0.05	1.75E-01	0.95	0.34	9.39E-01	2.09E+00	0.0014	4.70E-02	8.90E-04	0.98	1.45E-02
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	1.28E-01	1.28E-01	3.57E-01	1.20E-01	0.05	3.70E-01	0.95	0.34	9.46E-01	4.40E+00	0.0014	4.66E-02	9.00E-04	0.98	6.88E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.00E-02	1.00E-02	2.67E-02		0.05	2.81E-02	0.95	0.34	9.06E-01	3.35E-01	0.0014	4.54E-02	5.00E-04	0.98	4.89E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	7.85E-02	7.85E-02	2.19E-01		0.05	2.30E-01	0.95	0.34	9.47E-01	2.74E+00	0.0014	4.75E-02	4.70E-04	0.98	5.86E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	6.70E-03	6.70E-03	1.80E-02	3.60E-01	0.05		0.95	0.34	9.13E-01	4.27E-01	0.0014	8.66E-02		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	8.85E-02	8.85E-02	2.60E-01	5.20E+00	0.05		0.95	0.34	9.99E-01	6.60E-02	0.0014	1.01E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	0.00005	0.000005	7.07	70.66	3.63E-04	3.63E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.67E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	2.66E-04	2.66E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.95E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	7.64E-02	7.64E-02	2.12E-01	1.20E-01	0.05	2.17E-01	0.95	0.34	9.42E-01	2.58E+00	0.0014	4.59E-02	9.80E-04	0.98	1.26E-02
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	4.57E-03	4.57E-03	1.25E-02		0.05	1.31E-02	0.95	0.34	9.28E-01	1.56E-01	0.0014	4.65E-02	1.20E-04	0.98	2.57E-02
Fluoranthene	0.005	Bench NA	19	NA	9.81E-02	9.81E-02	2.75E-01	1.50E-01	0.05	2.82E-01	0.95	0.34	9.54E-01	3.35E+00	0.0014	4.65E-02		0.98	0.00E+00
Fluorene	0.0005	Bench NA	19	NA	9.03E-03	9.03E-03	2.53E-02		0.05	2.66E-02	0.95	0.34	9.52E-01	3.17E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.15E-02	1.15E-02	3.10E-02		0.05	3.26E-02	0.95	0.34	9.17E-01	3.88E-01	0.0014	4.60E-02	4.30E-04	0.98	3.67E-02
Naphthalene	0.003	0.001	5.07	9.99	1.48E-02	1.48E-02	4.15E-02		0.05	4.37E-02	0.95	0.34	9.52E-01	5.20E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	4.96E-02	4.96E-02	1.39E-01		0.05	1.46E-01	0.95	0.34	9.52E-01	1.74E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	0.04	0.02	2.90	5.02	1.24E-01	1.24E-01	3.45E-01	2.50E-01	0.05	3.50E-01	0.95	0.34	9.42E-01	4.16E+00	0.0014	4.55E-02	1.60E-03	0.98	1.26E-02
VOCs																			
Carbon Disulfide	0.000002	Bench NA	4	NA	8.83E-06	8.83E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	6.49E-03	0.0014	1.00E+00		0.98	0.00E+00

Notes:
Bench NA=benchmark not available/applicable
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since UCLs could not be calculated for invertebrate concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-4
Food Chain Model For Chronic Exposures
Raccoon Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	0.519	5.19	5.89E+01	5.89E+01	3.38E+01	5.75E+00	0.3	9.77E+01	0.3	6.96E+00	0.4	0.3	0.17	8.70E+03	0.0056	0.83		0.083	0.000
Barium	0.8	0.6	7.24	10.4	5.82E+00	5.82E+00	1.84E+01	1.07E+00	0.3	5.83E+01	0.3	1.50E+00	0.4	0.3	0.95	5.01E+01	0.0056	0.05	1.43E-01	0.083	0.002
Cobalt	Bench NA	Bench NA	NA	NA	6.05E-02	6.05E-02	1.06E-01	5.44E-02	0.3	2.73E-01	0.3	2.04E-02	0.4	0.3	0.53	5.10E+00	0.0056	0.47		0.083	0.000
Iron	Bench NA	Bench NA	NA	NA	1.41E+02	1.41E+02	2.07E+02	5.33E+01	0.3	6.23E+02	0.3	1.12E+01	0.4	0.3	0.44	1.40E+04	0.0056	0.55	8.22E+00	0.083	0.005
Lead	0.6	0.06	4	40	2.35E+00	2.35E+00	2.63E+00	4.99E-01	0.3	7.53E+00	0.3	5.56E-01	0.4	0.3	0.34	2.78E+02	0.0056	0.66		0.083	0.000
Manganese	0.4	0.1	44	141	1.76E+01	1.76E+01	4.19E+01	3.38E+01	0.3	4.66E+01	0.3	4.45E+01	0.4	0.3	0.71	8.91E+02	0.0056	0.28	5.35E-01	0.083	0.003
Nickel	0.8	0.1	2.03	12.1	1.66E+00	1.66E+00	3.91E+00	2.58E-01	0.3	7.43E-01	0.3	9.01E+00	0.4	0.3	0.71	8.67E+01	0.0056	0.29		0.083	0.000
Vanadium	**2**	0.2	0.097	0.97	2.03E-01	2.03E-01	2.57E-01	8.94E-02	0.3	7.33E-01	0.3	2.47E-02	0.4	0.3	0.38	2.25E+01	0.0056	0.62		0.083	0.000
Zinc	0.09	0.05	79.51	159.02	7.51E+00	7.51E+00	2.27E+01	1.60E+01	0.3	3.77E+01	0.3	1.65E+01	0.4	0.3	0.91	1.03E+02	0.0068	0.09		0.083	0.000
SVOCs																					
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	9.35E-03	9.35E-03	2.00E-02	ND	0.3		0.3	5.01E-02	0.4	0.3	0.64	5.96E-01	0.0056	0.36		0.083	0.000
Acenaphthene	0.0004	0.0002	9.4	19	3.97E-03	3.97E-03	8.67E-03	1.60E-03	0.3		0.3	2.05E-02	0.4	0.3	0.66	2.44E-01	0.0056	0.34		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.82E-02	1.82E-02	3.90E-02	ND	0.3		0.3	9.76E-02	0.4	0.3	0.64	1.16E+00	0.0056	0.36		0.083	0.000
Anthracene	0.0004	Bench NA	26.9	NA	1.07E-02	1.07E-02	2.28E-02	ND	0.3		0.3	5.71E-02	0.4	0.3	0.64	6.80E-01	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	2.32E-02	2.32E-02	4.99E-02	1.84E-03	0.3		0.3	1.23E-01	0.4	0.3	0.65	1.47E+00	0.0056	0.35		0.083	0.000
Benzo(a)pyrene	0.1	0.01	0.3	2.7	2.66E-02	2.66E-02	5.72E-02	2.01E-03	0.3		0.3	1.41E-01	0.4	0.3	0.65	1.68E+00	0.0056	0.35		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	3.57E-02	3.57E-02	7.68E-02	3.05E-03	0.3		0.3	1.90E-01	0.4	0.3	0.65	2.26E+00	0.0056	0.35	3.19E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	8.56E-03	8.56E-03	1.83E-02	ND	0.3		0.3	4.58E-02	0.4	0.3	0.64	5.45E-01	0.0056	0.36	1.78E-04	0.083	0.002
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	2.41E-02	2.41E-02	5.18E-02	2.20E-03	0.3		0.3	1.28E-01	0.4	0.3	0.65	1.52E+00	0.0056	0.35	1.99E-04	0.083	0.001
Benzoic acid	Bench NA	Bench NA	NA	NA	4.41E-01	4.41E-01	1.46E+00	3.23E+00	0.3	1.64E+00	0.3		0.4	0.3	0.99	5.45E-01	0.0056	0.01		0.083	0.000
bis(2-Ethylhexyl)phthalate	0.1	0.01	4.92	49.2	6.62E-01	6.62E-01	2.18E+00	7.28E+00	0.3		0.3		0.4	0.3	0.99	1.25E+00	0.0056	0.01		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.49E-03	1.49E-03	0.00E+00	ND	0.3		0.3		0.4	0.3	0.00	2.66E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	3.20E-02	3.20E-02	6.87E-02	1.98E-03	0.3		0.3	1.70E-01	0.4	0.3	0.64	2.03E+00	0.0056	0.35	3.45E-04	0.083	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	2.07E-03	2.07E-03	4.44E-03	ND	0.3		0.3	1.11E-02	0.4	0.3	0.64	1.32E-01	0.0056	0.36		0.083	0.000
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	6.00E-04	6.00E-04	0.00E+00	ND	0.3		0.3		0.4	0.3	0.00	1.07E-01	0.0056	1.00		0.083	0.000
Fluoranthene	0.005	Bench NA	13	NA	6.08E-02	6.08E-02	1.44E-01	ND	0.3	1.25E-01	0.3	2.66E-01	0.4	0.3	0.71	3.16E+00	0.0056	0.29		0.083	0.000
Fluorene	0.0004	Bench NA	13	NA	5.39E-03	5.39E-03	1.18E-02	2.10E-03	0.3		0.3	2.79E-02	0.4	0.3	0.66	3.32E-01	0.0056	0.34		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.02E-02	1.02E-02	2.18E-02	ND	0.3		0.3	5.45E-02	0.4	0.3	0.64	6.48E-01	0.0056	0.36		0.083	0.000
Naphthalene	0.003	0.001	3.5	7	8.93E-03	8.93E-03	1.91E-02	ND	0.3		0.3	4.78E-02	0.4	0.3	0.64	5.69E-01	0.0056	0.36		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	3.52E-02	3.52E-02	7.58E-02	2.86E-03	0.3		0.3	1.87E-01	0.4	0.3	0.65	2.23E+00	0.0056	0.35		0.083	0.000
Pyrene	0.03	0.02	2	3.5	5.64E-02	5.64E-02	1.21E-01	2.10E-03	0.3		0.3	3.01E-01	0.4	0.3	0.64	3.58E+00	0.0056	0.36	6.15E-04	0.083	0.001

Table D-4
Food Chain Model For Chronic Exposures
Raccoon Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food									Sediment			Water		
							Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	0.519	5.19	6.09E+01	6.09E+01	4.05E+01	5.75E+00	0.3	1.20E+02	0.3	6.96E+00	0.4	0.3	0.20	8.70E+03	0.0056	0.80		0.083	0.000
Barium	0.9	0.6	7.24	10.4	6.22E+00	6.22E+00	1.98E+01	1.90E+00	0.3	6.20E+01	0.3	1.50E+00	0.4	0.3	0.95	5.01E+01	0.0056	0.05	1.43E-01	0.083	0.002
Cobalt	Bench NA	Bench NA	NA	NA	6.74E-02	6.74E-02	1.29E-01	5.44E-02	0.3	3.50E-01	0.3	2.04E-02	0.4	0.3	0.58	5.10E+00	0.0056	0.42		0.083	0.000
Iron	Bench NA	Bench NA	NA	NA	1.52E+02	1.52E+02	2.44E+02	8.00E+01	0.3	7.20E+02	0.3	1.12E+01	0.4	0.3	0.48	1.40E+04	0.0056	0.51	8.22E+00	0.083	0.004
Lead	0.6	0.06	4	40	2.53E+00	2.53E+00	3.25E+00	4.99E-01	0.3	9.60E+00	0.3	5.56E-01	0.4	0.3	0.39	2.78E+02	0.0056	0.61		0.083	0.000
Manganese	0.5	0.2	44	141	2.25E+01	2.25E+01	5.83E+01	6.00E+01	0.3	7.50E+01	0.3	4.45E+01	0.4	0.3	0.78	8.91E+02	0.0056	0.22	5.35E-01	0.083	0.002
Nickel	0.8	0.1	2.03	12.1	1.69E+00	1.69E+00	4.00E+00	3.70E-01	0.3	9.50E-01	0.3	9.01E+00	0.4	0.3	0.71	8.67E+01	0.0056	0.29		0.083	0.000
Vanadium	**2**	0.2	0.097	0.97	2.14E-01	2.14E-01	2.95E-01	8.94E-02	0.3	8.60E-01	0.3	2.47E-02	0.4	0.3	0.41	2.25E+01	0.0056	0.59		0.083	0.000
Zinc	0.1	0.05	79.51	159.02	8.08E+00	8.08E+00	2.46E+01	1.80E+01	0.3	4.20E+01	0.3	1.65E+01	0.4	0.3	0.91	1.03E+02	0.0068	0.09		0.083	0.000
SVOCs																					
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	9.35E-03	9.35E-03	2.00E-02	ND	0.3		0.3	5.01E-02	0.4	0.3	0.64	5.96E-01	0.0056	0.36		0.083	0.000
Acenaphthene	0.0004	0.0002	9.4	19	4.03E-03	4.03E-03	8.88E-03	2.30E-03	0.3		0.3	2.05E-02	0.4	0.3	0.66	2.44E-01	0.0056	0.34		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.82E-02	1.82E-02	3.90E-02	ND	0.3		0.3	9.76E-02	0.4	0.3	0.64	1.16E+00	0.0056	0.36		0.083	0.000
Anthracene	0.0004	Bench NA	26.9	NA	1.07E-02	1.07E-02	2.28E-02	ND	0.3		0.3	5.71E-02	0.4	0.3	0.64	6.80E-01	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	2.33E-02	2.33E-02	5.02E-02	2.90E-03	0.3		0.3	1.23E-01	0.4	0.3	0.65	1.47E+00	0.0056	0.35		0.083	0.000
Benzo(a)pyrene	0.1	0.01	0.3	2.7	2.66E-02	2.66E-02	5.72E-02	2.01E-03	0.3		0.3	1.41E-01	0.4	0.3	0.65	1.68E+00	0.0056	0.35		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	3.58E-02	3.58E-02	7.71E-02	3.90E-03	0.3		0.3	1.90E-01	0.4	0.3	0.65	2.26E+00	0.0056	0.35	3.19E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	8.56E-03	8.56E-03	1.83E-02	ND	0.3		0.3	4.58E-02	0.4	0.3	0.64	5.45E-01	0.0056	0.36	1.78E-04	0.083	0.002
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	2.41E-02	2.41E-02	5.20E-02	3.10E-03	0.3		0.3	1.28E-01	0.4	0.3	0.65	1.52E+00	0.0056	0.35	1.99E-04	0.083	0.001
Benzoic acid	Bench NA	Bench NA	NA	NA	4.35E-01	4.35E-01	1.44E+00	2.00E+00	0.3	2.80E+00	0.3		0.4	0.3	0.99	5.45E-01	0.0056	0.01		0.083	0.000
bis(2-Ethylhexyl)phthalate	0.1	0.01	4.92	49.2	6.62E-01	6.62E-01	2.18E+00	7.28E+00	0.3		0.3		0.4	0.3	0.99	1.25E+00	0.0056	0.01		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.49E-03	1.49E-03	0.00E+00	ND	0.3		0.3		0.4	0.3	0.00	2.66E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	3.21E-02	3.21E-02	6.89E-02	2.60E-03	0.3		0.3	1.70E-01	0.4	0.3	0.64	2.03E+00	0.0056	0.35	3.45E-04	0.083	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	2.07E-03	2.07E-03	4.44E-03	ND	0.3		0.3	1.11E-02	0.4	0.3	0.64	1.32E-01	0.0056	0.36		0.083	0.000
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	2.97E-04	2.97E-04	0.00E+00	ND	0.3		0.3		0.4	0.3	0.00	5.30E-02	0.0056	1.00		0.083	0.000
Fluoranthene	0.005	Bench NA	13	NA	6.04E-02	6.04E-02	1.42E-01	ND	0.3	1.20E-01	0.3	2.66E-01	0.4	0.3	0.71	3.16E+00	0.0056	0.29		0.083	0.000
Fluorene	0.0004	Bench NA	13	NA	5.39E-03	5.39E-03	1.18E-02	2.10E-03	0.3		0.3	2.79E-02	0.4	0.3	0.66	3.32E-01	0.0056	0.34		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.02E-02	1.02E-02	2.18E-02	ND	0.3		0.3	5.45E-02	0.4	0.3	0.64	6.48E-01	0.0056	0.36		0.083	0.000
Naphthalene	0.003	0.001	3.5	7	8.93E-03	8.93E-03	1.91E-02	ND	0.3		0.3	4.78E-02	0.4	0.3	0.64	5.69E-01	0.0056	0.36		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	3.53E-02	3.53E-02	7.62E-02	4.30E-03	0.3		0.3	1.87E-01	0.4	0.3	0.65	2.23E+00	0.0056	0.35		0.083	0.000
Pyrene	0.03	0.02	2	3.5	5.63E-02	5.63E-02	1.21E-01	2.10E-03	0.3		0.3	3.01E-01	0.4	0.3	0.64	3.58E+00	0.0056	0.36		0.083	0.000

Notes:
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded
to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since UCLs could not be calculated for invertebrate concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-5
Food Chain Model For Chronic Exposures
Raccoon Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	0.519	5.19	6.12E+01	6.12E+01	4.35E+01	1.82E+01	0.3	1.18E+02	0.3	6.88E+00	0.4	0.3	0.21	8.60E+03	0.0056	0.79		0.083	0.000
Barium	0.9	0.6	7.24	10.4	6.61E+00	6.61E+00	2.01E+01	1.51E+00	0.3	6.13E+01	0.3	3.06E+00	0.4	0.3	0.91	1.02E+02	0.0056	0.09	1.43E-01	0.083	0.002
Beryllium	0.01	Bench NA	0.33	NA	3.46E-03	3.46E-03	4.74E-04		0.3		0.3	1.18E-03	0.4	0.3	0.04	5.92E-01	0.0056	0.96		0.083	0.000
Cadmium	0.2	0.02	0.48	4.79	8.85E-02	8.85E-02	2.06E-01	4.46E-02	0.3	9.77E-02	0.3	4.09E-01	0.4	0.3	0.70	4.76E+00	0.0056	0.30		0.083	0.000
Chromium	0.005	Bench NA	1360	NA	6.22E+00	6.22E+00	1.65E+01	9.28E-01	0.3	5.57E+00	0.3	3.64E+01	0.4	0.3	0.80	2.25E+02	0.0056	0.20		0.083	0.000
Cobalt	Bench NA	Bench NA	NA	NA	1.06E-01	1.06E-01	1.23E-01	5.05E-02	0.3	2.93E-01	0.3	4.96E-02	0.4	0.3	0.35	1.24E+01	0.0056	0.65		0.083	0.000
Copper	0.3	0.2	7.56	9.781	2.25E+00	2.25E+00	5.45E+00	1.67E+00	0.3	4.67E+00	0.3	8.86E+00	0.4	0.3	0.72	1.11E+02	0.0056	0.28		0.083	0.000
Lead	**6**	0.6	4	40	2.23E+01	2.23E+01	9.25E+00	8.90E-01	0.3	2.06E+01	0.3	6.98E+00	0.4	0.3	0.12	3.49E+03	0.0056	0.88		0.083	0.000
Manganese	0.3	0.08	44	141	1.12E+01	1.12E+01	2.46E+01	2.70E+01	0.3	1.01E+01	0.3	3.37E+01	0.4	0.3	0.66	6.75E+02	0.0056	0.34	5.35E-01	0.083	0.004
Mercury	0.02	Bench NA	0.6	NA	1.32E-02	1.32E-02	3.43E-02	1.00E-01	0.3	1.17E-02	0.3	1.75E-03	0.4	0.3	0.78	5.14E-01	0.0056	0.22		0.083	0.000
Nickel	**2**	0.4	2.03	12.1	4.37E+00	4.37E+00	1.03E+01	5.00E-01	0.3	2.19E+00	0.3	2.38E+01	0.4	0.3	0.71	2.29E+02	0.0056	0.29		0.083	0.000
Selenium	1	0.7	0.1	0.16	1.15E-01	1.15E-01	3.65E-01	6.81E-01	0.3	5.17E-01	0.3	1.37E-02	0.4	0.3	0.95	9.81E-01	0.0056	0.05		0.083	0.000
Silver	0.02	0.002	1.1	11	2.52E-02	2.52E-02	6.51E-02		0.3		0.3	1.63E-01	0.4	0.3	0.77	1.02E+00	0.0056	0.23		0.083	0.000
Thallium	0.3	0.03	0.0037	0.037	1.21E-03	1.21E-03	2.07E-03	4.35E-03	0.3	2.55E-03	0.3	8.45E-06	0.4	0.3	0.51	1.06E-01	0.0056	0.49		0.083	0.000
Vanadium	**3**	0.3	0.097	0.97	3.38E-01	3.38E-01	2.49E-01	1.22E-01	0.3	6.40E-01	0.3	5.17E-02	0.4	0.3	0.22	4.70E+01	0.0056	0.78		0.083	0.000
Zinc	0.2	0.09	80	160	1.48E+01	1.48E+01	4.33E+01	4.25E+01	0.3	3.30E+01	0.3	5.16E+01	0.4	0.3	0.88	3.22E+02	0.0056	0.12		0.083	0.000
SVOCs																					
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	1.71E-03	1.71E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	3.06E-01	0.0056	1.00		0.083	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	2.48E-03	2.48E-03	5.32E-03		0.3		0.3	1.33E-02	0.4	0.3	0.64	1.58E-01	0.0056	0.36		0.083	0.000
4-Methylphenol	0.002	0.0007	8.7	22.4	1.64E-02	1.64E-02	5.00E-02		0.3	1.67E-01	0.3		0.4	0.3	0.92	2.46E-01	0.0056	0.08		0.083	0.000
Acenaphthene	0.0003	0.0001	9.4	19	2.52E-03	2.52E-03	5.62E-03	2.07E-03	0.3		0.3	1.25E-02	0.4	0.3	0.67	1.49E-01	0.0056	0.33		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.07E-02	1.07E-02	2.29E-02		0.3		0.3	5.72E-02	0.4	0.3	0.64	6.81E-01	0.0056	0.36		0.083	0.000
Anthracene	0.0004	Bench NA	26.9	NA	1.18E-02	1.18E-02	2.53E-02		0.3		0.3	6.32E-02	0.4	0.3	0.64	7.53E-01	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	4.62E-02	4.62E-02	1.14E-01	3.27E-03	0.3	1.38E-01	0.3	1.79E-01	0.4	0.3	0.74	2.13E+00	0.0056	0.26		0.083	0.000
Benzo(a)pyrene	0.1	0.01	0.3	2.7	3.45E-02	3.45E-02	7.42E-02	3.55E-03	0.3		0.3	1.83E-01	0.4	0.3	0.65	2.18E+00	0.0056	0.35		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	4.45E-02	4.45E-02	9.66E-02	1.19E-02	0.3		0.3	2.32E-01	0.4	0.3	0.65	2.77E+00	0.0056	0.35	3.19E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	7.08E-03	7.08E-03	1.54E-02	2.21E-03	0.3		0.3	3.68E-02	0.4	0.3	0.65	4.38E-01	0.0056	0.35	1.78E-04	0.083	0.002
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	4.15E-02	4.15E-02	8.99E-02	8.93E-03	0.3		0.3	2.18E-01	0.4	0.3	0.65	2.59E+00	0.0056	0.35	1.99E-04	0.083	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.75E-01	2.75E-01	8.97E-01	2.12E+00	0.3	8.73E-01	0.3		0.4	0.3	0.98	1.12E+00	0.0056	0.02		0.083	0.000
Benzyl alcohol	Bench NA	Bench NA	NA	NA	1.57E-01	1.57E-01	5.20E-01		0.3	1.73E+00	0.3		0.4	0.3	1.00	1.07E-01	0.0056	0.00		0.083	0.000
bis(2-Ethylhexyl)phthalate	0.2	0.02	4.92	49.2	8.04E-01	8.04E-01	2.66E+00	8.87E+00	0.3		0.3		0.4	0.3	0.99	1.12E+00	0.0056	0.01		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.03E-03	1.03E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	1.84E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	5.16E-02	5.16E-02	1.25E-01	2.93E-03	0.3	1.32E-01	0.3	2.11E-01	0.4	0.3	0.73	2.51E+00	0.0056	0.27	3.45E-04	0.083	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	2.65E-03	2.65E-03	5.68E-03		0.3		0.3	1.42E-02	0.4	0.3	0.64	1.69E-01	0.0056	0.36		0.083	0.000
Fluoranthene	0.006	Bench NA	13	NA	7.95E-02	7.95E-02	1.91E-01	3.97E-03	0.3	1.87E-01	0.3	3.34E-01	0.4	0.3	0.72	3.97E+00	0.0056	0.28		0.083	0.000
Fluorene	0.0004	Bench NA	13	NA	4.56E-03	4.56E-03	1.02E-02	4.33E-03	0.3		0.3	2.23E-02	0.4	0.3	0.67	2.66E-01	0.0056	0.33		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	8.60E-03	8.60E-03	1.87E-02	2.74E-03	0.3		0.3	4.48E-02	0.4	0.3	0.65	5.33E-01	0.0056	0.35		0.083	0.000
Naphthalene	0.002	0.0009	3.5	7	6.01E-03	6.01E-03	1.32E-02	2.96E-03	0.3		0.3	3.08E-02	0.4	0.3	0.66	3.66E-01	0.0056	0.34		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	3.21E-02	3.21E-02	6.95E-02	7.89E-03	0.3		0.3	1.68E-01	0.4	0.3	0.65	2.00E+00	0.0056	0.35		0.083	0.000
Pyrene	0.04	0.02	2	3.5	8.72E-02	8.72E-02	2.11E-01	1.38E-02	0.3	2.17E-01	0.3	3.56E-01	0.4	0.3	0.73	4.24E+00	0.0056	0.27	6.15E-04	0.083	0.001
VOCs																					
Acetone	0.0003	0.00006	5	25	1.52E-03	1.52E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.71E-01	0.0056	1.00		0.083	0.000
Carbon Disulfide	0.00001	Bench NA	2	NA	2.45E-05	2.45E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	4.37E-03	0.0056	1.00		0.083	0.000
Methyl tert-butyl ether (MTBE)	0.000002	0.0000002	7.11	71.1	1.59E-05	1.59E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.84E-03	0.0056	1.00		0.083	0.000

Table D-5
Food Chain Model For Chronic Exposures
Raccoon Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food: Total Conc. in Food mg/kg wet	Food: Fish Tissue mg/kg wet	Food: Proportion Fish In Diet	Food: Invertebrate Concentration mg/kg wet	Food: Proportion Invert In Diet	Food: Plant Concentration mg/kg wet	Food: Proportion Plants In Diet	Food: Ingestion Rate kg/kg/day	Food: Proportion of Dose	Sediment: Conc. in Sediment mg/kg dry	Sediment: Dry Sediment Ing. Rate kg/kg/day	Sediment: Proportion of Dose	Water: Conc. in Water (1) mg/l	Water: Ingestion Rate l/kg/day	Water: Proportion of Dose
Aluminum	**100**	**10**	0.519	5.19	6.23E+01	6.23E+01	4.72E+01	1.82E+01	0.3	1.30E+02	0.3	6.88E+00	0.4	0.3	0.23	8.60E+03	0.0056	0.77		0.083	0.000
Barium	1	0.7	7.241	10.39	6.94E+00	6.94E+00	2.12E+01	1.51E+00	0.3	6.50E+01	0.3	3.06E+00	0.4	0.3	0.92	1.02E+02	0.0056	0.08	1.43E-01	0.083	0.002
Beryllium	0.01	Bench NA	0.328	NA	3.46E-03	3.46E-03	4.74E-04		0.3		0.3	1.18E-03	0.4	0.3	0.04	5.92E-01	0.0056	0.96		0.083	0.000
Cadmium	0.2	0.02	0.48	4.79	9.04E-02	9.04E-02	2.12E-01	6.40E-02	0.3	9.90E-02	0.3	4.09E-01	0.4	0.3	0.71	4.76E+00	0.0056	0.29		0.083	0.000
Chromium	0.005	Bench NA	1360.08	NA	6.50E+00	6.50E+00	1.75E+01	9.28E-01	0.3	8.70E+00	0.3	3.64E+01	0.4	0.3	0.81	2.25E+02	0.0056	0.19		0.083	0.000
Cobalt	Bench NA	Bench NA	NA	NA	1.10E-01	1.10E-01	1.37E-01	5.05E-02	0.3	3.40E-01	0.3	4.96E-02	0.4	0.3	0.37	1.24E+01	0.0056	0.63		0.083	0.000
Copper	0.3	0.3	7.56	9.78	2.45E+00	2.45E+00	6.09E+00	2.50E+00	0.3	6.00E+00	0.3	8.86E+00	0.4	0.3	0.75	1.11E+02	0.0056	0.25		0.083	0.000
Lead	**6**	0.6	3.98	39.75	2.35E+01	2.35E+01	1.33E+01	8.90E-01	0.3	3.40E+01	0.3	6.98E+00	0.4	0.3	0.17	3.49E+03	0.0056	0.83		0.083	0.000
Manganese	0.3	0.08	43.73	141.13	1.18E+01	1.18E+01	2.67E+01	2.70E+01	0.3	1.70E+01	0.3	3.37E+01	0.4	0.3	0.68	6.75E+02	0.0056	0.32	5.35E-01	0.083	0.004
Mercury	0.02	Bench NA	0.65	NA	1.34E-02	1.34E-02	3.50E-02	1.00E-01	0.3	1.40E-02	0.3	1.75E-03	0.4	0.3	0.78	5.14E-01	0.0056	0.22		0.083	0.000
Nickel	**2**	0.4	2.03	12.1	4.49E+00	4.49E+00	1.07E+01	5.00E-01	0.3	3.50E+00	0.3	2.38E+01	0.4	0.3	0.72	2.29E+02	0.0056	0.28		0.083	0.000
Selenium	1	0.7	0.10	0.16	1.21E-01	1.21E-01	3.87E-01	6.81E-01	0.3	5.90E-01	0.3	1.37E-02	0.4	0.3	0.95	9.81E-01	0.0056	0.05		0.083	0.000
Silver	0.02	0.002	1.1	11.0	2.52E-02	2.52E-02	6.51E-02		0.3		0.3	1.63E-01	0.4	0.3	0.77	1.02E+00	0.0056	0.23		0.083	0.000
Thallium	0.4	0.04	0.004	0.04	1.38E-03	1.38E-03	2.63E-03	4.35E-03	0.3	4.40E-03	0.3	8.45E-06	0.4	0.3	0.57	1.06E-01	0.0056	0.43		0.083	0.000
Vanadium	**4**	0.4	0.10	0.97	3.55E-01	3.55E-01	3.06E-01	1.22E-01	0.3	8.30E-01	0.3	5.17E-02	0.4	0.3	0.26	4.70E+01	0.0056	0.74		0.083	0.000
Zinc	0.2	0.1	79.51	159.02	1.52E+01	1.52E+01	4.48E+01	4.25E+01	0.3	3.80E+01	0.3	5.16E+01	0.4	0.3	0.88	3.22E+02	0.0056	0.12		0.083	0.000
SVOCs																					
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	1.71E-03	1.71E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	3.06E-01	0.0056	1.00		0.083	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	2.48E-03	2.48E-03	5.32E-03		0.3		0.3	1.33E-02	0.4	0.3	0.64	1.58E-01	0.0056	0.36		0.083	0.000
4-Methylphenol	0.002	0.0009	8.7	22.4	1.94E-02	1.94E-02	6.00E-02		0.3	2.00E-01	0.3		0.4	0.3	0.93	2.46E-01	0.0056	0.07		0.083	0.000
Acenaphthene	0.0003	0.0002	9.4	19	3.00E-03	3.00E-03	7.22E-03	7.42E-03	0.3		0.3	1.25E-02	0.4	0.3	0.72	1.49E-01	0.0056	0.28		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.07E-02	1.07E-02	2.29E-02		0.3		0.3	5.72E-02	0.4	0.3	0.64	6.81E-01	0.0056	0.36		0.083	0.000
Anthracene	0.0004	Bench NA	26.89	NA	1.18E-02	1.18E-02	2.53E-02		0.3		0.3	6.32E-02	0.4	0.3	0.64	7.53E-01	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	4.75E-02	4.75E-02	1.19E-01	1.68E-02	0.3	1.40E-01	0.3	1.79E-01	0.4	0.3	0.75	2.13E+00	0.0056	0.25		0.083	0.000
Benzo(a)pyrene	0.1	0.01	0.27	2.69	3.59E-02	3.59E-02	7.89E-02	1.92E-02	0.3		0.3	1.83E-01	0.4	0.3	0.66	2.18E+00	0.0056	0.34		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	4.45E-02	4.45E-02	9.66E-02	1.19E-02	0.3		0.3	2.32E-01	0.4	0.3	0.65	2.77E+00	0.0056	0.35	3.19E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	7.08E-03	7.08E-03	1.54E-02	2.21E-03	0.3		0.3	3.68E-02	0.4	0.3	0.65	4.38E-01	0.0056	0.35	1.78E-04	0.083	0.002
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	4.15E-02	4.15E-02	8.99E-02	8.93E-03	0.3		0.3	2.18E-01	0.4	0.3	0.65	2.59E+00	0.0056	0.35	1.99E-04	0.083	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.61E-01	1.61E-01	5.16E-01	7.50E-01	0.3	9.70E-01	0.3		0.4	0.3	0.96	1.12E+00	0.0056	0.04		0.083	0.000
Benzyl alcohol	Bench NA	Bench NA	NA	NA	2.17E-01	2.17E-01	7.20E-01		0.3	2.40E+00	0.3		0.4	0.3	1.00	1.00E-01	0.0056	0.00		0.083	0.000
bis(2-Ethylhexyl)phthalate	0.2	0.02	4.92	49.20	8.04E-01	8.04E-01	2.66E+00	8.87E+00	0.3		0.3		0.4	0.3	0.99	1.12E+00	0.0056	0.01		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.03E-03	1.03E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	1.84E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	5.91E-01	5.91E-01	1.92E+00	6.00E+00	0.3	1.30E-01	0.3	2.11E-01	0.4	0.3	0.98	2.51E+00	0.0056	0.02	3.45E-04	0.083	0.000
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	2.65E-03	2.65E-03	5.68E-03		0.3		0.3	1.42E-02	0.4	0.3	0.64	1.69E-01	0.0056	0.36		0.083	0.000
Fluoranthene	0.007	Bench NA	13	NA	9.15E-02	9.15E-02	2.31E-01	3.97E-03	0.3	3.20E-01	0.3	3.34E-01	0.4	0.3	0.76	3.97E+00	0.0056	0.24		0.083	0.000
Fluorene	0.0004	Bench NA	13	NA	4.56E-03	4.56E-03	1.02E-02	4.33E-03	0.3		0.3	2.23E-02	0.4	0.3	0.67	2.66E-01	0.0056	0.33		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	8.60E-03	8.60E-03	1.87E-02	2.74E-03	0.3		0.3	4.48E-02	0.4	0.3	0.65	5.33E-01	0.0056	0.35		0.083	0.000
Naphthalene	0.002	0.0009	3.53	6.96	6.01E-03	6.01E-03	1.32E-02	2.96E-03	0.3		0.3	3.08E-02	0.4	0.3	0.66	3.66E-01	0.0056	0.34		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	3.21E-02	3.21E-02	6.95E-02	7.89E-03	0.3		0.3	1.68E-01	0.4	0.3	0.65	2.00E+00	0.0056	0.35		0.083	0.000
Pyrene	0.05	0.03	2.02	3.50	1.03E-01	1.03E-01	2.63E-01	1.38E-02	0.3	3.90E-01	0.3	3.56E-01	0.4	0.3	0.77	4.24E+00	0.0056	0.23	6.15E-04	0.083	0.000
VOCs																					
Acetone	0.0003	0.00006	4.97	24.8	1.52E-03	1.52E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.71E-01	0.0056	1.00		0.083	0.000
Carbon Disulfide	0.00001	Bench NA	2	NA	2.45E-05	2.45E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	4.37E-03	0.0056	1.00		0.083	0.000
Methyl tert-butyl ether (MTBE)	0.000002	0.0000002	7.11	71.1	1.51E-05	1.51E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.70E-03	0.0056	1.00		0.083	0.000

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded
to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since UCLs could not be calculated for invertebrate concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-6
Food Chain Model For Chronic Exposures
Kingfisher Analysis
Ingestion of Fish in the Neponset River
Blackburn and Union Privileges Site
Walpole, MA

Central Tendency							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.03	Bench NA	109.7	NA	2.88E+00	2.88E+00	5.75E+00	5.75E+00	1	0.5	1.00		0.11	0.00
Barium	0.03	0.01	20.8	41.7	5.48E-01	5.48E-01	1.07E+00	1.07E+00	1	0.5	0.97	1.43E-01	0.11	0.03
Cobalt	0.002	0.0009	15	30	2.72E-02	2.72E-02	5.44E-02	5.44E-02	1	0.5	1.00		0.11	0.00
Iron	Bench NA	Bench NA	NA	NA	2.75E+01	2.75E+01	5.33E+01	5.33E+01	1	0.5	0.97	8.22E+00	0.11	0.03
Lead	0.2	0.02	1.13	11.3	2.49E-01	2.49E-01	4.99E-01	4.99E-01	1	0.5	1.00		0.11	0.00
Manganese	0.02	Bench NA	977	NA	1.69E+01	1.69E+01	3.38E+01	3.38E+01	1	0.5	0.997	5.35E-01	0.11	0.00
Nickel	0.002	0.001	77.40	107	1.29E-01	1.29E-01	2.58E-01	2.58E-01	1	0.5	1.00		0.11	0.00
Vanadium	0.004	Bench NA	11.4	NA	4.47E-02	4.47E-02	8.94E-02	8.94E-02	1	0.5	1.00		0.11	0.00
Zinc	0.6	0.06	14.50	131	8.00E+00	8.00E+00	1.60E+01	1.60E+01	1	0.5	1.00		0.11	0.00
SVOCs														
bis(2-Ethylhexyl)phthalate	**3**	Bench NA	1.1	NA	3.64E+00	3.64E+00	7.28E+00	7.28E+00	1	0.5	1.00		0.11	0.00
Total PAHs	0.0002	0.00002	71.2	712	1.51E-02	1.51E-02	2.98E-02	2.98E-02	1	0.5	0.99	1.63E-03	0.11	0.01

Reasonable Maximum							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.03	Bench NA	109.7	NA	2.88E+00	2.88E+00	5.75E+00	5.75E+00	1	0.5	1.00		0.11	0.00
Barium	0.05	0.02	20.8	41.7	9.66E-01	9.66E-01	1.90E+00	1.90E+00	1	0.5	0.98	1.43E-01	0.11	0.02
Cobalt	0.002	0.0009	15	30	2.72E-02	2.72E-02	5.44E-02	5.44E-02	1	0.5	1.00		0.11	0.00
Iron	Bench NA	Bench NA	NA	NA	4.09E+01	4.09E+01	8.00E+01	8.00E+01	1	0.5	0.98	8.22E+00	0.11	0.02
Lead	0.2	0.02	1.13	11.3	2.49E-01	2.49E-01	4.99E-01	4.99E-01	1	0.5	1.00		0.11	0.00
Manganese	0.03	Bench NA	977	NA	3.01E+01	3.01E+01	6.00E+01	6.00E+01	1	0.5	0.998	5.35E-01	0.11	0.00
Nickel	0.002	0.002	77.40	107	1.85E-01	1.85E-01	3.70E-01	3.70E-01	1	0.5	1.00		0.11	0.00
Vanadium	0.004	Bench NA	11.4	NA	4.47E-02	4.47E-02	8.94E-02	8.94E-02	1	0.5	1.00		0.11	0.00
Zinc	0.6	0.07	14.50	131	9.00E+00	9.00E+00	1.80E+01	1.80E+01	1	0.5	1.00		0.11	0.00
SVOCs														
bis(2-Ethylhexyl)phthalate	**3**	Bench NA	1.1	NA	3.64E+00	3.64E+00	7.28E+00	7.28E+00	1	0.5	1.00		0.11	0.00
Total PAHs	0.0002	0.00002	71.2	712	1.51E-02	1.51E-02	2.98E-02	2.98E-02	1	0.5	0.988	1.63E-03	0.11	0.01

Notes:
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-7
Food Chain Model For Chronic Exposures
Kingfisher Analysis
Ingestion of Fish in Lewis Pond
Blackburn and Union Privileges Site
Walpole, MA

Central Tendency							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.08	Bench NA	109.7	NA	9.09E+00	9.09E+00	1.82E+01	1.82E+01	1	0.5	1.00		0.11	0.00
Barium	0.04	0.02	20.8	41.7	7.69E-01	7.69E-01	1.51E+00	1.51E+00	1	0.5	0.98	1.43E-01	0.11	0.02
Cadmium	0.02	0.001	1.45	20.03	2.23E-02	2.23E-02	4.46E-02	4.46E-02	1	0.5	1.00		0.11	0.00
Chromium	0.5	0.09	1	5	4.64E-01	4.64E-01	9.28E-01	9.28E-01	1	0.5	1.00		0.11	0.00
Cobalt	0.002	0.0008	15	30	2.52E-02	2.52E-02	5.05E-02	5.05E-02	1	0.5	1.00		0.11	0.00
Copper	0.02	0.01	47.0	61.7	8.37E-01	8.37E-01	1.67E+00	1.67E+00	1	0.5	1.00		0.11	0.00
Lead	0.4	0.04	1.13	11.3	4.45E-01	4.45E-01	8.90E-01	8.90E-01	1	0.5	1.00		0.11	0.00
Manganese	0.01	Bench NA	977	NA	1.35E+01	1.35E+01	2.70E+01	2.70E+01	1	0.5	1.00	5.35E-01	0.11	0.00
Mercury	0.1	0.06	0.45	0.9	5.01E-02	5.01E-02	1.00E-01	1.00E-01	1	0.5	1.00		0.11	0.00
Nickel	0.003	0.002	77.4	107	2.50E-01	2.50E-01	5.00E-01	5.00E-01	1	0.5	1.00		0.11	0.00
Selenium	0.9	0.4	0.4	0.8	3.40E-01	3.40E-01	6.81E-01	6.81E-01	1	0.5	1.00		0.11	0.00
Thallium	Bench NA	Bench NA	NA	NA	2.18E-03	2.18E-03	4.35E-03	4.35E-03	1	0.5	1.00		0.11	0.00
Vanadium	0.005	Bench NA	11.4	NA	6.09E-02	6.09E-02	1.22E-01	1.22E-01	1	0.5	1.00		0.11	0.00
Zinc	1	0.2	14.5	131	2.12E+01	2.12E+01	4.25E+01	4.25E+01	1	0.5	1.00		0.11	0.00
SVOCs														
bis(2-Ethylhexyl)phthalate	**4**	Bench NA	1.1	NA	4.43E+00	4.43E+00	8.87E+00	8.87E+00	1	0.5	1.00		0.11	0.00
Total PAHs	0.0003	0.00003	71.2	712	2.44E-02	2.44E-02	4.85E-02	4.85E-02	1	0.5	0.99	1.63E-03	0.11	0.01

Reasonable Maximum							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.08	Bench NA	109.7	NA	9.09E+00	9.09E+00	1.82E+01	1.82E+01	1	0.5	1.00		0.11	0.00
Barium	0.04	0.02	20.8	41.7	7.69E-01	7.69E-01	1.51E+00	1.51E+00	1	0.5	0.98	1.43E-01	0.11	0.02
Cadmium	0.02	0.002	1.45	20.03	3.28E-02	3.28E-02	6.56E-02	6.56E-02	1	0.5	1.00		0.11	0.00
Chromium	0.5	0.09	1	5	4.64E-01	4.64E-01	9.28E-01	9.28E-01	1	0.5	1.00		0.11	0.00
Cobalt	0.002	0.0008	15	30	2.52E-02	2.52E-02	5.05E-02	5.05E-02	1	0.5	1.00		0.11	0.00
Copper	0.03	0.02	47.0	61.7	1.26E+00	1.26E+00	2.51E+00	2.51E+00	1	0.5	1.00		0.11	0.00
Lead	0.4	0.04	1.13	11.3	4.45E-01	4.45E-01	8.90E-01	8.90E-01	1	0.5	1.00		0.11	0.00
Manganese	0.01	Bench NA	977	NA	1.35E+01	1.35E+01	2.70E+01	2.70E+01	1	0.5	1.00	5.35E-01	0.11	0.00
Mercury	0.1	0.06	0.45	0.9	5.01E-02	5.01E-02	1.00E-01	1.00E-01	1	0.5	1.00		0.11	0.00
Nickel	0.003	0.002	77.4	107	2.50E-01	2.50E-01	5.00E-01	5.00E-01	1	0.5	1.00		0.11	0.00
Selenium	0.9	0.4	0.4	0.8	3.40E-01	3.40E-01	6.81E-01	6.81E-01	1	0.5	1.00		0.11	0.00
Thallium	Bench NA	Bench NA	NA	NA	2.18E-03	2.18E-03	4.35E-03	4.35E-03	1	0.5	1.00		0.11	0.00
Vanadium	0.005	Bench NA	11.4	NA	6.09E-02	6.09E-02	1.22E-01	1.22E-01	1	0.5	1.00		0.11	0.00
Zinc	1	0.2	14.5	131	2.12E+01	2.12E+01	4.25E+01	4.25E+01	1	0.5	1.00		0.11	0.00
SVOCs														
bis(2-Ethylhexyl)phthalate	**4**	Bench NA	1.1	NA	4.43E+00	4.43E+00	8.87E+00	8.87E+00	1	0.5	1.00		0.11	0.00
Total PAHs	0.0006	0.00006	71.2	712	4.40E-02	4.40E-02	8.77E-02	8.77E-02	1	0.5	1.00	1.63E-03	0.11	0.00

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-8
Food Chain Model For Chronic Exposures
Great Blue Heron Analysis
Ingestion of Fish in the Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency								Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Site Area to Forage Area Ratio	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.001	Bench NA	109.7	NA	1.45E-01	0.14	1.04E+00	5.75E+00	5.75E+00	1	0.18	1.00		0.045	0.00
Barium	0.001	0.0007	20.8	41.7	2.77E-02	0.14	1.98E-01	1.07E+00	1.07E+00	1	0.18	0.97	1.43E-01	0.045	0.03
Cobalt	0.00009	0.00005	15	30	1.37E-03	0.14	9.79E-03	5.44E-02	5.44E-02	1	0.18	1.00		0.045	0.00
Iron	Bench NA	Bench NA	NA	NA	1.39E+00	0.14	9.95E+00	5.33E+01	5.33E+01	1	0.18	0.96	8.22E+00	0.045	0.04
Lead	0.01	0.001	1.13	11.3	1.26E-02	0.14	8.98E-02	4.99E-01	4.99E-01	1	0.18	1.00		0.045	0.00
Manganese	0.0009	Bench NA	977	NA	8.54E-01	0.14	6.10E+00	3.38E+01	3.38E+01	1	0.18	0.996	5.35E-01	0.045	0.004
Nickel	0.00008	0.00006	77.40	107	6.49E-03	0.14	4.64E-02	2.58E-01	2.58E-01	1	0.18	1.00		0.045	0.00
Vanadium	0.0002	Bench NA	11.4	NA	2.25E-03	0.14	1.61E-02	8.94E-02	8.94E-02	1	0.18	1.00		0.045	0.00
Zinc	0.2	0.02	14.50	131	2.88E+00	1.00	2.88E+00	1.60E+01	1.60E+01	1	0.18	1.00		0.045	0.00
SVOCs															
bis(2-Ethylhexyl)phthalate	0.2	Bench NA	1.1	NA	1.83E-01	0.14	1.31E+00	7.28E+00	7.28E+00	1	0.18	1.00		0.045	0.00
Total PAHs	0.00002	0.000002	71.2	712	1.09E-03	0.20	5.44E-03	2.98E-02	2.98E-02	1	0.18	0.99	1.63E-03	0.045	0.01

Reasonable Maximum								Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Site Area to Forage Area Ratio	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.001	Bench NA	109.7	NA	1.45E-01	0.14	1.04E+00	5.75E+00	5.75E+00	1	0.18	1.00		0.045	0.00
Barium	0.002	0.001	20.8	41.7	4.88E-02	0.14	3.48E-01	1.90E+00	1.90E+00	1	0.18	0.98	1.43E-01	0.045	0.02
Cobalt	0.00009	0.00005	15	30	1.37E-03	0.14	9.79E-03	5.44E-02	5.44E-02	1	0.18	1.00		0.045	0.00
Iron	Bench NA	Bench NA	NA	NA	2.07E+00	0.14	1.48E+01	8.00E+01	8.00E+01	1	0.18	0.97	8.22E+00	0.045	0.03
Lead	0.01	0.001	1.13	11.30	1.26E-02	0.14	8.98E-02	4.99E-01	4.99E-01	1	0.18	1.00		0.045	0.00
Manganese	0.002	Bench NA	977	NA	1.52E+00	0.14	1.08E+01	6.00E+01	6.00E+01	1	0.18	0.998	5.35E-01	0.045	0.002
Nickel	0.0001	0.00009	77.40	107	9.32E-03	0.14	6.66E-02	3.70E-01	3.70E-01	1	0.18	1.00		0.045	0.00
Vanadium	0.0002	Bench NA	11.40	NA	2.25E-03	0.14	1.61E-02	8.94E-02	8.94E-02	1	0.18	1.00		0.045	0.00
Zinc	0.2	0.02	14.50	131	3.24E+00	1.00	3.24E+00	1.80E+01	1.80E+01	1	0.18	1.00		0.045	0.00
SVOCs															
bis(2-Ethylhexyl)phthalate	0.2	Bench NA	1.1	NA	1.83E-01	0.14	1.31E+00	7.28E+00	7.28E+00	1	0.18	1.00		0.045	0.00
Total PAHs	0.00001	0.000001	71.2	712	7.62E-04	0.14	5.44E-03	2.98E-02	2.98E-02	1	0.18	0.987	1.63E-03	0.045	0.013

Notes:
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-9
Food Chain Model For Chronic Exposures Great Blue Heron Analysis
Ingestion of Fish in Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency								Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Site Area to Forage Area Ratio	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.004	Bench NA	109.7	NA	4.58E-01	0.14	3.27E+00	1.82E+01	1.82E+01	1	0.18	1.00		0.045	0.00
Barium	0.002	0.0009	20.8	41.7	3.89E-02	0.14	2.78E-01	1.51E+00	1.51E+00	1	0.18	0.98	1.43E-01	0.045	0.02
Cadmium	0.0008	0.00006	1.45	20.03	1.12E-03	0.14	8.03E-03	4.46E-02	4.46E-02	1	0.18	1.00		0.045	0.00
Chromium	0.02	0.005	1	5	2.34E-02	0.14	1.67E-01	9.28E-01	9.28E-01	1	0.18	1.00		0.045	0.00
Cobalt	0.00008	0.00004	15	30	1.27E-03	0.14	9.08E-03	5.05E-02	5.05E-02	1	0.18	1.00		0.045	0.00
Copper	0.0009	0.0007	47.0	61.7	4.22E-02	0.14	3.01E-01	1.67E+00	1.67E+00	1	0.18	1.00		0.045	0.00
Lead	0.02	0.002	1.13	11.3	2.24E-02	0.14	1.60E-01	8.90E-01	8.90E-01	1	0.18	1.00		0.045	0.00
Manganese	0.0007	Bench NA	977	NA	6.83E-01	0.14	4.88E+00	2.70E+01	2.70E+01	1	0.18	0.995	5.35E-01	0.045	0.005
Mercury	0.006	0.003	0.45	0.9	2.53E-03	0.14	1.81E-02	1.00E-01	1.00E-01	1	0.18	1.00		0.045	0.00
Nickel	0.0002	0.0001	77.4	107	1.26E-02	0.14	9.01E-02	5.00E-01	5.00E-01	1	0.18	1.00		0.045	0.00
Selenium	0.04	0.02	0.4	0.8	1.72E-02	0.14	1.23E-01	6.81E-01	6.81E-01	1	0.18	1.00		0.045	0.00
Thallium	Bench NA	Bench NA	NA	NA	1.10E-04	0.14	7.83E-04	4.35E-03	4.35E-03	1	0.18	1.00		0.045	0.00
Vanadium	0.0003	Bench NA	11.4	NA	3.07E-03	0.14	2.19E-02	1.22E-01	1.22E-01	1	0.18	1.00		0.045	0.00
Zinc	0.07	0.008	14.5	131	1.07E+00	0.14	7.64E+00	4.25E+01	4.25E+01	1	0.18	1.00		0.045	0.00
SVOCs															
bis(2-Ethylhexyl)phthalate	0.2	Bench NA	1.1	NA	2.23E-01	0.14	1.60E+00	8.87E+00	8.87E+00	1	0.18	1.00		0.045	0.00
Total PAHs	0.0002	0.00002	71.2	712	1.22E-02	0.14	8.73E-02	4.85E-01	4.85E-01	1	0.18	0.999	1.63E-03	0.045	0.001

Reasonable Maximum								Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Site Area to Forage Area Ratio	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.004	Bench NA	109.7	NA	4.58E-01	0.14	3.27E+00	1.82E+01	1.82E+01	1	0.18	1.00		0.045	0.00
Barium	0.002	0.0009	20.8	41.7	3.89E-02	0.14	2.78E-01	1.51E+00	1.51E+00	1	0.18	0.98	1.43E-01	0.045	0.02
Cadmium	0.001	0.00008	1.45	20.03	1.61E-03	0.14	1.15E-02	6.40E-02	6.40E-02	1	0.18	1.00		0.045	0.00
Chromium	0.02	0.005	1	5	2.34E-02	0.14	1.67E-01	9.28E-01	9.28E-01	1	0.18	1.00		0.045	0.00
Cobalt	0.00008	0.00004	15	30	1.27E-03	0.14	9.08E-03	5.05E-02	5.05E-02	1	0.18	1.00		0.045	0.00
Copper	0.001	0.001	47.0	61.7	6.30E-02	0.14	4.50E-01	2.50E+00	2.50E+00	1	0.18	1.00		0.045	0.00
Lead	0.02	0.002	1.13	11.3	2.24E-02	0.14	1.60E-01	8.90E-01	8.90E-01	1	0.18	1.00		0.045	0.00
Manganese	0.0007	Bench NA	977	NA	6.83E-01	0.14	4.88E+00	2.70E+01	2.70E+01	1	0.18	0.995	5.35E-01	0.045	0.005
Mercury	0.006	0.003	0.45	0.9	2.53E-03	0.14	1.81E-02	1.00E-01	1.00E-01	1	0.18	1.00		0.045	0.00
Nickel	0.0002	0.0001	77.4	107	1.26E-02	0.14	9.01E-02	5.00E-01	5.00E-01	1	0.18	1.00		0.045	0.00
Selenium	0.04	0.02	0.4	0.8	1.72E-02	0.14	1.23E-01	6.81E-01	6.81E-01	1	0.18	1.00		0.045	0.00
Thallium	Bench NA	Bench NA	NA	NA	1.10E-04	0.14	7.83E-04	4.35E-03	4.35E-03	1	0.18	1.00		0.045	0.00
Vanadium	0.0003	Bench NA	11.4	NA	3.07E-03	0.14	2.19E-02	1.22E-01	1.22E-01	1	0.18	1.00		0.045	0.00
Zinc	0.07	0.008	14.5	131	1.07E+00	0.14	7.64E+00	4.25E+01	4.25E+01	1	0.18	1.00		0.045	0.00
SVOCs															
bis(2-Ethylhexyl)phthalate	0.2	Bench NA	1.1	NA	2.23E-01	0.14	1.60E+00	8.87E+00	8.87E+00	1	0.18	1.00		0.045	0.00
Total PAHs	0.00003	0.000003	71.2	712	2.22E-03	0.14	1.59E-02	8.77E-02	8.77E-02	1	0.18	0.995	1.63E-03	0.045	0.005

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

TABLE D-10
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**4**	Bench NA	109.7	NA	480	480	357	3.57E+02	1	0.9	0.67	8.83E+03	1	0.018	0.33		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.065	0.065	0.045	4.48E-02	1	0.9	0.63	1.34E+00	1	0.018	0.37		0.14	0.000
Arsenic	1	0.6	5.14	12.84	7.4	7.4	7.5	7.53E+00	1	0.9	0.92	3.30E+01	1	0.018	0.08		0.14	0.000
Barium	0.7	0.3	20.8	41.7	14	14	15	1.45E+01	1	0.9	0.91	6.65E+01	1	0.018	0.08	1.43E-01	0.14	0.001
Cadmium	1	0.09	1.45	20.03	1.9	1.9	2.1	2.07E+00	1	0.9	0.99	1.06E+00	1	0.018	0.010		0.14	0.000
Chromium	1	0.3	1	5	1.3	1.3	1.1	1.10E+00	1	0.9	0.77	1.67E+01	1	0.018	0.23		0.14	0.000
Cobalt	0.04	0.02	15	30	0.54	0.54	0.49	4.93E-01	1	0.9	0.82	5.33E+00	1	0.018	0.18		0.14	0.000
Copper	0.2	0.2	47.0	61.7	10	10	11	1.06E+01	1	0.9	0.93	4.28E+01	1	0.018	0.07		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	862	862	647	6.47E+02	1	0.9	0.68	1.55E+04	1	0.018	0.32	8.22E+00	0.14	0.001
Lead	**20**	**2**	1.13	11.3	27	27	26	2.62E+01	1	0.9	0.88	1.84E+02	1	0.018	0.123		0.14	0.000
Manganese	0.03	Bench NA	977	NA	33	33	31	3.10E+01	1	0.9	0.86	2.52E+02	1	0.018	0.14	5.35E-01	0.14	0.002
Mercury	0.2	0.1	0.45	0.9	0.088	0.088	0.091	9.05E-02	1	0.9	0.93	3.54E-01	1	0.018	0.072		0.14	0.000
Nickel	0.01	0.009	77.4	107	1.0	1.0	0.89	8.90E-01	1	0.9	0.80	1.09E+01	1	0.018	0.20		0.14	0.000
Selenium	**3**	1	0.4	0.8	1.2	1.2	1.3	1.30E+00	1	0.9	0.99	6.14E-01	1	0.018	0.009		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.016	0.016	0.015	1.54E-02	1	0.9	0.86	1.28E-01	1	0.018	0.14		0.14	0.000
Vanadium	0.2	Bench NA	11.4	NA	2.0	2.0	1.6	1.63E+00	1	0.9	0.74	2.81E+01	1	0.018	0.26		0.14	0.000
Zinc	**6**	0.7	14.5	131	94	94	101	1.01E+02	1	0.9	0.97	1.56E+02	1	0.018	0.030		0.14	0.000
Total PAHs	0.07	0.007	71.2	712	4.8	4.8	1.9	1.86E+00	1	0.9	0.35	1.72E+02	1	0.018	0.65	1.63E-03	0.14	0.00005
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.17	0.17	0.19	1.87E-01	1	0.9	0.98	1.72E-01	1	0.018	0.018		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.1	2.1	2.3	2.29E+00	1	0.9	0.99	1.03E+00	1	0.018	0.009		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0014	0.0014	0.0	ND	1	0.9	0.00	7.90E-02	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.9	0.00	6.97E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.017	0.017	0.0	ND	1	0.9	0.00	9.35E-01	1	0.018	1.00		0.14	0.000
Carbon disulfide	Bench NA	Bench NA	NA	NA	0.000023	0.000023	0.0	NA	1	0.9	0.00	1.26E-03	1	0.018	1.00		0.14	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.000044	0.000044	0.0	NA	1	0.9	0.00	2.45E-03	1	0.018	1.00		0.14	0.000

TABLE D-10
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**6**	Bench NA	109.7	NA	627	627	520	5.20E+02	1	0.9	0.75	8.83E+03	1	0.018	0.25		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.102	0.102	0.087	8.65E-02	1	0.9	0.76	1.34E+00	1	0.018	0.24		0.14	0.000
Arsenic	**3**	1	5.14	12.84	13.2	13.2	14.0	1.40E+01	1	0.9	0.95	3.30E+01	1	0.018	0.05		0.14	0.000
Barium	0.8	0.4	20.8	41.7	17	17	17	1.70E+01	1	0.9	0.93	6.65E+01	1	0.018	0.07	1.43E-01	0.14	0.001
Cadmium	**2**	0.1	1.45	20.03	2.8	2.8	3.1	3.10E+00	1	0.9	0.99	1.06E+00	1	0.018	0.007		0.14	0.000
Chromium	1	0.3	1	5	1.5	1.5	1.3	1.30E+00	1	0.9	0.80	1.67E+01	1	0.018	0.20		0.14	0.000
Cobalt	0.04	0.02	15	30	0.67	0.67	0.64	6.40E-01	1	0.9	0.86	5.33E+00	1	0.018	0.14		0.14	0.000
Copper	0.3	0.3	47.0	61.7	16	16	17	1.65E+01	1	0.9	0.95	4.28E+01	1	0.018	0.05		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	1270	1270	1100	1.10E+03	1	0.9	0.78	1.55E+04	1	0.018	0.22	8.22E+00	0.14	0.001
Lead	**40**	**4**	1.13	11.3	47	47	49	4.90E+01	1	0.9	0.93	1.84E+02	1	0.018	0.070		0.14	0.000
Manganese	0.06	Bench NA	977	NA	58	58	59	5.90E+01	1	0.9	0.92	2.52E+02	1	0.018	0.08	5.35E-01	0.14	0.001
Mercury	0.4	0.2	0.45	0.9	0.168	0.168	0.180	1.80E-01	1	0.9	0.96	3.54E-01	1	0.018	0.038		0.14	0.000
Nickel	0.02	0.01	77.4	107	1.3	1.3	1.20	1.20E+00	1	0.9	0.85	1.09E+01	1	0.018	0.15		0.14	0.000
Selenium	**6**	**3**	0.4	0.8	2.3	2.3	2.5	2.50E+00	1	0.9	1.00	6.14E-01	1	0.018	0.005		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.028	0.028	0.029	2.90E-02	1	0.9	0.92	1.28E-01	1	0.018	0.08		0.14	0.000
Vanadium	0.2	Bench NA	11.4	NA	2.3	2.3	2.0	2.00E+00	1	0.9	0.78	2.81E+01	1	0.018	0.22		0.14	0.000
Zinc	**10**	1	14.5	131	183	183	200	2.00E+02	1	0.9	0.98	1.56E+02	1	0.018	0.015		0.14	0.000
Total PAHs	0.07	0.007	71.2	712	5.3	5.3	2.4	2.41E+00	1	0.9	0.41	1.72E+02	1	0.018	0.59	1.63E-03	0.14	0.00004
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.16	0.16	0.17	1.70E-01	1	0.9	0.98	1.72E-01	1	0.018	0.020		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	4.0	4.0	4.4	4.40E+00	1	0.9	1.00	1.03E+00	1	0.018	0.005		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0014	0.0014	0.0	ND	1	0.9	0.00	7.90E-02	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.9	0.00	6.97E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.017	0.017	0.0	ND	1	0.9	0.00	9.35E-01	1	0.018	1.00		0.14	0.000
Carbon disulfide	Bench NA	Bench NA	NA	NA	0.000023	0.000023	0.0	NA	1	0.9	0.00	1.26E-03	1	0.018	1.00		0.14	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.000044	0.000044	0.0	NA	1	0.9	0.00	2.45E-03	1	0.018	1.00		0.14	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-11
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**5**	Bench NA	109.7	NA	598	598	520	5.20E+02	1	0.9	0.78	7.23E+03	1	0.018	0.22		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.9	0.00	4.34E-01	1	0.018	1.00		0.14	0.000
Arsenic	0.2	0.07	5.14	12.84	0.9	0.9	0.68	6.80E-01	1	0.9	0.71	1.36E+01	1	0.018	0.29		0.14	0.000
Barium	1	0.5	20.8	41.7	22	22	23	2.33E+01	1	0.9	0.96	5.28E+01	1	0.018	0.043	1.43E-01	0.14	0.001
Cadmium	0.8	0.06	1.45	20.03	1.1	1.1	1.3	1.27E+00	1	0.9	1.00	2.14E-01	1	0.018	0.0034		0.14	0.000
Chromium	1	0.3	1	5	1.4	1.4	1.3	1.32E+00	1	0.9	0.86	1.08E+01	1	0.018	0.14		0.14	0.000
Cobalt	0.04	0.02	15	30	0.53	0.53	0.51	5.07E-01	1	0.9	0.86	4.24E+00	1	0.018	0.14		0.14	0.000
Copper	0.09	0.07	47.0	61.7	4.2	4.2	4.2	4.23E+00	1	0.9	0.92	1.93E+01	1	0.018	0.08		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	789	789	610	6.10E+02	1	0.9	0.70	1.32E+04	1	0.018	0.30	8.22E+00	0.14	0.001
Lead	**10**	1	1.13	11.3	13	13	12	1.22E+01	1	0.9	0.86	9.64E+01	1	0.018	0.14		0.14	0.000
Manganese	0.03	Bench NA	977	NA	29	29	28	2.80E+01	1	0.9	0.86	2.17E+02	1	0.018	0.13	5.35E-01	0.14	0.003
Mercury	0.2	0.08	0.45	0.9	0.075	0.075	0.080	8.03E-02	1	0.9	0.97	1.39E-01	1	0.018	0.03		0.14	0.000
Nickel	0.02	0.01	77.4	107	1.4	1.4	1.3	1.29E+00	1	0.9	0.85	1.15E+01	1	0.018	0.15		0.14	0.000
Selenium	**3**	1	0.4	0.8	1.1	1.1	1.2	1.23E+00	1	0.9	0.99	3.53E-01	1	0.018	0.0057		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.009	0.009	0.009	9.07E-03	1	0.9	0.87	6.85E-02	1	0.018	0.13		0.14	0.000
Vanadium	0.2	Bench NA	11.4	NA	2.2	2.2	1.9	1.90E+00	1	0.9	0.79	2.49E+01	1	0.018	0.21		0.14	0.000
Zinc	**5**	0.6	14.5	131	72	72	79	7.87E+01	1	0.9	0.98	7.60E+01	1	0.018	0.019		0.14	0.000
Total PAHs	0.04	0.004	71.2	712	3.1	3.1	2.7	2.66E+00	1	0.9	0.77	3.92E+01	1	0.018	0.23	1.63E-03	0.14	0.0001
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.24	0.24	0.27	2.65E-01	1	0.9	1.00	ND	1	0.018	0.00		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.6	1.6	1.7	1.70E+00	1	0.9	0.98	1.64E+00	1	0.018	0.019		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0019	0.0019	0.0	ND	1	0.9	0.00	1.08E-01	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.9	0.00	3.48E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0025	0.0025	0.0	ND	1	0.9	0.00	1.37E-01	1	0.018	1.00		0.14	0.000
C11-C22 Aromatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.44	0.44	0.0	NA	1	0.9	0.00	2.44E+01	1	0.018	1.00		0.14	0.000
C19-C36 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.21	0.21	0.0	NA	1	0.9	0.00	1.16E+01	1	0.018	1.00		0.14	0.000
C9-C18 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.056	0.056	0.0	NA	1	0.9	0.00	3.10E+00	1	0.018	1.00		0.14	0.000
o-Xylene	Bench NA	Bench NA	NA	NA	0.000018	0.000018	0.0	NA	1	0.9	0.00	1.00E-03	1	0.018	1.00		0.14	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.0007	0.0007	0.0	NA	1	0.9	0.00	4.15E-02	1	0.018	1.00		0.14	0.000

TABLE D-11
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food: Total Conc. in Food mg/kg wet	Food: Earthworm Tissue mg/kg wet	Food: Proportion Worm In Diet	Food: Ingestion Rate kg/kg/day	Food: Proportion of Dose	Soil: Conc. in Soil mg/kg dry	Soil: Ave. Percent Solids in Soil	Soil: Ingestion Rate kg/kg/day	Soil: Proportion of Dose	Water: Conc. in Water [1] mg/l	Water: Ingestion Rate l/kg/day	Water: Proportion of Dose
Aluminum	**8**	Bench NA	109.7	NA	895	895	850	8.50E+02	1	0.9	0.85	7.23E+03	1	0.018	0.15		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.9	0.00	4.34E-01	1	0.018	1.00		0.14	0.000
Arsenic	0.2	0.08	5.14	12.84	1.0	1.0	0.89	8.90E-01	1	0.9	0.77	1.36E+01	1	0.018	0.23		0.14	0.000
Barium	1	0.6	20.8	41.7	26	26	28	2.80E+01	1	0.9	0.96	5.28E+01	1	0.018	0.036	1.43E-01	0.14	0.001
Cadmium	0.9	0.06	1.45	20.03	1.3	1.3	1.4	1.40E+00	1	0.9	1.00	2.14E-01	1	0.018	0.0030		0.14	0.000
Chromium	**2**	0.4	1	5	1.8	1.8	1.8	1.80E+00	1	0.9	0.89	1.08E+01	1	0.018	0.11		0.14	0.000
Cobalt	0.04	0.02	15	30	0.58	0.58	0.56	5.60E-01	1	0.9	0.87	4.24E+00	1	0.018	0.13		0.14	0.000
Copper	0.1	0.07	47.0	61.7	4.5	4.5	4.6	4.60E+00	1	0.9	0.92	1.93E+01	1	0.018	0.08		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	924	924	760	7.60E+02	1	0.9	0.74	1.32E+04	1	0.018	0.26	8.22E+00	0.14	0.001
Lead	**10**	1	1.13	11.3	16	16	16	1.60E+01	1	0.9	0.89	9.64E+01	1	0.018	0.11		0.14	0.000
Manganese	0.04	Bench NA	977	NA	35	35	34	3.40E+01	1	0.9	0.88	2.17E+02	1	0.018	0.11	5.35E-01	0.14	0.002
Mercury	0.2	0.09	0.45	0.9	0.082	0.082	0.088	8.80E-02	1	0.9	0.97	1.39E-01	1	0.018	0.03		0.14	0.000
Nickel	0.03	0.02	77.4	107	2.3	2.3	2.3	2.30E+00	1	0.9	0.91	1.15E+01	1	0.018	0.09		0.14	0.000
Selenium	**4**	**2**	0.4	0.8	1.5	1.5	1.7	1.70E+00	1	0.9	1.00	3.53E-01	1	0.018	0.0041		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.013	0.013	0.013	1.30E-02	1	0.9	0.90	6.85E-02	1	0.018	0.10		0.14	0.000
Vanadium	0.3	Bench NA	11.4	NA	3.1	3.1	3.0	3.00E+00	1	0.9	0.86	2.49E+01	1	0.018	0.14		0.14	0.000
Zinc	**6**	0.7	14.5	131	91	91	100	1.00E+02	1	0.9	0.99	7.60E+01	1	0.018	0.015		0.14	0.000
Total PAHs	0.06	0.006	71.2	712	4.5	4.5	4.2	4.17E+00	1	0.9	0.84	3.92E+01	1	0.018	0.16	1.63E-03	0.14	0.0001
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.41	0.41	0.45	4.50E-01	1	0.9	1.00	ND	1	0.018	0.00		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.1	2.1	2.3	2.30E+00	1	0.9	0.99	1.64E+00	1	0.018	0.014		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0019	0.0019	0.0	ND	1	0.9	0.00	1.08E-01	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.9	0.00	3.48E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0038	0.0038	0.0	ND	1	0.9	0.00	2.10E-01	1	0.018	1.00		0.14	0.000
C11-C22 Aromatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.70	0.70	0.0	NA	1	0.9	0.00	3.90E+01	1	0.018	1.00		0.14	0.000
C19-C36 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.38	0.38	0.0	NA	1	0.9	0.00	2.10E+01	1	0.018	1.00		0.14	0.000
C9-C18 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.081	0.081	0.0	NA	1	0.9	0.00	4.50E+00	1	0.018	1.00		0.14	0.000
o-Xylene	Bench NA	Bench NA	NA	NA	0.000018	0.000018	0.0	NA	1	0.9	0.00	1.00E-03	1	0.018	1.00		0.14	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.0036	0.0036	0.0	NA	1	0.9	0.00	2.00E-01	1	0.018	1.00		0.14	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-12
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**3**	Bench NA	109.7	NA	314	314	177	1.77E+02	1	0.9	0.51	8.63E+03	1	0.018	0.49		0.14	0.000
Arsenic	0.08	0.03	5.14	12.84	0.44	0.44	0.43	4.27E-01	1	0.9	0.88	2.89E+00	1	0.018	0.12		0.14	0.000
Barium	0.3	0.2	20.8	41.7	6	6	6	6.17E+00	1	0.9	0.88	4.12E+01	1	0.018	0.118	1.43E-01	0.14	0.003
Cadmium	1	0.1	1.45	20.03	2.1	2.1	2.3	2.30E+00	1	0.9	1.00	2.60E-01	1	0.018	0.0023		0.14	0.000
Chromium	0.7	0.1	1	5	0.67	0.67	0.51	5.07E-01	1	0.9	0.68	1.19E+01	1	0.018	0.32		0.14	0.000
Cobalt	0.03	0.02	15	30	0.50	0.50	0.45	4.47E-01	1	0.9	0.80	5.53E+00	1	0.018	0.20		0.14	0.000
Copper	0.06	0.05	47.0	61.7	2.9	2.9	2.9	2.93E+00	1	0.9	0.90	1.58E+01	1	0.018	0.10		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	481	481	223	2.23E+02	1	0.9	0.42	1.55E+04	1	0.018	0.58	8.22E+00	0.14	0.002
Lead	**30**	**3**	1.13	11.3	28	28	30	3.01E+01	1	0.9	0.96	6.51E+01	1	0.018	0.041		0.14	0.000
Manganese	0.03	Bench NA	977	NA	28	28	23	2.28E+01	1	0.9	0.73	4.11E+02	1	0.018	0.26	5.35E-01	0.14	0.003
Mercury	0.2	0.1	0.45	0.9	0.09	0.09	0.10	1.01E-01	1	0.9	0.99	6.96E-02	1	0.018	0.014		0.14	0.000
Nickel	0.006	0.004	77.4	107	0.43	0.43	0.33	3.30E-01	1	0.9	0.70	7.16E+00	1	0.018	0.30		0.14	0.000
Selenium	**10**	**5**	0.4	0.8	4.0	4.0	4.5	4.45E+00	1	0.9	1.00	3.57E-01	1	0.018	0.0016		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0082	8.20E-03	1	0.9	0.82	9.20E-02	1	0.018	0.18		0.14	0.000
Vanadium	0.1	Bench NA	11.4	NA	1.2	1.2	0.69	6.93E-01	1	0.9	0.52	3.14E+01	1	0.018	0.48		0.14	0.000
Zinc	**7**	0.7	14.5	131	95	95	104	1.04E+02	1	0.9	0.99	5.43E+01	1	0.018	0.0103		0.14	0.000
Total PAHs	0.01	0.001	71.2	712	1.0	1.0	0.0	ND	1	0.9	0.00	5.73E+01	1	0.018	1.00	1.63E-03	0.14	0.0002
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.32	0.32	0.35	3.50E-01	1	0.9	1.00	5.60E-02	1	0.018	0.003		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	3.2	3.2	3.6	3.60E+00	1	0.9	1.00	2.51E-01	1	0.018	0.001		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.012	0.012	0.0	ND	1	0.9	0.00	6.43E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0088	0.0088	0.0	ND	1	0.9	0.00	4.88E-01	1	0.018	1.00		0.14	0.000

TABLE D-12
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**3**	Bench NA	109.7	NA	362	362	230	2.30E+02	1	0.9	0.57	8.63E+03	1	0.018	0.43		0.14	0.000
Arsenic	0.1	0.04	5.14	12.84	0.56	0.56	0.56	5.60E-01	1	0.9	0.91	2.89E+00	1	0.018	0.09		0.14	0.000
Barium	0.6	0.3	20.8	41.7	12	12	13	1.30E+01	1	0.9	0.94	4.12E+01	1	0.018	0.060	1.43E-01	0.14	0.002
Cadmium	**3**	0.2	1.45	20.03	3.9	3.9	4.3	4.30E+00	1	0.9	1.00	2.60E-01	1	0.018	0.0012		0.14	0.000
Chromium	0.7	0.1	1	5	0.73	0.73	0.57	5.70E-01	1	0.9	0.71	1.19E+01	1	0.018	0.29		0.14	0.000
Cobalt	0.04	0.02	15	30	0.57	0.57	0.52	5.20E-01	1	0.9	0.82	5.53E+00	1	0.018	0.18		0.14	0.000
Copper	0.08	0.06	47.0	61.7	3.6	3.6	3.7	3.70E+00	1	0.9	0.92	1.58E+01	1	0.018	0.08		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	532	532	280	2.80E+02	1	0.9	0.47	1.55E+04	1	0.018	0.52	8.22E+00	0.14	0.002
Lead	**60**	**6**	1.13	11.3	63	63	69	6.90E+01	1	0.9	0.98	6.51E+01	1	0.018	0.019		0.14	0.000
Manganese	0.05	Bench NA	977	NA	49	49	46	4.60E+01	1	0.9	0.85	4.11E+02	1	0.018	0.15	5.35E-01	0.14	0.002
Mercury	0.4	0.2	0.45	0.9	0.17	0.17	0.19	1.90E-01	1	0.9	0.99	6.96E-02	1	0.018	0.007		0.14	0.000
Nickel	0.007	0.005	77.4	107	0.53	0.53	0.45	4.50E-01	1	0.9	0.76	7.16E+00	1	0.018	0.24		0.14	0.000
Selenium	**20**	**8**	0.4	0.8	6.7	6.7	7.4	7.40E+00	1	0.9	1.00	3.57E-01	1	0.018	0.0010		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0096	9.60E-03	1	0.9	0.84	9.20E-02	1	0.018	0.16		0.14	0.000
Vanadium	0.1	Bench NA	11.4	NA	1.3	1.3	0.87	8.70E-01	1	0.9	0.58	3.14E+01	1	0.018	0.42		0.14	0.000
Zinc	**10**	1	14.5	131	172	172	190	1.90E+02	1	0.9	0.99	5.43E+01	1	0.018	0.0057		0.14	0.000
Total PAHs	0.01	0.001	71.2	712	1.0	1.0	0.0	ND	1	0.9	0.00	5.73E+01	1	0.018	1.00	1.63E-03	0.14	0.0002
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.55	0.55	0.61	6.10E-01	1	0.9	1.00	5.60E-02	1	0.018	0.002		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	7.4	7.4	8.2	8.20E+00	1	0.9	1.00	2.51E-01	1	0.018	0.001		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.012	0.012	0.0	ND	1	0.9	0.00	6.43E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0088	0.0088	0.0	ND	1	0.9	0.00	4.88E-01	1	0.018	1.00		0.14	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-13
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil				Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**4**	Bench NA	109.7	NA	455	455	347	3.47E+02	1	0.9	0.69	7.92E+03	1	0.018	0.31		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.08	0.08	0.033	3.32E-02	1	0.9	0.37	2.77E+00	1	0.018	0.63		0.14	0.000
Arsenic	0.2	0.06	5.14	12.84	0.8	0.8	0.7	7.43E-01	1	0.9	0.81	8.84E+00	1	0.018	0.19		0.14	0.000
Barium	0.9	0.5	20.8	41.7	20	20	20	1.98E+01	1	0.9	0.91	9.63E+01	1	0.018	0.09	1.43E-01	0.14	0.001
Cadmium	**2**	0.1	1.45	20.03	2.9	2.9	3.2	3.20E+00	1	0.9	0.99	1.23E+00	1	0.018	0.008		0.14	0.000
Chromium	**3**	0.5	1	5	2.5	2.5	1.8	1.85E+00	1	0.9	0.65	4.90E+01	1	0.018	0.35		0.14	0.000
Copper	0.2	0.1	47.0	61.7	8	8	6.9	6.87E+00	1	0.9	0.81	7.82E+01	1	0.018	0.19		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	1113	1113	577	5.77E+02	1	0.9	0.47	3.29E+04	1	0.018	0.53	8.22E+00	0.14	0.001
Lead	**40**	**4**	1.13	11.3	47	47	45	4.53E+01	1	0.9	0.86	3.62E+02	1	0.018	0.14		0.14	0.000
Manganese	0.06	Bench NA	977	NA	57	57	56	5.60E+01	1	0.9	0.88	3.85E+02	1	0.018	0.12	5.35E-01	0.14	0.001
Mercury	0.1	0.07	0.45	0.9	0.07	0.07	0.062	6.17E-02	1	0.9	0.85	5.65E-01	1	0.018	0.15		0.14	0.000
Nickel	0.03	0.02	77.4	107	2.0	2.0	0.9	8.53E-01	1	0.9	0.39	6.76E+01	1	0.018	0.61		0.14	0.000
Selenium	**2**	1	0.4	0.8	0.9	0.9	0.9	9.47E-01	1	0.9	0.98	9.95E-01	1	0.018	0.021		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.015	0.015	0.013	1.34E-02	1	0.9	0.83	1.40E-01	1	0.018	0.17		0.14	0.000
Vanadium	0.2	Bench NA	11.4	NA	2.1	2.1	1.6	1.59E+00	1	0.9	0.68	3.70E+01	1	0.018	0.32		0.14	0.000
Zinc	**6**	0.6	14.5	131	84	84	90	8.97E+01	1	0.9	0.96	2.08E+02	1	0.018	0.044		0.14	0.000
Total PAHs	0.009	0.0009	71.2	712	0.6	0.6	0.45	4.50E-01	1	0.9	0.64	1.25E+01	1	0.018	0.36	1.63E-03	0.14	0.0004
1,2-Dichlorobenzene	Bench NA	Bench NA	NA	NA	0.0007	0.0007	0.0	ND	1	0.9	0.00	4.00E-02	1	0.018	1.00		0.14	0.000
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.17	0.17	0.19	1.85E-01	1	0.9	0.99	9.30E-02	1	0.018	0.010		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.3	2.3	2.5	2.50E+00	1	0.9	0.99	1.27E+00	1	0.018	0.010		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0015	0.0015	0.0	ND	1	0.9	0.00	8.40E-02	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.9	0.00	4.85E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.9	0.00	3.56E-01	1	0.018	1.00		0.14	0.000

TABLE D-13
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food					Soil				Water		
							Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**6**	Bench NA	109.7	NA	683	683	600	6.00E+02	1	0.9	0.79	7.92E+03	1	0.018	0.21		0.14	0.000
Antimony	Bench NA	Bench NA	NA	NA	0.10	0.10	0.052	5.20E-02	1	0.9	0.48	2.77E+00	1	0.018	0.52		0.14	0.000
Arsenic	0.2	0.1	5.14	12.84	1.2	1.2	1.2	1.20E+00	1	0.9	0.87	8.84E+00	1	0.018	0.13		0.14	0.000
Barium	1	0.7	20.8	41.7	28	28	29	2.90E+01	1	0.9	0.94	9.63E+01	1	0.018	0.06	1.43E-01	0.14	0.001
Cadmium	**2**	0.2	1.45	20.03	3.6	3.6	4.0	4.00E+00	1	0.9	0.99	1.23E+00	1	0.018	0.006		0.14	0.000
Chromium	**4**	0.7	1	5	3.6	3.6	3.0	3.00E+00	1	0.9	0.75	4.90E+01	1	0.018	0.25		0.14	0.000
Copper	0.2	0.1	47.0	61.7	9	9	8.5	8.50E+00	1	0.9	0.84	7.82E+01	1	0.018	0.16		0.14	0.000
Iron	Bench NA	Bench NA	NA	NA	1476	1476	980	9.80E+02	1	0.9	0.60	3.29E+04	1	0.018	0.40	8.22E+00	0.14	0.001
Lead	**50**	**5**	1.13	11.3	58	58	57	5.70E+01	1	0.9	0.89	3.62E+02	1	0.018	0.11		0.14	0.000
Manganese	0.1	Bench NA	977	NA	106	106	110	1.10E+02	1	0.9	0.93	3.85E+02	1	0.018	0.07	5.35E-01	0.14	0.001
Mercury	0.2	0.1	0.45	0.9	0.10	0.10	0.097	9.70E-02	1	0.9	0.90	5.65E-01	1	0.018	0.10		0.14	0.000
Nickel	0.03	0.02	77.4	107	2.4	2.4	1.3	1.30E+00	1	0.9	0.49	6.76E+01	1	0.018	0.51		0.14	0.000
Selenium	**3**	**2**	0.4	0.8	1.3	1.3	1.4	1.40E+00	1	0.9	0.99	9.95E-01	1	0.018	0.014		0.14	0.000
Thallium	Bench NA	Bench NA	NA	NA	0.026	0.026	0.026	2.60E-02	1	0.9	0.90	1.40E-01	1	0.018	0.10		0.14	0.000
Vanadium	0.3	Bench NA	11.4	NA	3.1	3.1	2.7	2.70E+00	1	0.9	0.78	3.70E+01	1	0.018	0.22		0.14	0.000
Zinc	**8**	0.9	14.5	131	112	112	120	1.20E+02	1	0.9	0.97	2.08E+02	1	0.018	0.034		0.14	0.000
Total PAHs	0.01	0.001	71.2	712	0.7	0.7	0.57	5.70E-01	1	0.9	0.69	1.25E+01	1	0.018	0.31	1.63E-03	0.14	0.0003
1,2-Dichlorobenzene	Bench NA	Bench NA	NA	NA	0.0007	0.0007	0.0	ND	1	0.9	0.00	4.00E-02	1	0.018	1.00		0.14	0.000
4-Methylphenol	Bench NA	Bench NA	NA	NA	0.15	0.15	0.16	1.60E-01	1	0.9	0.99	9.30E-02	1	0.018	0.011		0.14	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	3.7	3.7	4.1	4.10E+00	1	0.9	0.99	1.27E+00	1	0.018	0.006		0.14	0.000
Butylbenzylphthalate	Bench NA	Bench NA	NA	NA	0.0015	0.0015	0.0	ND	1	0.9	0.00	8.40E-02	1	0.018	1.00		0.14	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.9	0.00	4.85E-01	1	0.018	1.00		0.14	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.9	0.00	3.56E-01	1	0.018	1.00		0.14	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-14
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	2.3	23	352	352	356.7	357	1	0.6	0.61	8.83E+03	1	1	0.016	0.39		0.22	0.000
Antimony	0.3	0.03	0.149	1.49	0.05	0.05	0.0	0.045	1	0.6	0.56	1.34E+00	1	1	0.016	0.44		0.22	0.000
Arsenic	0.9	Bench NA	5.5	NA	5	5	7.5	7.5	1	0.6	0.90	3.30E+01	1	1	0.016	0.10		0.22	0.000
Barium	0.3	0.2	32	45.9	10	10	14.5	15	1	0.6	0.89	6.65E+01	1	1	0.016	0.11	1.43E-01	0.22	0.003
Cadmium	0.6	0.06	2	21	1.3	1.3	2.1	2.1	1	0.6	0.99	1.06E+00	1	1	0.016	0.01		0.22	0.000
Chromium	0.0002	Bench NA	6015	NA	0.9	0.9	1.1	1.1	1	0.6	0.72	1.67E+01	1	1	0.016	0.28		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.38	0.38	0.5	0.49	1	0.6	0.78	5.33E+00	1	1	0.016	0.22		0.22	0.000
Copper	0.2	0.2	33.4	43.26	7	7	10.6	11	1	0.6	0.91	4.28E+01	1	1	0.016	0.09		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	631	631	646.7	647	1	0.6	0.61	1.55E+04	1	1	0.016	0.38	8.22E+00	0.22	0.003
Lead	0.9	0.09	20	200	19	19	26	26	1	0.6	0.85	1.84E+02	1	1	0.016	0.15		0.22	0.000
Manganese	0.1	0.04	190	624	23	23	31	31	1	0.6	0.82	2.52E+02	1	1	0.016	0.17	5.35E-01	0.22	0.005
Mercury	0.02	Bench NA	3	NA	0.06	0.06	0.09	0.091	1	0.6	0.91	3.54E-01	1	1	0.016	0.09		0.22	0.000
Nickel	0.3	0.06	2.03	12.1	0.7	0.7	0.9	0.89	1	0.6	0.76	1.09E+01	1	1	0.016	0.24		0.22	0.000
Selenium	**2**	1	0.4	0.73	0.8	0.8	1.3	1.3	1	0.6	0.99	6.14E-01	1	1	0.016	0.01		0.22	0.000
Thallium	0.7	0.07	0.016	0.16	0.011	0.011	0.015	0.015	1	0.6	0.82	1.28E-01	1	1	0.016	0.18		0.22	0.000
Vanadium	**3**	0.3	0.4	4.3	1.4	1.4	1.6	1.6	1	0.6	0.69	2.81E+01	1	1	0.016	0.31		0.22	0.000
Zinc	0.2	0.09	350	700	63	63	101	101	1	0.6	0.96	1.56E+02	1	1	0.016	0.04		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.37E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0004	0.0002	42	83	0.016	0.016	0.0	ND	1	0.6	0.00	1.05E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.09	0.09	0.0	ND	1	0.6	0.00	5.77E+00	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0008	Bench NA	119	NA	0.09	0.09	0.0	ND	1	0.6	0.00	6.04E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.34	0.34	0.21	0.21	1	0.6	0.37	1.36E+01	1	1	0.016	0.63		0.22	0.000
Benzo[a]pyrene	0.3	0.03	1	12	0.33	0.33	0.20	0.20	1	0.6	0.36	1.35E+01	1	1	0.016	0.64		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.52	0.52	0.28	0.28	1	0.6	0.33	2.24E+01	1	1	0.016	0.67	3.19E-04	0.22	0.0001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.09	0.09	0.0	ND	1	0.6	0.00	5.50E+00	1	1	0.016	1.00	1.78E-04	0.22	0.0005
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.29	0.29	0.21	0.21	1	0.6	0.43	1.07E+01	1	1	0.016	0.57	1.99E-04	0.22	0.0002
Chrysene	Bench NA	Bench NA	NA	NA	0.38	0.38	0.21	0.21	1	0.6	0.32	1.65E+01	1	1	0.016	0.68	3.45E-04	0.22	0.0002
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.029	0.029	0.0	ND	1	0.6	0.00	1.85E+00	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.01	Bench NA	59	NA	0.6	0.6	0.26	0.26	1	0.6	0.26	2.89E+01	1	1	0.016	0.74		0.22	0.000
Fluorene	0.0003	Bench NA	59	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.74E-01	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.24	0.24	0.20	0.20	1	0.6	0.50	7.57E+00	1	1	0.016	0.50		0.22	0.000
Naphthalene	0.0006	0.0003	16	31	0.010	0.010	0.0	ND	1	0.6	0.00	6.50E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.17	0.17	0.0	ND	1	0.6	0.00	1.08E+01	1	1	0.016	1.00		0.22	0.000
Pyrene	0.06	0.04	8.9	15	0.6	0.6	0.30	0.30	1	0.6	0.32	2.39E+01	1	1	0.016	0.68	6.15E-04	0.22	0.0002
4-Methylphenol	0.003	0.001	38.5	98.9	0.11	0.11	0.19	0.19	1	0.6	0.98	1.72E-01	1	1	0.016	0.02		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.4	1.4	2.3	2.3	1	0.6	0.99	1.03E+00	1	1	0.016	0.01		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0012	0.0012	0.0	ND	1	0.6	0.00	7.90E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.011	0.011	0.0	ND	1	0.6	0.00	6.97E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.35E-01	1	1	0.016	1.00		0.22	0.000
Carbon disulfide [a]	0.000002	Bench NA	11	NA	0.000020	0.000020	0.0	NA	1	0.6	0.00	1.26E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.000038	0.000038	0.0	NA	1	0.6	0.00	2.45E-03	1	1	0.016	1.00		0.22	0.000

TABLE D-14
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food: Total Conc. in Food mg/kg wet	Food: Earthworm Tissue mg/kg wet	Food: Proportion Worm In Diet	Food: Ingestion Rate kg/kg/day	Food: Proportion of Dose	Soil: Conc. in Soil mg/kg	Soil: Ave. Percent Solids in Soil	Soil: Percentage Soil in Diet	Soil: Ingestion Rate kg/kg/day	Soil: Proportion of Dose	Water: Conc. in Water [1] mg/l	Water: Ingestion Rate l/kg/day	Water: Proportion of Dose
Aluminum	**200**	**20**	2.3	23	450	450	520.0	520	1	0.6	0.69	8.83E+03	1	1	0.016	0.31		0.22	0.000
Antimony	0.5	0.05	0.149	1.49	0.07	0.07	0.1	0.087	1	0.6	0.71	1.34E+00	1	1	0.016	0.29		0.22	0.000
Arsenic	**2**	Bench NA	5.5	NA	9	9	14.0	14	1	0.6	0.94	3.30E+01	1	1	0.016	0.06		0.22	0.000
Barium	0.4	0.2	32	45.9	11	11	17.0	17	1	0.6	0.91	6.65E+01	1	1	0.016	0.09	1.43E-01	0.22	0.003
Cadmium	0.9	0.09	2	21	1.9	1.9	3.1	3.1	1	0.6	0.99	1.06E+00	1	1	0.016	0.01		0.22	0.000
Chromium	0.0002	Bench NA	6015	NA	1.0	1.0	1.3	1.3	1	0.6	0.75	1.67E+01	1	1	0.016	0.25		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.47	0.47	0.6	0.64	1	0.6	0.82	5.33E+00	1	1	0.016	0.18		0.22	0.000
Copper	0.3	0.2	33.4	43.26	11	11	16.5	16.5	1	0.6	0.94	4.28E+01	1	1	0.016	0.06		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	903	903	1100.0	1100	1	0.6	0.73	1.55E+04	1	1	0.016	0.27	8.22E+00	0.22	0.002
Lead	**2**	0.2	20	200	32	32	49	49	1	0.6	0.91	1.84E+02	1	1	0.016	0.09		0.22	0.000
Manganese	0.2	0.06	193	624	39	39	59	59	1	0.6	0.90	2.52E+02	1	1	0.016	0.10	5.35E-01	0.22	0.003
Mercury	0.04	Bench NA	3	NA	0.11	0.11	0.18	0.18	1	0.6	0.95	3.54E-01	1	1	0.016	0.05		0.22	0.000
Nickel	0.4	0.07	2.03	12.1	0.9	0.9	1.2	1.2	1	0.6	0.81	1.09E+01	1	1	0.016	0.19		0.22	0.000
Selenium	**3**	**2**	0.4	0.73	1.5	1.5	2.5	2.5	1	0.6	0.99	6.14E-01	1	1	0.016	0.01		0.22	0.000
Thallium	1	0.1	0.016	0.16	0.019	0.019	0.029	0.029	1	0.6	0.90	1.28E-01	1	1	0.016	0.10		0.22	0.000
Vanadium	**4**	0.4	0.43	4.3	1.6	1.6	2.0	2.0	1	0.6	0.73	2.81E+01	1	1	0.016	0.27		0.22	0.000
Zinc	0.3	0.2	350	700	122	122	200	200	1	0.6	0.98	1.56E+02	1	1	0.016	0.02		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.37E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0004	0.0002	42	83	0.016	0.016	0.0	ND	1	0.6	0.00	1.05E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.09	0.09	0.0	ND	1	0.6	0.00	5.77E+00	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0008	Bench NA	119	NA	0.09	0.09	0.0	ND	1	0.6	0.00	6.04E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.35	0.35	0.23	0.23	1	0.6	0.39	1.36E+01	1	1	0.016	0.61		0.22	0.000
Benzo[a]pyrene	0.3	0.03	1.2	12	0.33	0.33	0.20	0.20	1	0.6	0.36	1.35E+01	1	1	0.016	0.64		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.62	0.62	0.45	0.45	1	0.6	0.44	2.24E+01	1	1	0.016	0.56	3.19E-04	0.22	0.0001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.09	0.09	0.0	ND	1	0.6	0.00	5.50E+00	1	1	0.016	1.00	1.78E-04	0.22	0.0005
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.31	0.31	0.23	0.23	1	0.6	0.45	1.07E+01	1	1	0.016	0.55	1.99E-04	0.22	0.0001
Chrysene	Bench NA	Bench NA	NA	NA	0.39	0.39	0.22	0.22	1	0.6	0.34	1.65E+01	1	1	0.016	0.66	3.45E-04	0.22	0.0002
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.029	0.029	0.0	ND	1	0.6	0.00	1.85E+00	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.01	Bench NA	59	NA	0.7	0.7	0.39	0.39	1	0.6	0.34	2.89E+01	1	1	0.016	0.66		0.22	0.000
Fluorene	0.0003	Bench NA	59	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.74E-01	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.23	0.23	0.19	0.19	1	0.6	0.49	7.57E+00	1	1	0.016	0.51		0.22	0.000
Naphthalene	0.0006	0.0003	16	31	0.010	0.010	0.0	ND	1	0.6	0.00	6.50E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.17	0.17	0.0	ND	1	0.6	0.00	1.08E+01	1	1	0.016	1.00		0.22	0.000
Pyrene	0.08	0.04	8.9	15	0.7	0.7	0.50	0.50	1	0.6	0.45	2.39E+01	1	1	0.016	0.55	6.15E-04	0.22	0.0002
4-Methylphenol	0.003	0.001	38.5	98.9	0.10	0.10	0.17	0.17	1	0.6	0.97	1.72E-01	1	1	0.016	0.03		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.7	2.7	4.4	4.4	1	0.6	0.99	1.03E+00	1	1	0.016	0.01		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0012	0.0012	0.0	ND	1	0.6	0.00	7.90E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.011	0.011	0.0	ND	1	0.6	0.00	6.97E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.35E-01	1	1	0.016	1.00		0.22	0.000
Carbon disulfide [a]	0.000002	Bench NA	11	NA	0.000020	0.000020	0.0	NA	1	0.6	0.00	1.26E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.000038	0.000038	0.0	NA	1	0.6	0.00	2.45E-03	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
[a] For non-bioaccumulative compounds (i.e. VOCs such as carbon disulfide and o-xylene), we only evaluate exposure via incidental soil ingestion, not food ingestion.
[b] We use the endpoint for total xylene from Sample et al., 1996 to calculate hazard quotient for o-xylene.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-15
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	2.3	23	425	425	520	520	1	0.6	0.73	7.23E+03	1	1	0.016	0.27		0.22	0.000
Antimony	0.05	0.005	0.149	1.49	0.007	0.007	0.0	ND	1	0.6	0.00	4.34E-01	1	1	0.016	1.00		0.22	0.000
Arsenic	0.1	Bench NA	5.5	NA	0.6	0.6	0.68	0.68	1	0.6	0.66	1.36E+01	1	1	0.016	0.34		0.22	0.000
Barium	0.5	0.3	32	46	15	15	23	23.3	1	0.6	0.94	5.28E+01	1	1	0.016	0.06	1.43E-01	0.22	0.002
Cadmium	0.4	0.04	2	21	0.76	0.76	1.3	1.3	1	0.6	1.00	2.14E-01	1	1	0.016	0.004		0.22	0.000
Chromium	0.0002	Bench NA	6015	NA	1.0	1.0	1.3	1.3	1	0.6	0.82	1.08E+01	1	1	0.016	0.18		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.37	0.37	0.51	0.51	1	0.6	0.82	4.24E+00	1	1	0.016	0.18		0.22	0.000
Copper	0.09	0.07	33.4	43.26	2.8	2.8	4.2	4.2	1	0.6	0.89	1.93E+01	1	1	0.016	0.11		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	574	574	610	610	1	0.6	0.64	1.32E+04	1	1	0.016	0.36	8.22E+00	0.22	0.003
Lead	0.4	0.04	20	200	9	9	12	12	1	0.6	0.83	9.64E+01	1	1	0.016	0.17		0.22	0.000
Manganese	0.1	0.03	190	624	20	20	28	28	1	0.6	0.83	2.17E+02	1	1	0.016	0.17	5.35E-01	0.22	0.006
Mercury	0.02	Bench NA	3	NA	0.05	0.05	0.080	0.08	1	0.6	0.96	1.39E-01	1	1	0.016	0.04		0.22	0.000
Nickel	0.5	0.08	2.03	12.1	1.0	1.0	1.3	1.3	1	0.6	0.81	1.15E+01	1	1	0.016	0.19		0.22	0.000
Selenium	**2**	1	0.4	0.73	0.7	0.7	1.2	1.2	1	0.6	0.99	3.53E-01	1	1	0.016	0.01		0.22	0.000
Thallium	0.4	0.04	0.016	0.16	0.007	0.007	0.009	0.0091	1	0.6	0.84	6.85E-02	1	1	0.016	0.16		0.22	0.000
Vanadium	**4**	0.4	0.43	4.3	1.5	1.5	1.9	1.9	1	0.6	0.75	2.49E+01	1	1	0.016	0.25		0.22	0.000
Zinc	0.1	0.07	350	700	48	48	79	79	1	0.6	0.98	7.60E+01	1	1	0.016	0.02		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.022	0.022	0.0	ND	1	0.6	0.00	1.41E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0002	0.0001	42	83	0.009	0.009	0.0	ND	1	0.6	0.00	5.45E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.014	0.014	0.0	ND	1	0.6	0.00	9.22E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0003	Bench NA	119	NA	0.033	0.033	0.0	ND	1	0.6	0.00	2.11E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.18	0.18	0.23	0.23	1	0.6	0.76	2.71E+00	1	1	0.016	0.24		0.22	0.000
Benzo[a]pyrene	0.3	0.03	1.2	12	0.31	0.31	0.26	0.26	1	0.6	0.50	9.99E+00	1	1	0.016	0.50		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.21	0.21	0.27	0.27	1	0.6	0.79	2.79E+00	1	1	0.016	0.21	3.19E-04	0.22	0.0003
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.18	0.18	0.22	0.22	1	0.6	0.72	3.30E+00	1	1	0.016	0.28	1.78E-04	0.22	0.0002
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.20	0.20	0.18	0.18	1	0.6	0.53	6.19E+00	1	1	0.016	0.47	1.99E-04	0.22	0.0002
Chrysene	Bench NA	Bench NA	NA	NA	0.19	0.19	0.23	0.23	1	0.6	0.73	3.28E+00	1	1	0.016	0.27	3.45E-04	0.22	0.0004
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.6	0.00	8.14E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.004	Bench NA	59	NA	0.26	0.26	0.30	0.30	1	0.6	0.70	5.00E+00	1	1	0.016	0.30		0.22	0.000
Fluorene	0.0004	Bench NA	59	NA	0.021	0.021	0.0	ND	1	0.6	0.00	1.38E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.20	0.20	0.22	0.22	1	0.6	0.66	4.22E+00	1	1	0.016	0.34		0.22	0.000
Naphthalene	0.001	0.0006	16	31	0.019	0.019	0.0	ND	1	0.6	0.00	1.19E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.42	0.42	0.27	0.27	1	0.6	0.38	1.67E+01	1	1	0.016	0.62		0.22	0.000
Pyrene	0.07	0.04	8.9	15	0.60	0.60	0.5	0.49	1	0.6	0.49	1.97E+01	1	1	0.016	0.51	6.15E-04	0.22	0.0002
4-Methylphenol	0.004	0.002	38.5	98.9	0.16	0.16	0.27	0.27	1	0.6	1.00		1	1	0.016	0.00		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.0	1.0	1.7	1.7	1	0.6	0.98	1.64E+00	1	1	0.016	0.02		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0017	0.0017	0.0	ND	1	0.6	0.00	1.08E-01	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.005	0.005	0.0	ND	1	0.6	0.00	3.48E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0021	0.0021	0.0	ND	1	0.6	0.00	1.37E-01	1	1	0.016	1.00		0.22	0.000
C11-C22 Aromatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.4	0.38	0.0	NA	1	0.6	0.00	2.44E+01	1	1	0.016	1.00		0.22	0.000
C19-C36 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.18	0.18	0.0	NA	1	0.6	0.00	1.16E+01	1	1	0.016	1.00		0.22	0.000
C9-C18 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.048	0.048	0.0	NA	1	0.6	0.00	3.10E+00	1	1	0.016	1.00		0.22	0.000
o-Xylene [a,b]	0.000006	0.000005	2.5	3.1	0.000016	0.000016	0.0	NA	1	0.6	0.00	1.00E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.0006	0.0006	0.0	NA	1	0.6	0.00	4.15E-02	1	1	0.016	1.00		0.22	0.000

TABLE D-15
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food: Total Conc. in Food mg/kg wet	Food: Earthworm Tissue mg/kg wet	Food: Proportion Worm In Diet	Food: Ingestion Rate kg/kg/day	Food: Proportion of Dose	Soil: Conc. in Soil mg/kg	Soil: Ave. Percent Solids in Soil	Soil: Percentage Soil in Diet	Soil: Ingestion Rate kg/kg/day	Soil: Proportion of Dose	Water: Conc. in Water [1] mg/l	Water: Ingestion Rate l/kg/day	Water: Proportion of Dose
Aluminum	**300**	**30**	2.3	23	623	623	850	850	1	0.6	0.82	7.23E+03	1	1	0.016	0.18		0.22	0.000
Antimony	0.05	0.005	0.15	1.5	0.007	0.007	0.0	ND	1	0.6	0.00	4.34E-01	1	1	0.016	1.00		0.22	0.000
Arsenic	0.1	Bench NA	5.5	NA	0.7	0.7	0.89	0.89	1	0.6	0.72	1.36E+01	1	1	0.016	0.28		0.22	0.000
Barium	0.6	0.4	32	46	18	18	28	28	1	0.6	0.95	5.28E+01	1	1	0.016	0.05	1.43E-01	0.22	0.002
Cadmium	0.4	0.04	2.1	21	0.84	0.84	1.4	1.4	1	0.6	1.00	2.14E-01	1	1	0.016	0.004		0.22	0.000
Chromium	0.0002	Bench NA	6010	NA	1.2	1.2	1.8	1.8	1	0.6	0.86	1.08E+01	1	1	0.016	0.14		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.40	0.40	0.56	0.56	1	0.6	0.84	4.24E+00	1	1	0.016	0.16		0.22	0.000
Copper	0.09	0.07	33.4	43.26	3.1	3.1	4.6	4.6	1	0.6	0.90	1.93E+01	1	1	0.016	0.10		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	664	664	760	760	1	0.6	0.69	1.32E+04	1	1	0.016	0.31	8.22E+00	0.22	0.003
Lead	0.6	0.06	17.6	176	11	11	16	16	1	0.6	0.86	9.64E+01	1	1	0.016	0.14		0.22	0.000
Manganese	0.1	0.04	193	624	24	24	34	34	1	0.6	0.85	2.17E+02	1	1	0.016	0.14	5.35E-01	0.22	0.005
Mercury	0.02	Bench NA	2.9	NA	0.05	0.05	0.088	0.088	1	0.6	0.96	1.39E-01	1	1	0.016	0.04		0.22	0.000
Nickel	0.8	0.1	2.03	12.1	1.6	1.6	2.3	2.3	1	0.6	0.88	1.15E+01	1	1	0.016	0.12		0.22	0.000
Selenium	**2**	1	0.44	0.73	1.0	1.0	1.7	1.7	1	0.6	0.99	3.53E-01	1	1	0.016	0.01		0.22	0.000
Thallium	0.5	0.05	0.016	0.16	0.009	0.009	0.013	0.013	1	0.6	0.88	6.85E-02	1	1	0.016	0.12		0.22	0.000
Vanadium	**5**	0.5	0.43	4.3	2.2	2.2	3.0	3.0	1	0.6	0.82	2.49E+01	1	1	0.016	0.18		0.22	0.000
Zinc	0.2	0.09	352	703	61	61	100	100	1	0.6	0.98	7.60E+01	1	1	0.016	0.02		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.022	0.022	0.0	ND	1	0.6	0.00	1.41E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0002	0.0001	42	83	0.009	0.009	0.0	ND	1	0.6	0.00	5.45E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.014	0.014	0.0	ND	1	0.6	0.00	9.22E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0003	Bench NA	119	NA	0.033	0.033	0.0	ND	1	0.6	0.00	2.11E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.22	0.22	0.30	0.30	1	0.6	0.81	2.71E+00	1	1	0.016	0.19		0.22	0.000
Benzo[a]pyrene	0.3	0.03	1.2	12	0.39	0.39	0.39	0.39	1	0.6	0.60	9.99E+00	1	1	0.016	0.40		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.31	0.31	0.44	0.44	1	0.6	0.86	2.79E+00	1	1	0.016	0.14	3.19E-04	0.22	0.0002
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.21	0.21	0.27	0.27	1	0.6	0.76	3.30E+00	1	1	0.016	0.24	1.78E-04	0.22	0.0002
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.19	0.19	0.16	0.16	1	0.6	0.50	6.19E+00	1	1	0.016	0.50	1.99E-04	0.22	0.0002
Chrysene	Bench NA	Bench NA	NA	NA	0.23	0.23	0.30	0.30	1	0.6	0.78	3.28E+00	1	1	0.016	0.22	3.45E-04	0.22	0.0003
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.6	0.00	8.14E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.007	Bench NA	59	NA	0.39	0.39	0.52	0.52	1	0.6	0.80	5.00E+00	1	1	0.016	0.20		0.22	0.000
Fluorene	0.0004	Bench NA	59	NA	0.021	0.021	0.0	ND	1	0.6	0.00	1.38E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.23	0.23	0.27	0.27	1	0.6	0.71	4.22E+00	1	1	0.016	0.29		0.22	0.000
Naphthalene	0.001	0.0006	16	31	0.019	0.019	0.0	ND	1	0.6	0.00	1.19E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.51	0.51	0.42	0.42	1	0.6	0.49	1.67E+01	1	1	0.016	0.51		0.22	0.000
Pyrene	0.1	0.06	8.9	15	0.97	0.97	1.1	1.1	1	0.6	0.68	1.97E+01	1	1	0.016	0.32	6.15E-04	0.22	0.0001
4-Methylphenol	0.007	0.003	38.5	98.9	0.27	0.27	0.45	0.45	1	0.6	1.00		1	1	0.016	0.00		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.4	1.4	2.3	2.3	1	0.6	0.98	1.64E+00	1	1	0.016	0.02		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0017	0.0017	0.0	ND	1	0.6	0.00	1.08E-01	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.005	0.005	0.0	ND	1	0.6	0.00	3.48E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.0033	0.0033	0.0	ND	1	0.6	0.00	2.10E-01	1	1	0.016	1.00		0.22	0.000
C11-C22 Aromatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.6	0.61	0.0	NA	1	0.6	0.00	3.90E+01	1	1	0.016	1.00		0.22	0.000
C19-C36 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.33	0.33	0.0	NA	1	0.6	0.00	2.10E+01	1	1	0.016	1.00		0.22	0.000
C9-C18 Aliphatic Hydrocarbons	Bench NA	Bench NA	NA	NA	0.070	0.070	0.0	NA	1	0.6	0.00	4.50E+00	1	1	0.016	1.00		0.22	0.000
o-Xylene [a,b]	0.000006	0.000005	2.5	3.1	0.000016	0.000016	0.0	NA	1	0.6	0.00	1.00E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	0.0031	0.0031	0.0	NA	1	0.6	0.00	2.00E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
[a] For non-bioaccumulative compounds (i.e. VOCs such as carbon disulfide and o-xylene), we only evaluate exposure via incidental soil ingestion, not food ingestion.
[b] We use the endpoint for total xylene from Sample et al., 1996 to calculate hazard quotient for o-xylene.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-16
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	2.3	23	241	241	176.7	177	1	0.6	0.44	8.63E+03	1	1	0.016	0.56		0.22	0.000
Arsenic	0.05	Bench NA	5.5	NA	0.30	0.30	0.4	0.43	1	0.6	0.85	2.89E+00	1	1	0.016	0.15		0.22	0.000
Barium	0.1	0.1	32	46	4.4	4.4	6.2	6.2	1	0.6	0.85	4.12E+01	1	1	0.016	0.15	1.43E-01	0.22	0.007
Cadmium	0.7	0.07	2	21	1.4	1.4	2.3	2.3	1	0.6	1.00	2.60E-01	1	1	0.016	0.003		0.22	0.000
Chromium	0.00008	Bench NA	6015	NA	0.49	0.49	0.5	0.51	1	0.6	0.62	1.19E+01	1	1	0.016	0.38		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.35	0.35	0.4	0.45	1	0.6	0.76	5.53E+00	1	1	0.016	0.24		0.22	0.000
Copper	0.06	0.05	33.4	43.26	2.0	2.0	2.9	2.9	1	0.6	0.88	1.58E+01	1	1	0.016	0.12		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	378	378	223.3	223	1	0.6	0.35	1.55E+04	1	1	0.016	0.64	8.22E+00	0.22	0.005
Lead	1	0.1	20	200	19	19	30.1	30	1	0.6	0.95	6.51E+01	1	1	0.016	0.05		0.22	0.000
Manganese	0.1	0.03	190	624	20	20	22.8	23	1	0.6	0.68	4.11E+02	1	1	0.016	0.32	5.35E-01	0.22	0.006
Mercury	0.02	Bench NA	3	NA	0.06	0.06	0.1	0.10	1	0.6	0.98	6.96E-02	1	1	0.016	0.02		0.22	0.000
Nickel	0.2	0.03	2.03	12.1	0.31	0.31	0.3	0.33	1	0.6	0.64	7.16E+00	1	1	0.016	0.36		0.22	0.000
Selenium	**6**	**4**	0.4	0.73	2.7	2.7	4.5	4.5	1	0.6	1.00	3.57E-01	1	1	0.016	0.002		0.22	0.000
Thallium	0.4	0.04	0.016	0.16	0.0064	0.0064	0.0	0.0082	1	0.6	0.77	9.20E-02	1	1	0.016	0.23		0.22	0.000
Vanadium	**2**	0.2	0.43	4.3	0.9	0.9	0.7	0.69	1	0.6	0.46	3.14E+01	1	1	0.016	0.54		0.22	0.000
Zinc	0.2	0.09	350	700	63	63	104.3	104	1	0.6	0.99	5.43E+01	1	1	0.016	0.01		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.012	0.012	0.0	ND	1	0.6	0.00	7.77E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0007	0.0003	42	83	0.028	0.028	0.0	ND	1	0.6	0.00	1.79E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.0015	0.0015	0.0	ND	1	0.6	0.00	9.41E-02	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0004	Bench NA	119	NA	0.051	0.051	0.0	ND	1	0.6	0.00	3.29E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.078	0.078	0.0	ND	1	0.6	0.00	4.98E+00	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.05	0.005	1.2	12	0.059	0.059	0.0	ND	1	0.6	0.00	3.78E+00	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.054	0.054	0.0	ND	1	0.6	0.00	3.49E+00	1	1	0.016	1.00	3.19E-04	0.22	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.92E-01	1	1	0.016	0.99	1.78E-04	0.22	0.005
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.048	0.048	0.0	ND	1	0.6	0.00	3.09E+00	1	1	0.016	1.00	1.99E-04	0.22	0.001
Chrysene	Bench NA	Bench NA	NA	NA	0.072	0.072	0.0	ND	1	0.6	0.00	4.58E+00	1	1	0.016	1.00	3.45E-04	0.22	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.6	0.00	6.08E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.002	Bench NA	59	NA	0.13	0.13	0.0	ND	1	0.6	0.00	8.27E+00	1	1	0.016	1.00		0.22	0.000
Fluorene	0.0005	Bench NA	59	NA	0.028	0.028	0.0	ND	1	0.6	0.00	1.79E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.033	0.033	0.0	ND	1	0.6	0.00	2.09E+00	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.001	0.0005	16	31	0.016	0.016	0.0	ND	1	0.6	0.00	9.96E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.14	0.14	0.0	ND	1	0.6	0.00	9.16E+00	1	1	0.016	1.00		0.22	0.000
Pyrene	0.01	0.007	8.9	15	0.11	0.11	0.0	ND	1	0.6	0.00	7.07E+00	1	1	0.016	1.00	6.15E-04	0.22	0.001
4-Methylphenol	0.005	0.002	38.5	98.9	0.21	0.21	0.4	0.35	1	0.6	1.00	5.60E-02	1	1	0.016	0.004		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.2	2.2	3.6	3.6	1	0.6	1.00	2.51E-01	1	1	0.016	0.002		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.43E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.88E-01	1	1	0.016	1.00		0.22	0.000

TABLE D-16
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food					Soil					Water		
							Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	2.3	23	273	273	230.0	230	1	0.6	0.51	8.63E+03	1	1	0.016	0.49		0.22	0.000
Arsenic	0.07	Bench NA	5.5	NA	0.38	0.38	0.6	0.56	1	0.6	0.88	2.89E+00	1	1	0.016	0.12		0.22	0.000
Barium	0.3	0.2	32	46	8.5	8.5	13.0	13	1	0.6	0.92	4.12E+01	1	1	0.016	0.08	1.43E-01	0.22	0.004
Cadmium	1	0.1	2	21	2.6	2.6	4.3	4.3	1	0.6	1.00	2.60E-01	1	1	0.016	0.002		0.22	0.000
Chromium	0.00009	Bench NA	6015	NA	0.53	0.53	0.6	0.57	1	0.6	0.65	1.19E+01	1	1	0.016	0.35		0.22	0.000
Cobalt	Bench NA	Bench NA	NA	NA	0.40	0.40	0.5	0.52	1	0.6	0.78	5.53E+00	1	1	0.016	0.22		0.22	0.000
Copper	0.07	0.06	33.4	43.26	2.5	2.5	3.7	3.7	1	0.6	0.90	1.58E+01	1	1	0.016	0.10		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	412	412	280.0	280.0	1	0.6	0.41	1.55E+04	1	1	0.016	0.59	8.22E+00	0.22	0.004
Lead	**2**	0.2	20	200	42	42	69.0	69	1	0.6	0.98	6.51E+01	1	1	0.016	0.02		0.22	0.000
Manganese	0.2	0.05	190	624	34	34	46.0	46	1	0.6	0.81	4.11E+02	1	1	0.016	0.19	5.35E-01	0.22	0.003
Mercury	0.04	Bench NA	3	NA	0.12	0.12	0.2	0.19	1	0.6	0.99	6.96E-02	1	1	0.016	0.01		0.22	0.000
Nickel	0.2	0.03	2.03	12.1	0.38	0.38	0.5	0.45	1	0.6	0.71	7.16E+00	1	1	0.016	0.29		0.22	0.000
Selenium	**10**	**6**	0.4	0.73	4.4	4.4	7.4	7.4	1	0.6	1.00	3.57E-01	1	1	0.016	0.001		0.22	0.000
Thallium	0.4	0.04	0.016	0.16	0.0072	0.0072	0.0	0.0096	1	0.6	0.80	9.20E-02	1	1	0.016	0.20		0.22	0.000
Vanadium	**2**	0.2	0.43	4.3	1.0	1.0	0.9	0.87	1	0.6	0.52	3.14E+01	1	1	0.016	0.48		0.22	0.000
Zinc	0.3	0.2	350	700	115	115	190.0	190	1	0.6	0.99	5.43E+01	1	1	0.016	0.01		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.012	0.012	0.0	ND	1	0.6	0.00	7.77E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthene	0.0007	0.0003	42	83	0.028	0.028	0.0	ND	1	0.6	0.00	1.79E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.0015	0.0015	0.0	ND	1	0.6	0.00	9.41E-02	1	1	0.016	1.00		0.22	0.000
Anthracene	0.0004	Bench NA	119	NA	0.051	0.051	0.0	ND	1	0.6	0.00	3.29E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.078	0.078	0.0	ND	1	0.6	0.00	4.98E+00	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.05	0.005	1.2	12	0.059	0.059	0.0	ND	1	0.6	0.00	3.78E+00	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.054	0.054	0.0	ND	1	0.6	0.00	3.49E+00	1	1	0.016	1.00	3.19E-04	0.22	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.92E-01	1	1	0.016	0.99	1.78E-04	0.22	0.005
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.048	0.048	0.0	ND	1	0.6	0.00	3.09E+00	1	1	0.016	1.00	1.99E-04	0.22	0.001
Chrysene	Bench NA	Bench NA	NA	NA	0.072	0.072	0.0	ND	1	0.6	0.00	4.58E+00	1	1	0.016	1.00	3.45E-04	0.22	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.6	0.00	6.08E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.002	Bench NA	59	NA	0.13	0.13	0.0	ND	1	0.6	0.00	8.27E+00	1	1	0.016	1.00		0.22	0.000
Fluorene	0.0005	Bench NA	59	NA	0.028	0.028	0.0	ND	1	0.6	0.00	1.79E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.033	0.033	0.0	ND	1	0.6	0.00	2.09E+00	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.001	0.0005	16	31	0.016	0.016	0.0	ND	1	0.6	0.00	9.96E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.14	0.14	0.0	ND	1	0.6	0.00	9.16E+00	1	1	0.016	1.00		0.22	0.000
Pyrene	0.01	0.007	8.9	15	0.11	0.11	0.0	ND	1	0.6	0.00	7.07E+00	1	1	0.016	1.00	6.15E-04	0.22	0.001
4-Methylphenol	0.01	0.004	38.5	98.9	0.37	0.37	0.6	0.61	1	0.6	1.00	5.60E-02	1	1	0.016	0.002		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	4.9	4.9	8.2	8.2	1	0.6	1.00	2.51E-01	1	1	0.016	0.001		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.43E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.88E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
[a] For non-bioaccumulative compounds (i.e. VOCs such as carbon disulfide and o-xylene), we only evaluate exposure via incidental soil ingestion, not food ingestion.
[b] We use the endpoint for total xylene from Sample et al., 1996 to calculate hazard quotient for o-xylene.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-17
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**100**	**10**	2.3	23	332	332	347	347	1	0.6	0.63	7.92E+03	1	1	0.016	0.37		0.22	0.000
Antimony	0.4	0.04	0.149	1.49	0.06	0.06	0.033	0.033	1	0.6	0.31	2.77E+00	1	1	0.016	0.69		0.22	0.000
Arsenic	0.1	Bench NA	5.5	NA	0.6	0.6	0.7	0.74	1	0.6	0.76	8.84E+00	1	1	0.016	0.24		0.22	0.000
Barium	0.4	0.3	32	46	13	13	20	20	1	0.6	0.89	9.63E+01	1	1	0.016	0.11	1.43E-01	0.22	0.002
Cadmium	0.9	0.09	2	21	1.9	1.9	3.2	3.2	1	0.6	0.99	1.23E+00	1	1	0.016	0.010		0.22	0.000
Chromium	0.0003	Bench NA	6015	NA	1.9	1.9	1.8	1.8	1	0.6	0.59	4.90E+01	1	1	0.016	0.41		0.22	0.000
Copper	0.2	0.1	33.4	43.26	5.3	5.3	6.9	6.9	1	0.6	0.77	7.82E+01	1	1	0.016	0.23		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	861	861	577	577	1	0.6	0.40	3.29E+04	1	1	0.016	0.60	8.22E+00	0.22	0.002
Lead	**2**	0.2	20	200	33	33	45	45	1	0.6	0.83	3.62E+02	1	1	0.016	0.17		0.22	0.000
Manganese	0.2	0.06	190	624	40	40	56	56	1	0.6	0.85	3.85E+02	1	1	0.016	0.15	5.35E-01	0.22	0.003
Mercury	0.02	Bench NA	3	NA	0.046	0.046	0.062	0.062	1	0.6	0.81	5.65E-01	1	1	0.016	0.19		0.22	0.000
Nickel	0.8	0.1	2.03	12.1	1.6	1.6	0.9	0.85	1	0.6	0.33	6.76E+01	1	1	0.016	0.67		0.22	0.000
Selenium	1	0.8	0.4	0.73	0.58	0.58	0.9	0.95	1	0.6	0.97	9.95E-01	1	1	0.016	0.03		0.22	0.000
Thallium	0.6	0.06	0.016	0.16	0.010	0.010	0.013	0.013	1	0.6	0.79	1.40E-01	1	1	0.016	0.21		0.22	0.000
Vanadium	**4**	0.4	0.43	4.3	1.5	1.5	1.6	1.6	1	0.6	0.62	3.70E+01	1	1	0.016	0.38		0.22	0.000
Zinc	0.2	0.08	350	700	57	57	90	90	1	0.6	0.94	2.08E+02	1	1	0.016	0.06		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.32E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.0019	0.0019	0.0	ND	1	0.6	0.00	1.21E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	0.00004	Bench NA	119	NA	0.005	0.005	0.0	ND	1	0.6	0.00	3.33E-01	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.6	0.00	8.14E-01	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.009	0.0009	1.2	12	0.011	0.011	0.0	ND	1	0.6	0.00	7.13E-01	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.014	0.014	0.0	ND	1	0.6	0.00	8.67E-01	1	1	0.016	0.99	3.19E-04	0.22	0.005
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.005	0.005	0.0	ND	1	0.6	0.00	2.87E-01	1	1	0.016	0.99	1.78E-04	0.22	0.009
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.6	0.00	6.03E-01	1	1	0.016	1.00	1.99E-04	0.22	0.005
Chrysene	Bench NA	Bench NA	NA	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.36E-01	1	1	0.016	0.99	3.45E-04	0.22	0.005
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.0013	0.0013	0.0	ND	1	0.6	0.00	8.36E-02	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.003	Bench NA	59	NA	0.18	0.18	0.24	0.24	1	0.6	0.79	2.51E+00	1	1	0.016	0.21		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.6	0.00	3.56E-01	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.0007	0.0003	16	31	0.011	0.011	0.0	ND	1	0.6	0.00	6.81E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.03	0.03	0.0	ND	1	0.6	0.00	1.75E+00	1	1	0.016	1.00		0.22	0.000
Pyrene	0.02	0.01	8.9	15	0.16	0.16	0.21	0.21	1	0.6	0.78	2.28E+00	1	1	0.016	0.22	6.15E-04	0.22	0.001
1,2-Dichlorobenzene	0.000003	Bench NA	189	NA	0.00062	0.00062	0.0	ND	1	0.6	0.00	4.00E-02	1	1	0.016	1.00		0.22	0.000
4-Methylphenol	0.003	0.001	38.5	98.9	0.112	0.112	0.19	0.19	1	0.6	0.99	9.30E-02	1	1	0.016	0.01		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.5	1.5	2.5	2.5	1	0.6	0.99	1.27E+00	1	1	0.016	0.01		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0013	0.0013	0.0	ND	1	0.6	0.00	8.40E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.85E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.6	0.00	3.56E-01	1	1	0.016	1.00		0.22	0.000

TABLE D-17
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

Reasonable Maximum Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food: Total Conc. in Food mg/kg wet	Food: Earthworm Tissue mg/kg wet	Food: Proportion Worm In Diet	Food: Ingestion Rate kg/kg/day	Food: Proportion of Dose	Soil: Conc. in Soil mg/kg	Soil: Ave. Percent Solids in Soil	Soil: Percentage Soil in Diet	Soil: Ingestion Rate kg/kg/day	Soil: Proportion of Dose	Water: Conc. in Water [1] mg/l	Water: Ingestion Rate l/kg/day	Water: Proportion of Dose
Aluminum	**200**	**20**	2.3	23	484	484	600	600	1	0.6	0.74	7.92E+03	1	1	0.016	0.26		0.22	0.000
Antimony	0.5	0.05	0.149	1.49	0.07	0.07	0.052	0.052	1	0.6	0.42	2.77E+00	1	1	0.016	0.58		0.22	0.000
Arsenic	0.2	Bench NA	5.5	NA	0.9	0.9	1.2	1.2	1	0.6	0.84	8.84E+00	1	1	0.016	0.16		0.22	0.000
Barium	0.6	0.4	32	46	19	19	29	29	1	0.6	0.92	9.63E+01	1	1	0.016	0.08	1.43E-01	0.22	0.002
Cadmium	1	0.1	2	21	2.4	2.4	4.0	4.0	1	0.6	0.99	1.23E+00	1	1	0.016	0.008		0.22	0.000
Chromium	0.0004	Bench NA	6015	NA	2.6	2.6	3.0	3.0	1	0.6	0.70	4.90E+01	1	1	0.016	0.30		0.22	0.000
Copper	0.2	0.1	33.4	43.26	6.3	6.3	8.5	8.5	1	0.6	0.81	7.82E+01	1	1	0.016	0.19		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	1103	1103	980	980	1	0.6	0.53	3.29E+04	1	1	0.016	0.47	8.22E+00	0.22	0.002
Lead	**2**	0.2	20	200	40	40	57	57	1	0.6	0.86	3.62E+02	1	1	0.016	0.14		0.22	0.000
Manganese	0.4	0.1	190	624	72	72	110	110	1	0.6	0.92	3.85E+02	1	1	0.016	0.08	5.35E-01	0.22	0.002
Mercury	0.02	Bench NA	3	NA	0.067	0.067	0.097	0.097	1	0.6	0.87	5.65E-01	1	1	0.016	0.13		0.22	0.000
Nickel	0.9	0.2	2.03	12.1	1.8	1.8	1.3	1.3	1	0.6	0.43	6.76E+01	1	1	0.016	0.57		0.22	0.000
Selenium	**2**	1	0.4	0.73	0.86	0.86	1.4	1.4	1	0.6	0.98	9.95E-01	1	1	0.016	0.02		0.22	0.000
Thallium	1	0.1	0.016	0.16	0.018	0.018	0.026	0.026	1	0.6	0.88	1.40E-01	1	1	0.016	0.12		0.22	0.000
Vanadium	**5**	0.5	0.43	4.3	2.2	2.2	2.7	2.7	1	0.6	0.74	3.70E+01	1	1	0.016	0.26		0.22	0.000
Zinc	0.2	0.1	350	700	75	75	120	120	1	0.6	0.96	2.08E+02	1	1	0.016	0.04		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	0.010	0.010	0.0	ND	1	0.6	0.00	6.32E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	0.0019	0.0019	0.0	ND	1	0.6	0.00	1.21E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	0.00004	Bench NA	119	NA	0.005	0.005	0.0	ND	1	0.6	0.00	3.33E-01	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	0.013	0.013	0.0	ND	1	0.6	0.00	8.14E-01	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.009	0.0009	1.2	12	0.011	0.011	0.0	ND	1	0.6	0.00	7.13E-01	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	0.014	0.014	0.0	ND	1	0.6	0.00	8.67E-01	1	1	0.016	0.99	3.19E-04	0.22	0.005
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	0.005	0.005	0.0	ND	1	0.6	0.00	2.87E-01	1	1	0.016	0.99	1.78E-04	0.22	0.009
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	0.009	0.009	0.0	ND	1	0.6	0.00	6.03E-01	1	1	0.016	1.00	1.99E-04	0.22	0.005
Chrysene	Bench NA	Bench NA	NA	NA	0.015	0.015	0.0	ND	1	0.6	0.00	9.36E-01	1	1	0.016	0.99	3.45E-04	0.22	0.005
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	0.0013	0.0013	0.0	ND	1	0.6	0.00	8.36E-02	1	1	0.016	1.00		0.22	0.000
Fluoranthene	0.004	Bench NA	59	NA	0.24	0.24	0.33	0.33	1	0.6	0.83	2.51E+00	1	1	0.016	0.17		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.6	0.00	3.56E-01	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.0007	0.0003	16	31	0.011	0.011	0.0	ND	1	0.6	0.00	6.81E-01	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	0.03	0.03	0.0	ND	1	0.6	0.00	1.75E+00	1	1	0.016	1.00		0.22	0.000
Pyrene	0.02	0.01	8.9	15	0.18	0.18	0.24	0.24	1	0.6	0.80	2.28E+00	1	1	0.016	0.20	6.15E-04	0.22	0.001
1,2-Dichlorobenzene	0.000003	Bench NA	189	NA	0.00062	0.00062	0.0	ND	1	0.6	0.00	4.00E-02	1	1	0.016	1.00		0.22	0.000
4-Methylphenol	0.003	0.001	38.5	98.9	0.097	0.097	0.16	0.16	1	0.6	0.99	9.30E-02	1	1	0.016	0.01		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.5	2.5	4.1	4.1	1	0.6	0.99	1.27E+00	1	1	0.016	0.01		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	0.0013	0.0013	0.0	ND	1	0.6	0.00	8.40E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	0.008	0.008	0.0	ND	1	0.6	0.00	4.85E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	0.006	0.006	0.0	ND	1	0.6	0.00	3.56E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

Table D-18
Food Chain Model for Acute Exposures
Muskrat Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food							Sediment			Water		
							Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**2**	0.2	11.4	111	2.47E+01	2.47E+01	1.66E+01	1.20E+02	0.05	1.12E+01	0.95	0.34	2.29E-01	1.40E+04	0.0014	7.71E-01		0.98	0.00E+00
Barium	0.06	0.02	47	141	2.76E+00	2.76E+00	6.95E+00	6.20E+01	0.05	4.05E+00	0.95	0.34	8.56E-01	1.35E+02	0.0014	6.65E-02	2.19E-01	0.98	7.78E-02
Cobalt	0.002	Bench NA	17.7	NA	3.27E-02	3.27E-02	5.59E-02	3.50E-01	0.05	4.04E-02	0.95	0.34	5.80E-01	1.01E+01	0.0014	4.20E-01		0.98	0.00E+00
Iron	Bench NA	Bench NA	NA	NA	6.17E+01	6.17E+01	5.29E+01	7.20E+02	0.05	1.78E+01	0.95	0.34	2.91E-01	2.22E+04	0.0014	4.89E-01	1.38E+01	0.98	2.19E-01
Lead	0.07	0.007	28	278	1.87E+00	1.87E+00	2.10E+00	9.60E+00	0.05	1.70E+00	0.95	0.34	3.81E-01	8.50E+02	0.0014	6.19E-01		0.98	0.00E+00
Manganese	Bench NA	Bench NA	NA	NA	4.32E+01	4.32E+01	1.15E+02	7.50E+01	0.05	1.17E+02	0.95	0.34	9.05E-01	2.34E+03	0.0014	7.37E-02	9.50E-01	0.98	2.16E-02
Nickel	0.06	Bench NA	57	NA	3.27E+00	3.27E+00	9.25E+00	9.50E-01	0.05	9.68E+00	0.95	0.34	9.61E-01	9.31E+01	0.0014	3.87E-02		0.98	0.00E+00
Vanadium	0.009	0.003	11	29	9.76E-02	9.76E-02	9.36E-02	8.60E-01	0.05	5.32E-02	0.95	0.34	3.26E-01	4.84E+01	0.0014	6.74E-01		0.98	0.00E+00
Zinc	Bench NA	Bench NA	NA	NA	1.23E+01	1.23E+01	3.54E+01	4.20E+01	0.05	3.50E+01	0.95	0.34	9.76E-01	2.19E+02	0.0014	2.42E-02		0.98	0.00E+00
SVOCs																			
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	2.08E-02	2.08E-02	5.83E-02		0.05	6.13E-02	0.95	0.34	9.52E-01	7.30E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthene	Bench NA	Bench NA	NA	NA	1.71E-02	1.71E-02	4.79E-02		0.05	5.04E-02	0.95	0.34	9.52E-01	6.00E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	3.70E-02	3.70E-02	1.04E-01		0.05	1.09E-01	0.95	0.34	9.52E-01	1.30E+00	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	Bench NA	Bench NA	NA	NA	3.99E-02	3.99E-02	1.12E-01		0.05	1.18E-01	0.95	0.34	9.52E-01	1.40E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	1.14E-01	1.14E-01	3.19E-01		0.05	3.36E-01	0.95	0.34	9.52E-01	4.00E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)pyrene	0.02	0.006	4	15	9.12E-02	9.12E-02	2.55E-01		0.05	2.69E-01	0.95	0.34	9.52E-01	3.20E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	1.32E-01	1.32E-01	3.67E-01		0.05	3.86E-01	0.95	0.34	9.48E-01	4.60E+00	0.0014	4.75E-02	5.70E-04	0.98	4.24E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	4.59E-02	4.59E-02	1.28E-01		0.05	1.34E-01	0.95	0.34	9.46E-01	1.60E+00	0.0014	4.74E-02	3.10E-04	0.98	6.62E-03
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	1.09E-01	1.09E-01	3.03E-01		0.05	3.19E-01	0.95	0.34	9.50E-01	3.80E+00	0.0014	4.76E-02	3.00E-04	0.98	2.71E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	4.84E-02	4.84E-02	1.40E-01	2.80E+00	0.05		0.95	0.34	9.83E-01	6.20E-01	0.0014	1.74E-02		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	Bench NA	Bench NA	NA	NA	8.84E-03	8.84E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	6.50E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	8.57E-04	8.57E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	6.30E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	1.29E-01	1.29E-01	3.59E-01		0.05	3.78E-01	0.95	0.34	9.48E-01	4.50E+00	0.0014	4.75E-02	6.20E-04	0.98	4.72E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	6.84E-03	6.84E-03	1.92E-02		0.05	2.02E-02	0.95	0.34	9.52E-01	2.40E-01	0.0014	4.77E-02		0.98	0.00E+00
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	7.21E-05	7.21E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	5.30E-02	0.0014	1.00E+00		0.98	0.00E+00
Fluoranthene	Bench NA	Bench NA	NA	NA	2.58E-01	2.58E-01	7.24E-01	1.20E-01	0.05	7.56E-01	0.95	0.34	9.53E-01	9.00E+00	0.0014	4.74E-02		0.98	0.00E+00
Fluorene	Bench NA	Bench NA	NA	NA	2.48E-02	2.48E-02	6.94E-02		0.05	7.31E-02	0.95	0.34	9.52E-01	8.70E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	5.13E-02	5.13E-02	1.44E-01		0.05	1.51E-01	0.95	0.34	9.52E-01	1.80E+00	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.0007	0.0001	39	194	2.62E-02	2.62E-02	7.34E-02		0.05	7.73E-02	0.95	0.34	9.52E-01	9.20E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	1.97E-01	1.97E-01	5.51E-01		0.05	5.80E-01	0.95	0.34	9.52E-01	6.90E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	Bench NA	Bench NA	NA	NA	2.43E-01	2.43E-01	6.78E-01		0.05	7.14E-01	0.95	0.34	9.48E-01	8.50E+00	0.0014	4.75E-02	1.10E-03	0.98	4.43E-03

Notes:
Bench NA=benchmark not available/applicable
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-19
Food Chain Model for Acute Exposures
Muskrat Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**2**	0.2	11.4	111	2.00E+01	2.00E+01	1.49E+01	1.30E+02	0.05	8.80E+00	0.95	0.34	2.52E-01	1.10E+04	0.0014	7.48E-01		0.98	0.00E+00
Barium	0.06	0.02	47	141	2.72E+00	2.72E+00	6.87E+00	6.50E+01	0.05	3.81E+00	0.95	0.34	8.58E-01	1.27E+02	0.0014	6.34E-02	2.19E-01	0.98	7.88E-02
Beryllium	Bench NA	Bench NA	NA	NA	1.79E-03	1.79E-03	1.69E-03		0.05	1.78E-03	0.95	0.34	3.22E-01	8.90E-01	0.0014	6.78E-01		0.98	0.00E+00
Cadmium	0.05	0.02	4.4	13.13	2.35E-01	2.35E-01	6.59E-01	9.90E-02	0.05	6.88E-01	0.95	0.34	9.54E-01	8.00E+00	0.0014	4.63E-02		0.98	0.00E+00
Chromium	1	0.5	22	46	2.22E+01	2.22E+01	6.35E+01	8.70E+00	0.05	6.64E+01	0.95	0.34	9.75E-01	4.10E+02	0.0014	2.52E-02		0.98	0.00E+00
Cobalt	0.004	Bench NA	17.7	NA	7.21E-02	7.21E-02	1.12E-01	3.40E-01	0.05	1.00E-01	0.95	0.34	5.28E-01	2.50E+01	0.0014	4.72E-01		0.98	0.00E+00
Copper	0.7	0.07	7.1	71	5.00E+00	5.00E+00	1.40E+01	6.00E+00	0.05	1.44E+01	0.95	0.34	9.51E-01	1.80E+02	0.0014	4.90E-02		0.98	0.00E+00
Lead	0.6	0.06	28	278	1.58E+01	1.58E+01	1.61E+01	3.40E+01	0.05	1.52E+01	0.95	0.34	3.47E-01	7.60E+03	0.0014	6.53E-01		0.98	0.00E+00
Manganese	Bench NA	Bench NA	NA	NA	1.89E+01	1.89E+01	4.88E+01	1.70E+01	0.05	5.05E+01	0.95	0.34	8.78E-01	1.01E+03	0.0014	7.27E-02	9.50E-01	0.98	4.92E-02
Mercury	0.0007	0.0003	3.8	7.8	2.45E-03	2.45E-03	3.61E-03	1.40E-02	0.05	3.06E-03	0.95	0.34	5.00E-01	9.00E-01	0.0014	5.00E-01		0.98	0.00E+00
Nickel	0.3	Bench NA	57	NA	1.79E+01	1.79E+01	5.06E+01	3.50E+00	0.05	5.30E+01	0.95	0.34	9.61E-01	5.10E+02	0.0014	3.88E-02		0.98	0.00E+00
Selenium	0.005	0.004	3.6	4.1	1.77E-02	1.77E-02	4.68E-02	5.90E-01	0.05	1.82E-02	0.95	0.34	9.00E-01	1.30E+00	0.0014	1.00E-01		0.98	0.00E+00
Silver	0.0008	0.0004	128	257	1.01E-01	1.01E-01	2.89E-01		0.05	3.04E-01	0.95	0.34	9.74E-01	1.90E+00	0.0014	2.56E-02		0.98	0.00E+00
Thallium	0.05	0.005	0.006	0.06	2.69E-04	2.69E-04	2.31E-04	4.40E-03	0.05	1.12E-05	0.95	0.34	2.92E-01	1.40E-01	0.0014	7.08E-01		0.98	0.00E+00
Vanadium	0.01	0.005	11	29	1.59E-01	1.59E-01	1.30E-01	8.30E-01	0.05	9.31E-02	0.95	0.34	2.77E-01	8.46E+01	0.0014	7.23E-01		0.98	0.00E+00
Zinc	Bench NA	Bench NA	NA	NA	2.59E+01	2.59E+01	7.44E+01	3.80E+01	0.05	7.63E+01	0.95	0.34	9.75E-01	4.77E+02	0.0014	2.50E-02		0.98	0.00E+00
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	8.30E-04	8.30E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	6.10E-01	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	5.41E-03	5.41E-03	1.52E-02		0.05	1.60E-02	0.95	0.34	9.52E-01	1.90E-01	0.0014	4.77E-02		0.98	0.00E+00
4-Methylphenol	0.00003	0.00001	125	321	4.15E-03	4.15E-03	1.00E-02	2.00E-01	0.05		0.95	0.34	8.20E-01	5.50E-01	0.0014	1.80E-01		0.98	0.00E+00
Acenaphthene	Bench NA	Bench NA	NA	NA	6.55E-03	6.55E-03	1.84E-02		0.05	1.93E-02	0.95	0.34	9.52E-01	2.30E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	2.56E-02	2.56E-02	7.18E-02		0.05	7.56E-02	0.95	0.34	9.52E-01	9.00E-01	0.0014	4.77E-02		0.98	0.00E+00
Anthracene	Bench NA	Bench NA	NA	NA	3.13E-02	3.13E-02	8.78E-02		0.05	9.24E-02	0.95	0.34	9.52E-01	1.10E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	9.93E-02	9.93E-02	2.78E-01	1.40E-01	0.05	2.86E-01	0.95	0.34	9.53E-01	3.40E+00	0.0014	4.66E-02		0.98	0.00E+00
Benzo(a)pyrene	0.03	0.007	4	15	1.05E-01	1.05E-01	2.95E-01		0.05	3.11E-01	0.95	0.34	9.52E-01	3.70E+00	0.0014	4.77E-02		0.98	0.00E+00
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	1.15E-01	1.15E-01	3.19E-01		0.05	3.36E-01	0.95	0.34	9.48E-01	4.00E+00	0.0014	4.75E-02	5.70E-04	0.98	4.88E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.88E-02	1.88E-02	5.19E-02		0.05	5.46E-02	0.95	0.34	9.37E-01	6.50E-01	0.0014	4.70E-02	3.10E-04	0.98	1.61E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	1.11E-01	1.11E-01	3.11E-01		0.05	3.28E-01	0.95	0.34	9.50E-01	3.90E+00	0.0014	4.76E-02	3.00E-04	0.98	2.64E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	1.87E-02	1.87E-02	4.85E-02	9.70E-01	0.05		0.95	0.34	8.83E-01	1.60E+00	0.0014	1.17E-01		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	4.09E-02	4.09E-02	1.20E-01	2.40E+00	0.05		0.95	0.34	9.97E-01	1.00E-01	0.0014	3.32E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	Bench NA	Bench NA	NA	NA	4.08E-03	4.08E-03	0.00E+00		0.05		0.95	0.34	0.00E+00	3.00E+00	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	3.81E-04	3.81E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.80E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	1.20E-01	1.20E-01	3.34E-01	1.30E-01	0.05	3.44E-01	0.95	0.34	9.48E-01	4.10E+00	0.0014	4.66E-02	6.20E-04	0.98	5.08E-03
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	7.12E-03	7.12E-03	2.00E-02		0.05	2.10E-02	0.95	0.34	9.52E-01	2.50E-01	0.0014	4.77E-02		0.98	0.00E+00
Fluoranthene	Bench NA	Bench NA	NA	NA	1.79E-01	1.79E-01	5.03E-01	3.20E-01	0.05	5.12E-01	0.95	0.34	9.54E-01	6.10E+00	0.0014	4.63E-02		0.98	0.00E+00
Fluorene	Bench NA	Bench NA	NA	NA	1.03E-02	1.03E-02	2.87E-02		0.05	3.02E-02	0.95	0.34	9.52E-01	3.60E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	2.05E-02	2.05E-02	5.75E-02		0.05	6.05E-02	0.95	0.34	9.52E-01	7.20E-01	0.0014	4.77E-02		0.98	0.00E+00
Naphthalene	0.0006	0.0001	39	194	2.17E-02	2.17E-02	6.06E-02		0.05	6.38E-02	0.95	0.34	9.52E-01	7.60E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	7.69E-02	7.69E-02	2.15E-01		0.05	2.27E-01	0.95	0.34	9.52E-01	2.70E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	Bench NA	Bench NA	NA	NA	2.16E-01	2.16E-01	6.02E-01	3.90E-01	0.05	6.13E-01	0.95	0.34	9.49E-01	7.30E+00	0.0014	4.60E-02	1.10E-03	0.98	5.00E-03
VOCs																			
Acetone	Bench NA	Bench NA	NA	NA	5.98E-04	5.98E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	4.40E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbon Disulfide	Bench NA	Bench NA	NA	NA	1.12E-05	1.12E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	8.20E-03	0.0014	1.00E+00		0.98	0.00E+00
Methyl tert-butyl ether (MTBE)	Bench NA	Bench NA	NA	NA	3.67E-06	3.67E-06	0.00E+00		0.05		0.95	0.34	0.00E+00	2.70E-03	0.0014	1.00E+00		0.98	0.00E+00

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
Bench NA=benchmark not available/applicable
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-20
Food Chain Model for Acute Exposures
Muskrat Analysis
Upper Former Mill Tailrace
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**3**	0.3	11.4	111	3.38E+01	3.38E+01	2.60E+01	3.20E+02	0.05	1.05E+01	0.95	0.34	2.61E-01	1.31E+04	0.0014	5.27E-01	7.33E+00	0.98	2.12E-01
Barium	0.04	0.01	47	141	2.07E+00	2.07E+00	5.33E+00	2.50E+01	0.05	4.29E+00	0.95	0.34	8.74E-01	1.43E+02	0.0014	9.39E-02	6.69E-02	0.98	3.17E-02
Beryllium	Bench NA	Bench NA	NA	NA	1.18E-03	1.18E-03	1.12E-03		0.05	1.18E-03	0.95	0.34	3.22E-01	5.90E-01	0.0014	6.78E-01		0.98	0.00E+00
Cobalt	0.002	Bench NA	17.7	NA	4.21E-02	4.21E-02	6.70E-02	3.90E-01	0.05	5.00E-02	0.95	0.34	5.41E-01	1.25E+01	0.0014	4.03E-01	2.40E-03	0.98	5.58E-02
Lead	0.05	0.005	28	278	1.27E+00	1.27E+00	1.37E+00	7.10E+00	0.05	1.07E+00	0.95	0.34	3.68E-01	5.35E+02	0.0014	5.74E-01	7.44E-02	0.98	5.76E-02
Manganese	Bench NA	Bench NA	NA	NA	4.41E+01	4.41E+01	1.19E+02	8.50E+00	0.05	1.25E+02	0.95	0.34	9.20E-01	2.50E+03	0.0014	7.72E-02	1.49E-01	0.98	3.31E-03
Mercury	0.00009	0.00004	3.8	7.8	3.44E-04	3.44E-04	4.52E-04		0.05	4.76E-04	0.95	0.34	4.47E-01	1.40E-01	0.0014	5.53E-01		0.98	0.00E+00
Nickel	0.04	Bench NA	57	NA	2.01E+00	2.01E+00	5.63E+00	9.70E-01	0.05	5.88E+00	0.95	0.34	9.54E-01	5.65E+01	0.0014	3.83E-02	1.56E-02	0.98	7.62E-03
Selenium	0.003	0.003	3.6	4.1	1.14E-02	1.14E-02	3.11E-02	4.60E-01	0.05	8.54E-03	0.95	0.34	9.27E-01	6.10E-01	0.0014	7.27E-02		0.98	0.00E+00
Thallium	0.05	0.005	0.006	0.06	3.04E-04	3.04E-04	1.34E-04	2.40E-03	0.05	1.52E-05	0.95	0.34	1.50E-01	1.90E-01	0.0014	8.50E-01		0.98	0.00E+00
Vanadium	0.01	0.005	11	29	1.36E-01	1.36E-01	9.73E-02	9.20E-01	0.05	5.40E-02	0.95	0.34	2.44E-01	4.91E+01	0.0014	4.92E-01	3.66E-02	0.98	2.64E-01
Zinc	Bench NA	Bench NA	NA	NA	1.45E+01	1.45E+01	4.13E+01	2.40E+01	0.05	4.22E+01	0.95	0.34	9.69E-01	2.64E+02	0.0014	2.48E-02	9.33E-02	0.98	6.30E-03
SVOCs																			
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	8.16E-05	8.16E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	6.00E-02	0.0014	1.00E+00		0.98	0.00E+00
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.31E-02	1.31E-02	3.59E-02		0.05	3.78E-02	0.95	0.34	9.32E-01	4.50E-01	0.0014	4.67E-02	2.90E-04	0.98	2.17E-02
4-Methylphenol	0.000002	0.0000007	125	321	2.18E-04	2.18E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	1.60E-01	0.0014	1.00E+00		0.98	0.00E+00
Acenaphthene	Bench NA	Bench NA	NA	NA	7.12E-03	7.12E-03	2.00E-02		0.05	2.10E-02	0.95	0.34	9.52E-01	2.50E-01	0.0014	4.77E-02		0.98	0.00E+00
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.94E-02	1.94E-02	5.35E-02		0.05	5.63E-02	0.95	0.34	9.39E-01	6.70E-01	0.0014	4.71E-02	2.70E-04	0.98	1.37E-02
Anthracene	Bench NA	Bench NA	NA	NA	2.22E-02	2.22E-02	6.22E-02		0.05	6.55E-02	0.95	0.34	9.52E-01	7.80E-01	0.0014	4.77E-02		0.98	0.00E+00
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	7.75E-02	7.75E-02	2.15E-01		0.05	2.27E-01	0.95	0.34	9.45E-01	2.70E+00	0.0014	4.74E-02	6.00E-04	0.98	7.59E-03
Benzo(a)pyrene	0.02	0.004	4	15	6.93E-02	6.93E-02	1.92E-01		0.05	2.02E-01	0.95	0.34	9.40E-01	2.40E+00	0.0014	4.71E-02	8.90E-04	0.98	1.26E-02
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	1.28E-01	1.28E-01	3.57E-01	1.20E-01	0.05	3.70E-01	0.95	0.34	9.46E-01	4.40E+00	0.0014	4.66E-02	9.00E-04	0.98	6.88E-03
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.13E-02	1.13E-02	3.03E-02		0.05	3.19E-02	0.95	0.34	9.11E-01	3.80E-01	0.0014	4.57E-02	5.00E-04	0.98	4.33E-02
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	9.16E-02	9.16E-02	2.55E-01		0.05	2.69E-01	0.95	0.34	9.47E-01	3.20E+00	0.0014	4.75E-02	4.70E-04	0.98	5.03E-03
Benzoic acid	Bench NA	Bench NA	NA	NA	6.77E-03	6.77E-03	1.80E-02	3.60E-01	0.05		0.95	0.34	9.04E-01	4.80E-01	0.0014	9.64E-02		0.98	0.00E+00
Benzyl alcohol	Bench NA	Bench NA	NA	NA	8.85E-02	8.85E-02	2.60E-01	5.20E+00	0.05		0.95	0.34	9.99E-01	6.60E-02	0.0014	1.01E-03		0.98	0.00E+00
bis(2-Ethylhexyl)phthalate	Bench NA	Bench NA	NA	NA	3.94E-04	3.94E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.90E-01	0.0014	1.00E+00		0.98	0.00E+00
Carbazole	Bench NA	Bench NA	NA	NA	2.86E-04	2.86E-04	0.00E+00		0.05		0.95	0.34	0.00E+00	2.10E-01	0.0014	1.00E+00		0.98	0.00E+00
Chrysene	Bench NA	Bench NA	NA	NA	8.85E-02	8.85E-02	2.45E-01	1.20E-01	0.05	2.52E-01	0.95	0.34	9.43E-01	3.00E+00	0.0014	4.61E-02	9.80E-04	0.98	1.09E-02
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	5.25E-03	5.25E-03	1.44E-02		0.05	1.51E-02	0.95	0.34	9.31E-01	1.80E-01	0.0014	4.67E-02	1.20E-04	0.98	2.24E-02
Fluoranthene	Bench NA	Bench NA	NA	NA	1.14E-01	1.14E-01	3.19E-01	1.50E-01	0.05	3.28E-01	0.95	0.34	9.53E-01	3.90E+00	0.0014	4.67E-02		0.98	0.00E+00
Fluorene	Bench NA	Bench NA	NA	NA	1.03E-02	1.03E-02	2.87E-02		0.05	3.02E-02	0.95	0.34	9.52E-01	3.60E-01	0.0014	4.77E-02		0.98	0.00E+00
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.30E-02	1.30E-02	3.51E-02		0.05	3.70E-02	0.95	0.34	9.21E-01	4.40E-01	0.0014	4.62E-02	4.30E-04	0.98	3.25E-02
Naphthalene	0.0004	0.00008	39	194	1.48E-02	1.48E-02	4.15E-02		0.05	4.37E-02	0.95	0.34	9.52E-01	5.20E-01	0.0014	4.77E-02		0.98	0.00E+00
Phenanthrene	Bench NA	Bench NA	NA	NA	5.70E-02	5.70E-02	1.60E-01		0.05	1.68E-01	0.95	0.34	9.52E-01	2.00E+00	0.0014	4.77E-02		0.98	0.00E+00
Pyrene	Bench NA	Bench NA	NA	NA	1.43E-01	1.43E-01	3.96E-01	2.50E-01	0.05	4.03E-01	0.95	0.34	9.43E-01	4.80E+00	0.0014	4.58E-02	1.60E-03	0.98	1.10E-02
VOCs																			
Carbon Disulfide	Bench NA	Bench NA	NA	NA	1.01E-05	1.01E-05	0.00E+00		0.05		0.95	0.34	0.00E+00	7.40E-03	0.0014	1.00E+00		0.98	0.00E+00

Notes:
Bench NA=benchmark not available/applicable
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-21
Food Chain Model For Acute Exposures
Raccoon Analysis
Neponset River
Blackburn and Union Privileges Site
Walpole, Massachusetts

Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Food									Sediment			Water		
							Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plants Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	8.0	77.0	9.11E+01	9.11E+01	4.25E+01	6.60E+00	0.3	1.20E+02	0.3	1.12E+01	0.4	0.3	0.14	1.40E+04	0.0056	0.86		0.083	0.000
Barium	0.2	0.07	33	98	7.01E+00	7.01E+00	2.08E+01	1.90E+00	0.3	6.20E+01	0.3	4.05E+00	0.4	0.3	0.89	1.35E+02	0.0056	0.11	2.19E-01	0.083	0.003
Cobalt	0.008	Bench NA	12.3	NA	9.84E-02	9.84E-02	1.39E-01	6.10E-02	0.3	3.50E-01	0.3	4.04E-02	0.4	0.3	0.43	1.01E+01	0.0056	0.57		0.083	0.000
Iron	Bench NA	Bench NA	NA	NA	2.00E+02	2.00E+02	2.47E+02	8.00E+01	0.3	7.20E+02	0.3	1.78E+01	0.4	0.3	0.37	2.22E+04	0.0056	0.62	1.38E+01	0.083	0.006
Lead	0.3	0.03	19	194	5.88E+00	5.88E+00	3.73E+00	5.70E-01	0.3	9.60E+00	0.3	1.70E+00	0.4	0.3	0.19	8.50E+02	0.0056	0.81		0.083	0.000
Manganese	Bench NA	Bench NA	NA	NA	3.94E+01	3.94E+01	8.73E+01	6.00E+01	0.3	7.50E+01	0.3	1.17E+02	0.4	0.3	0.67	2.34E+03	0.0056	0.33	9.50E-01	0.083	0.002
Nickel	0.03	Bench NA	57	NA	1.80E+00	1.80E+00	4.27E+00	3.70E-01	0.3	9.50E-01	0.3	9.68E+00	0.4	0.3	0.71	9.31E+01	0.0056	0.29		0.083	0.000
Vanadium	0.05	0.02	8.0	20	3.64E-01	3.64E-01	3.09E-01	9.90E-02	0.3	8.60E-01	0.3	5.32E-02	0.4	0.3	0.25	4.84E+01	0.0056	0.75		0.083	0.000
Zinc	Bench NA	Bench NA	NA	NA	1.11E+01	1.11E+01	3.20E+01	1.80E+01	0.3	4.20E+01	0.3	3.50E+01	0.4	0.3	0.87	2.19E+02	0.0068	0.13		0.083	0.000
SVOCs																					
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.14E-02	1.14E-02	2.45E-02	ND	0.3		0.3	6.13E-02	0.4	0.3	0.64	7.30E-01	0.0056	0.36		0.083	0.000
Acenaphthene	Bench NA	Bench NA	NA	NA	9.62E-03	9.62E-03	2.09E-02	2.30E-03	0.3		0.3	5.04E-02	0.4	0.3	0.65	6.00E-01	0.0056	0.35		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	2.04E-02	2.04E-02	4.37E-02	ND	0.3		0.3	1.09E-01	0.4	0.3	0.64	1.30E+00	0.0056	0.36		0.083	0.000
Anthracene	Bench NA	Bench NA	NA	NA	2.20E-02	2.20E-02	4.70E-02	ND	0.3		0.3	1.18E-01	0.4	0.3	0.64	1.40E+00	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	6.30E-02	6.30E-02	1.35E-01	2.90E-03	0.3		0.3	3.36E-01	0.4	0.3	0.64	4.00E+00	0.0056	0.36		0.083	0.000
Benzo(a)pyrene	0.02	0.005	3	11	5.04E-02	5.04E-02	1.08E-01	2.20E-03	0.3		0.3	2.69E-01	0.4	0.3	0.64	3.20E+00	0.0056	0.36		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	7.25E-02	7.25E-02	1.56E-01	3.90E-03	0.3		0.3	3.86E-01	0.4	0.3	0.64	4.60E+00	0.0056	0.36	5.70E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	2.51E-02	2.51E-02	5.38E-02	ND	0.3		0.3	1.34E-01	0.4	0.3	0.64	1.60E+00	0.0056	0.36	3.10E-04	0.083	0.001
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	5.99E-02	5.99E-02	1.29E-01	3.10E-03	0.3		0.3	3.19E-01	0.4	0.3	0.64	3.80E+00	0.0056	0.36	3.00E-04	0.083	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	4.35E-01	4.35E-01	1.44E+00	2.00E+00	0.3	2.80E+00	0.3		0.4	0.3	0.99	6.20E-01	0.0056	0.01		0.083	0.000
bis(2-Ethylhexyl)phthalate	Bench NA	Bench NA	NA	NA	7.20E-01	7.20E-01	2.28E+00	7.60E+00	0.3		0.3		0.4	0.3	0.95	6.50E+00	0.0056	0.05		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	3.53E-03	3.53E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	6.30E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	7.08E-02	7.08E-02	1.52E-01	2.60E-03	0.3		0.3	3.78E-01	0.4	0.3	0.64	4.50E+00	0.0056	0.36	6.20E-04	0.083	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	3.76E-03	3.76E-03	8.06E-03		0.3		0.3	2.02E-02	0.4	0.3	0.64	2.40E-01	0.0056	0.36		0.083	0.000
Di-n-octylphthalate	Bench NA	Bench NA	NA	NA	2.97E-04	2.97E-04	0.00E+00		0.3		0.3		0.4	0.3	0.00	5.30E-02	0.0056	1.00		0.083	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	1.52E-01	1.52E-01	3.38E-01		0.3	1.20E-01	0.3	7.56E-01	0.4	0.3	0.67	9.00E+00	0.0056	0.33		0.083	0.000
Fluorene	Bench NA	Bench NA	NA	NA	1.38E-02	1.38E-02	2.99E-02	2.30E-03	0.3		0.3	7.31E-02	0.4	0.3	0.65	8.70E-01	0.0056	0.35		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	2.82E-02	2.82E-02	6.05E-02		0.3		0.3	1.51E-01	0.4	0.3	0.64	1.80E+00	0.0056	0.36		0.083	0.000
Naphthalene	0.0005	0.0001	27	135	1.44E-02	1.44E-02	3.09E-02		0.3		0.3	7.73E-02	0.4	0.3	0.64	9.20E-01	0.0056	0.36		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	1.09E-01	1.09E-01	2.33E-01	4.30E-03	0.3		0.3	5.80E-01	0.4	0.3	0.64	6.90E+00	0.0056	0.36		0.083	0.000
Pyrene	Bench NA	Bench NA	NA	NA	1.34E-01	1.34E-01	2.86E-01	2.30E-03	0.3		0.3	7.14E-01	0.4	0.3	0.64	8.50E+00	0.0056	0.36	1.10E-03	0.083	0.001

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-22
Food Chain Model For Acute Exposures
Raccoon Analysis
Lewis Pond
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plants Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water (1) mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	8.0	77.0	7.67E+01	7.67E+01	5.03E+01	2.60E+01	0.3	1.30E+02	0.3	8.80E+00	0.4	0.3	0.20	1.10E+04	0.0056	0.80		0.083	0.000
Barium	0.2	0.07	33	98	7.18E+00	7.18E+00	2.15E+01	1.60E+00	0.3	6.50E+01	0.3	3.81E+00	0.4	0.3	0.90	1.27E+02	0.0056	0.10	2.19E-01	0.083	0.003
Beryllium	Bench NA	Bench NA	NA	NA	5.20E-03	5.20E-03	7.12E-04		0.3		0.3	1.78E-03	0.4	0.3	0.04	8.90E-01	0.0056	0.96		0.083	0.000
Cadmium	0.05	0.02	3.0	9.14	1.42E-01	1.42E-01	3.24E-01	6.40E-02	0.3	9.90E-02	0.3	6.88E-01	0.4	0.3	0.68	8.00E+00	0.0056	0.32		0.083	0.000
Chromium	0.7	0.3	15	32	1.11E+01	1.11E+01	2.95E+01	9.80E-01	0.3	8.70E+00	0.3	6.64E+01	0.4	0.3	0.79	4.10E+02	0.0056	0.21		0.083	0.000
Cobalt	0.02	Bench NA	12.3	NA	1.87E-01	1.87E-01	1.58E-01	5.30E-02	0.3	3.40E-01	0.3	1.00E-01	0.4	0.3	0.25	2.50E+01	0.0056	0.75		0.083	0.000
Copper	0.7	0.07	5	50	3.50E+00	3.50E+00	8.31E+00	2.50E+00	0.3	6.00E+00	0.3	1.44E+01	0.4	0.3	0.71	1.80E+02	0.0056	0.29		0.083	0.000
Lead	**2**	0.2	19	194	4.75E+01	4.75E+01	1.66E+01	1.10E+00	0.3	3.40E+01	0.3	1.52E+01	0.4	0.3	0.10	7.60E+03	0.0056	0.90		0.083	0.000
Manganese	Bench NA	Bench NA	NA	NA	1.65E+01	1.65E+01	3.58E+01	3.50E+01	0.3	1.70E+01	0.3	5.05E+01	0.4	0.3	0.65	1.01E+03	0.0056	0.34	9.50E-01	0.083	0.005
Mercury	0.007	0.003	2.6	5.5	1.75E-02	1.75E-02	4.14E-02	1.20E-01	0.3	1.40E-02	0.3	3.06E-03	0.4	0.3	0.71	9.00E-01	0.0056	0.29		0.083	0.000
Nickel	0.2	Bench NA	57	NA	9.59E+00	9.59E+00	2.25E+01	6.20E-01	0.3	3.50E+00	0.3	5.30E+01	0.4	0.3	0.70	5.10E+02	0.0056	0.30		0.083	0.000
Selenium	0.05	0.05	2.5	2.8	1.34E-01	1.34E-01	4.21E-01	7.90E-01	0.3	5.90E-01	0.3	1.82E-02	0.4	0.3	0.95	1.30E+00	0.0056	0.05		0.083	0.000
Silver	0.0005	0.0003	89	179	4.71E-02	4.71E-02	1.22E-01		0.3		0.3	3.04E-01	0.4	0.3	0.77	1.90E+00	0.0056	0.23		0.083	0.000
Thallium	0.4	0.04	0.004	0.04	1.58E-03	1.58E-03	2.64E-03	4.40E-03	0.3	4.40E-03	0.3	1.12E-05	0.4	0.3	0.50	1.40E-01	0.0056	0.50		0.083	0.000
Vanadium	0.07	0.03	8	20	5.72E-01	5.72E-01	3.28E-01	1.40E-01	0.3	8.30E-01	0.3	9.31E-02	0.4	0.3	0.17	8.46E+01	0.0056	0.83		0.083	0.000
Zinc	Bench NA	Bench NA	NA	NA	1.99E+01	1.99E+01	5.75E+01	5.20E+01	0.3	3.80E+01	0.3	7.63E+01	0.4	0.3	0.87	4.77E+02	0.0056	0.13		0.083	0.000
SVOCs																					
2,4-Dimethylphenol	Bench NA	Bench NA	NA	NA	3.42E-03	3.42E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	6.10E-01	0.0056	1.00		0.083	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	2.98E-03	2.98E-03	6.38E-03		0.3		0.3	1.60E-02	0.4	0.3	0.64	1.90E-01	0.0056	0.36		0.083	0.000
4-Methylphenol	0.0002	0.00009	87	224	2.11E-02	2.11E-02	6.00E-02		0.3	2.00E-01	0.3		0.4	0.3	0.85	5.50E-01	0.0056	0.15		0.083	0.000
Acenaphthene	Bench NA	Bench NA	NA	NA	4.05E-03	4.05E-03	9.20E-03	4.90E-03	0.3		0.3	1.93E-02	0.4	0.3	0.68	2.30E-01	0.0056	0.32		0.083	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.41E-02	1.41E-02	3.02E-02		0.3		0.3	7.56E-02	0.4	0.3	0.64	9.00E-01	0.0056	0.36		0.083	0.000
Anthracene	Bench NA	Bench NA	NA	NA	1.72E-02	1.72E-02	3.70E-02		0.3		0.3	9.24E-02	0.4	0.3	0.64	1.10E+00	0.0056	0.36		0.083	0.000
Benzo(a)anthracene	Bench NA	Bench NA	NA	NA	6.65E-02	6.65E-02	1.58E-01	6.70E-03	0.3	1.40E-01	0.3	2.86E-01	0.4	0.3	0.71	3.40E+00	0.0056	0.29		0.083	0.000
Benzo(a)pyrene	0.02	0.005	3	11	5.88E-02	5.88E-02	1.27E-01	8.40E-03	0.3		0.3	3.11E-01	0.4	0.3	0.65	3.70E+00	0.0056	0.35		0.083	0.000
Benzo(b)fluoranthene	Bench NA	Bench NA	NA	NA	6.41E-02	6.41E-02	1.39E-01	1.50E-02	0.3		0.3	3.36E-01	0.4	0.3	0.65	4.00E+00	0.0056	0.35	5.70E-04	0.083	0.001
Benzo[g,h,i]perylene	Bench NA	Bench NA	NA	NA	1.05E-02	1.05E-02	2.27E-02	2.90E-03	0.3		0.3	5.46E-02	0.4	0.3	0.65	6.50E-01	0.0056	0.35	3.10E-04	0.083	0.002
Benzo(k)fluoranthene	Bench NA	Bench NA	NA	NA	6.22E-02	6.22E-02	1.34E-01	1.10E-02	0.3		0.3	3.28E-01	0.4	0.3	0.65	3.90E+00	0.0056	0.35	3.00E-04	0.083	0.0004
Benzoic acid	Bench NA	Bench NA	NA	NA	1.64E-01	1.64E-01	5.16E-01	7.50E-01	0.3	9.70E-01	0.3		0.4	0.3	0.95	1.60E+00	0.0056	0.05		0.083	0.000
Benzyl alcohol	Bench NA	Bench NA	NA	NA	2.17E-01	2.17E-01	7.20E-01		0.3	2.40E+00	0.3		0.4	0.3	1.00	1.00E-01	0.0056	0.00		0.083	0.000
bis(2-Ethylhexyl)phthalate	Bench NA	Bench NA	NA	NA	1.10E+00	1.10E+00	3.60E+00	1.20E+01	0.3		0.3		0.4	0.3	0.98	3.00E+00	0.0056	0.02		0.083	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.57E-03	1.57E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.80E-01	0.0056	1.00		0.083	0.000
Chrysene	Bench NA	Bench NA	NA	NA	7.66E-02	7.66E-02	1.79E-01	6.00E-03	0.3	1.30E-01	0.3	3.44E-01	0.4	0.3	0.70	4.10E+00	0.0056	0.30	6.20E-04	0.083	0.001
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	3.92E-03	3.92E-03	8.40E-03		0.3		0.3	2.10E-02	0.4	0.3	0.64	2.50E-01	0.0056	0.36		0.083	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	1.25E-01	1.25E-01	3.02E-01	4.80E-03	0.3	3.20E-01	0.3	5.12E-01	0.4	0.3	0.73	6.10E+00	0.0056	0.27		0.083	0.000
Fluorene	Bench NA	Bench NA	NA	NA	6.07E-03	6.07E-03	1.35E-02	4.70E-03	0.3		0.3	3.02E-02	0.4	0.3	0.67	3.60E-01	0.0056	0.33		0.083	0.000
Indeno[1,2,3-cd]pyrene	Bench NA	Bench NA	NA	NA	1.16E-02	1.16E-02	2.52E-02	3.20E-03	0.3		0.3	6.05E-02	0.4	0.3	0.65	7.20E-01	0.0056	0.35		0.083	0.000
Naphthalene	0.0005	0.00009	27	135	1.22E-02	1.22E-02	2.65E-02	3.30E-03	0.3		0.3	6.38E-02	0.4	0.3	0.65	7.60E-01	0.0056	0.35		0.083	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	4.32E-02	4.32E-02	9.35E-02	9.20E-03	0.3		0.3	2.27E-01	0.4	0.3	0.65	2.70E+00	0.0056	0.35		0.083	0.000
Pyrene	Bench NA	Bench NA	NA	NA	1.51E-01	1.51E-01	3.67E-01	1.70E-02	0.3	3.90E-01	0.3	6.13E-01	0.4	0.3	0.73	7.30E+00	0.0056	0.27	1.10E-03	0.083	0.001
VOCs																					
Acetone	Bench NA	Bench NA	NA	NA	2.46E-03	2.46E-03	0.00E+00		0.3		0.3		0.4	0.3	0.00	4.40E-01	0.0056	1.00		0.083	0.000
Carbon Disulfide	Bench NA	Bench NA	NA	NA	4.59E-05	4.59E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	8.20E-03	0.0056	1.00		0.083	0.000
Methyl tert-butyl ether (MTBE)	Bench NA	Bench NA	NA	NA	1.51E-05	1.51E-05	0.00E+00		0.3		0.3		0.4	0.3	0.00	2.70E-03	0.0056	1.00		0.083	0.000

Notes:
(1) Neponset River surface water data used to represent concentrations in Lewis Pond (See discussion in text Section 3.1.2)
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

TABLE D-23
FOOD CHAIN MODEL FOR ACUTE EXPOSURES SHORT-TAILED SHREW ANALYSIS
East of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	35.2	341	5.02E+02	5.02E+02	5.20E+02	5.20E+02	1	0.6	0.62	1.22E+04	1	1	0.016	0.38		0.22	0.000
Antimony	Bench NA	Bench NA	NA	NA	1.21E-01	1.21E-01	8.65E-02	8.65E-02	1	0.6	0.43	4.40E+00	1	1	0.016	0.57		0.22	0.000
Arsenic	0.8	0.4	13.1	27.4	1.01E+01	1.01E+01	1.40E+01	1.40E+01	1	0.6	0.84	1.06E+02	1	1	0.016	0.16		0.22	0.000
Barium	0.09	0.03	145	435	1.29E+01	1.29E+01	1.70E+01	1.70E+01	1	0.6	0.79	1.70E+02	1	1	0.016	0.21	2.19E-01	0.22	0.004
Cadmium	0.1	0.05	13.4	40.4	1.91E+00	1.91E+00	3.10E+00	3.10E+00	1	0.6	0.97	3.50E+00	1	1	0.016	0.03		0.22	0.000
Chromium	0.02	0.01	68	143	1.48E+00	1.48E+00	1.30E+00	1.30E+00	1	0.6	0.53	4.50E+01	1	1	0.016	0.47		0.22	0.000
Cobalt	0.01	Bench NA	54.5	NA	5.42E-01	5.42E-01	6.40E-01	6.40E-01	1	0.6	0.71	1.01E+01	1	1	0.016	0.29		0.22	0.000
Copper	0.5	0.05	22	220	1.09E+01	1.09E+01	1.65E+01	1.65E+01	1	0.6	0.90	6.70E+01	1	1	0.016	0.10		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	1.03E+03	1.03E+03	1.10E+03	1.10E+03	1	0.6	0.64	2.33E+04	1	1	0.016	0.35	1.38E+01	0.22	0.003
Lead	0.4	0.04	86	857	3.60E+01	3.60E+01	4.90E+01	4.90E+01	1	0.6	0.82	4.20E+02	1	1	0.016	0.18		0.22	0.000
Manganese	Bench NA	Bench NA	NA	NA	4.15E+01	4.15E+01	5.90E+01	5.90E+01	1	0.6	0.85	3.79E+02	1	1	0.016	0.14	9.50E-01	0.22	0.005
Mercury	0.01	0.005	11.6	24.2	1.24E-01	1.24E-01	1.80E-01	1.80E-01	1	0.6	0.87	1.00E+00	1	1	0.016	0.13		0.22	0.000
Nickel	0.02	Bench NA	57	NA	1.02E+00	1.02E+00	1.20E+00	1.20E+00	1	0.6	0.71	1.91E+01	1	1	0.016	0.29		0.22	0.000
Selenium	0.1	0.1	11.2	12.5	1.53E+00	1.53E+00	2.50E+00	2.50E+00	1	0.6	0.98	1.70E+00	1	1	0.016	0.02		0.22	0.000
Thallium	1	0.1	0.018	0.18	2.11E-02	2.11E-02	2.90E-02	2.90E-02	1	0.6	0.82	2.40E-01	1	1	0.016	0.18		0.22	0.000
Vanadium	0.05	0.02	35	90	1.89E+00	1.89E+00	2.00E+00	2.00E+00	1	0.6	0.63	4.43E+01	1	1	0.016	0.37		0.22	0.000
Zinc	Bench NA	Bench NA	NA	NA	1.26E+02	1.26E+02	2.00E+02	2.00E+02	1	0.6	0.95	3.90E+02	1	1	0.016	0.05		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	3.59E-02	3.59E-02	0.00E+00	ND	1	0.6	0.00	2.30E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthene	Bench NA	Bench NA	NA	NA	6.24E-02	6.24E-02	0.00E+00	ND	1	0.6	0.00	4.00E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	1.87E-01	1.87E-01	0.00E+00	ND	1	0.6	0.00	1.20E+01	1	1	0.016	1.00		0.22	0.000
Anthracene	Bench NA	Bench NA	NA	NA	2.18E-01	2.18E-01	0.00E+00	ND	1	0.6	0.00	1.40E+01	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	4.81E-01	4.81E-01	2.30E-01	2.30E-01	1	0.6	0.29	2.20E+01	1	1	0.016	0.71		0.22	0.000
Benzo[a]pyrene	0.03	0.008	12	48	4.01E-01	4.01E-01	2.00E-01	2.00E-01	1	0.6	0.30	1.80E+01	1	1	0.016	0.70		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	7.38E-01	7.38E-01	4.50E-01	4.50E-01	1	0.6	0.37	3.00E+01	1	1	0.016	0.63	5.70E-04	0.22	0.000
Benzo[g,h,I] pyrene	Bench NA	Bench NA	NA	NA	1.72E-01	1.72E-01	0.00E+00	ND	1	0.6	0.00	1.10E+01	1	1	0.016	1.00	3.10E-04	0.22	0.000
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	3.56E-01	3.56E-01	2.30E-01	2.30E-01	1	0.6	0.39	1.40E+01	1	1	0.016	0.61	3.00E-04	0.22	0.000
Chrysene	Bench NA	Bench NA	NA	NA	5.07E-01	5.07E-01	2.20E-01	2.20E-01	1	0.6	0.26	2.40E+01	1	1	0.016	0.74	6.20E-04	0.22	0.000
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	5.30E-02	5.30E-02	0.00E+00	ND	1	0.6	0.00	3.40E+00	1	1	0.016	1.00		0.22	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	1.11E+00	1.11E+00	3.90E-01	3.90E-01	1	0.6	0.21	5.60E+01	1	1	0.016	0.79		0.22	0.000
Fluorene	Bench NA	Bench NA	NA	NA	6.71E-02	6.71E-02	0.00E+00	ND	1	0.6	0.00	4.30E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	3.17E-01	3.17E-01	1.90E-01	1.90E-01	1	0.6	0.36	1.30E+01	1	1	0.016	0.64		0.22	0.000
Naphthalene	0.0003	0.00006	120	598	3.43E-02	3.43E-02	0.00E+00	ND	1	0.6	0.00	2.20E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	3.43E-01	3.43E-01	0.00E+00	ND	1	0.6	0.00	2.20E+01	1	1	0.016	1.00		0.22	0.000
Pyrene	Bench NA	Bench NA	NA	NA	1.00E+00	1.00E+00	5.00E-01	5.00E-01	1	0.6	0.30	4.50E+01	1	1	0.016	0.70	1.10E-03	0.22	0.000
4-Methylphenol	0.0003	0.0001	385	989	1.10E-01	1.10E-01	1.70E-01	1.70E-01	1	0.6	0.93	5.00E-01	1	1	0.016	0.07		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.68E+00	2.68E+00	4.40E+00	4.40E+00	1	0.6	0.98	2.70E+00	1	1	0.016	0.02		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	1.23E-03	1.23E-03	0.00E+00	ND	1	0.6	0.00	7.90E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	3.12E-02	3.12E-02	0.00E+00	ND	1	0.6	0.00	2.00E+00	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	4.37E-02	4.37E-02	0.00E+00	ND	1	0.6	0.00	2.80E+00	1	1	0.016	1.00		0.22	0.000
Carbon disulfide	Bench NA	Bench NA	NA	NA	2.03E-05	2.03E-05	0.00E+00	NA	1	0.6	0.00	1.30E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	4.21E-05	4.21E-05	0.00E+00	NA	1	0.6	0.00	2.70E-03	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
ND= Not Detected
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-24
FOOD CHAIN MODEL FOR ACUTE EXPOSURES SHORT-TAILED SHREW ANALYSIS
West of South Street
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	35.2	341	6.59E+02	6.59E+02	8.50E+02	8.50E+02	1	0.6	0.77	9.58E+03	1	1	0.016	0.23		0.22	0.000
Antimony	Bench NA	Bench NA	NA	NA	1.12E-02	1.12E-02	0.00E+00	ND	1	0.6	0.00	7.20E-01	1	1	0.016	1.00		0.22	0.000
Arsenic	0.08	0.04	13.1	27.4	1.09E+00	1.09E+00	8.90E-01	8.90E-01	1	0.6	0.49	3.57E+01	1	1	0.016	0.51		0.22	0.000
Barium	0.1	0.04	145	435	1.84E+01	1.84E+01	2.80E+01	2.80E+01	1	0.6	0.91	9.87E+01	1	1	0.016	0.08	2.19E-01	0.22	0.003
Cadmium	0.06	0.02	13.4	40.4	8.45E-01	8.45E-01	1.40E+00	1.40E+00	1	0.6	0.99	3.00E-01	1	1	0.016	0.01		0.22	0.000
Chromium	0.02	0.009	68	143	1.33E+00	1.33E+00	1.80E+00	1.80E+00	1	0.6	0.81	1.63E+01	1	1	0.016	0.19		0.22	0.000
Cobalt	0.008	Bench NA	54.5	NA	4.31E-01	4.31E-01	5.60E-01	5.60E-01	1	0.6	0.78	6.10E+00	1	1	0.016	0.22		0.22	0.000
Copper	0.2	0.02	22	220	3.31E+00	3.31E+00	4.60E+00	4.60E+00	1	0.6	0.83	3.50E+01	1	1	0.016	0.17		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	8.27E+02	8.27E+02	7.60E+02	7.60E+02	1	0.6	0.55	2.36E+04	1	1	0.016	0.45	1.38E+01	0.22	0.004
Lead	0.2	0.02	86	857	1.30E+01	1.30E+01	1.60E+01	1.60E+01	1	0.6	0.74	2.20E+02	1	1	0.016	0.26		0.22	0.000
Manganese	Bench NA	Bench NA	NA	NA	2.58E+01	2.58E+01	3.40E+01	3.40E+01	1	0.6	0.79	3.30E+02	1	1	0.016	0.20	9.50E-01	0.22	0.008
Mercury	0.005	0.003	11.6	24.2	6.11E-02	6.11E-02	8.80E-02	8.80E-02	1	0.6	0.86	5.30E-01	1	1	0.016	0.14		0.22	0.000
Nickel	0.03	Bench NA	57	NA	1.73E+00	1.73E+00	2.30E+00	2.30E+00	1	0.6	0.80	2.22E+01	1	1	0.016	0.20		0.22	0.000
Selenium	0.09	0.08	11.2	12.5	1.03E+00	1.03E+00	1.70E+00	1.70E+00	1	0.6	0.99	4.70E-01	1	1	0.016	0.01		0.22	0.000
Thallium	0.5	0.05	0.018	0.18	9.33E-03	9.33E-03	1.30E-02	1.30E-02	1	0.6	0.84	9.80E-02	1	1	0.016	0.16		0.22	0.000
Vanadium	0.07	0.03	35	90	2.39E+00	2.39E+00	3.00E+00	3.00E+00	1	0.6	0.75	3.78E+01	1	1	0.016	0.25		0.22	0.000
Zinc	Bench NA	Bench NA	NA	NA	6.22E+01	6.22E+01	1.00E+02	1.00E+02	1	0.6	0.96	1.40E+02	1	1	0.016	0.04		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	2.96E-02	2.96E-02	0.00E+00	ND	1	0.6	0.00	1.90E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthene	Bench NA	Bench NA	NA	NA	1.17E-02	1.17E-02	0.00E+00	ND	1	0.6	0.00	7.50E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	3.74E-02	3.74E-02	0.00E+00	ND	1	0.6	0.00	2.40E+00	1	1	0.016	1.00		0.22	0.000
Anthracene	Bench NA	Bench NA	NA	NA	3.59E-02	3.59E-02	0.00E+00	ND	1	0.6	0.00	2.30E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	2.80E-01	2.80E-01	3.00E-01	3.00E-01	1	0.6	0.64	6.40E+00	1	1	0.016	0.36		0.22	0.000
Benzo[a]pyrene	0.03	0.008	12	48	3.62E-01	3.62E-01	3.90E-01	3.90E-01	1	0.6	0.65	8.20E+00	1	1	0.016	0.35		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	3.69E-01	3.69E-01	4.40E-01	4.40E-01	1	0.6	0.72	6.70E+00	1	1	0.016	0.28	5.70E-04	0.22	0.000
Benzo[g,h,I] pyrene	Bench NA	Bench NA	NA	NA	2.12E-01	2.12E-01	2.70E-01	2.70E-01	1	0.6	0.76	3.20E+00	1	1	0.016	0.24	3.10E-04	0.22	0.000
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	1.77E-01	1.77E-01	1.60E-01	1.60E-01	1	0.6	0.54	5.20E+00	1	1	0.016	0.46	3.00E-04	0.22	0.000
Chrysene	Bench NA	Bench NA	NA	NA	3.02E-01	3.02E-01	3.00E-01	3.00E-01	1	0.6	0.60	7.80E+00	1	1	0.016	0.40	6.20E-04	0.22	0.000
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	1.37E-02	1.37E-02	0.00E+00	ND	1	0.6	0.00	8.80E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	5.15E-01	5.15E-01	5.20E-01	5.20E-01	1	0.6	0.61	1.30E+01	1	1	0.016	0.39		0.22	0.000
Fluorene	Bench NA	Bench NA	NA	NA	2.96E-02	2.96E-02	0.00E+00	ND	1	0.6	0.00	1.90E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	2.28E-01	2.28E-01	2.70E-01	2.70E-01	1	0.6	0.71	4.20E+00	1	1	0.016	0.29		0.22	0.000
Naphthalene	0.0003	0.00007	120	598	3.90E-02	3.90E-02	0.00E+00	ND	1	0.6	0.00	2.50E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	5.48E-01	5.48E-01	4.20E-01	4.20E-01	1	0.6	0.46	1.90E+01	1	1	0.016	0.54		0.22	0.000
Pyrene	Bench NA	Bench NA	NA	NA	9.41E-01	9.41E-01	1.10E+00	1.10E+00	1	0.6	0.70	1.80E+01	1	1	0.016	0.30	1.10E-03	0.22	0.000
4-Methylphenol	0.0007	0.0003	385	989	2.70E-01	2.70E-01	4.50E-01	4.50E-01	1	0.6	1.00	ND	1	1	0.016	0.00		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	1.45E+00	1.45E+00	2.30E+00	2.30E+00	1	0.6	0.95	4.60E+00	1	1	0.016	0.05		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	1.68E-03	1.68E-03	0.00E+00	ND	1	0.6	0.00	1.08E-01	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.19E-02	1.19E-02	0.00E+00	ND	1	0.6	0.00	7.60E-01	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	3.28E-03	3.28E-03	0.00E+00	ND	1	0.6	0.00	2.10E-01	1	1	0.016	1.00		0.22	0.000
o-Xylene	Bench NA	Bench NA	NA	NA	1.56E-05	1.56E-05	0.00E+00	NA	1	0.6	0.00	1.00E-03	1	1	0.016	1.00		0.22	0.000
Trichlorofluoromethane	Bench NA	Bench NA	NA	NA	3.12E-03	3.12E-03	0.00E+00	NA	1	0.6	0.00	2.00E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
ND= Not Detected
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-25
FOOD CHAIN MODEL FOR ACUTE EXPOSURES SHORT-TAILED SHREW ANALYSIS
Orlando Property
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**9**	0.9	35.2	341	3.10E+02	3.10E+02	2.30E+02	2.30E+02	1	0.6	0.45	1.10E+04	1	1	0.016	0.55		0.22	0.000
Arsenic	0.03	0.01	13.1	27.4	4.05E-01	4.05E-01	5.60E-01	5.60E-01	1	0.6	0.83	4.40E+00	1	1	0.016	0.17		0.22	0.000
Barium	0.06	0.02	145	435	8.88E+00	8.88E+00	1.30E+01	1.30E+01	1	0.6	0.88	6.60E+01	1	1	0.016	0.12	2.19E-01	0.22	0.005
Cadmium	0.2	0.06	13.4	40.4	2.59E+00	2.59E+00	4.30E+00	4.30E+00	1	0.6	1.00	4.50E-01	1	1	0.016	0.00		0.22	0.000
Chromium	0.009	0.004	68	143	6.10E-01	6.10E-01	5.70E-01	5.70E-01	1	0.6	0.56	1.72E+01	1	1	0.016	0.44		0.22	0.000
Cobalt	0.008	Bench NA	54.5	NA	4.62E-01	4.62E-01	5.20E-01	5.20E-01	1	0.6	0.68	9.60E+00	1	1	0.016	0.32		0.22	0.000
Copper	0.1	0.01	22	220	2.59E+00	2.59E+00	3.70E+00	3.70E+00	1	0.6	0.86	2.40E+01	1	1	0.016	0.14		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	6.05E+02	6.05E+02	2.80E+02	2.80E+02	1	0.6	0.28	2.78E+04	1	1	0.016	0.72	1.38E+01	0.22	0.005
Lead	0.5	0.05	86	857	4.30E+01	4.30E+01	6.90E+01	6.90E+01	1	0.6	0.96	1.00E+02	1	1	0.016	0.04		0.22	0.000
Manganese	Bench NA	Bench NA	NA	NA	3.74E+01	3.74E+01	4.60E+01	4.60E+01	1	0.6	0.74	6.15E+02	1	1	0.016	0.26	9.50E-01	0.22	0.006
Mercury	0.01	0.005	11.6	24.2	1.16E-01	1.16E-01	1.90E-01	1.90E-01	1	0.6	0.98	1.30E-01	1	1	0.016	0.02		0.22	0.000
Nickel	0.007	Bench NA	57	NA	4.15E-01	4.15E-01	4.50E-01	4.50E-01	1	0.6	0.65	9.30E+00	1	1	0.016	0.35		0.22	0.000
Selenium	0.4	0.4	11.2	12.5	4.45E+00	4.45E+00	7.40E+00	7.40E+00	1	0.6	1.00	5.50E-01	1	1	0.016	0.00		0.22	0.000
Thallium	0.5	0.05	0.018	0.18	8.72E-03	8.72E-03	9.60E-03	9.60E-03	1	0.6	0.66	1.90E-01	1	1	0.016	0.34		0.22	0.000
Vanadium	0.04	0.02	35	90	1.41E+00	1.41E+00	8.70E-01	8.70E-01	1	0.6	0.37	5.67E+01	1	1	0.016	0.63		0.22	0.000
Zinc	Bench NA	Bench NA	NA	NA	1.15E+02	1.15E+02	1.90E+02	1.90E+02	1	0.6	0.99	8.40E+01	1	1	0.016	0.01		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.22E-02	1.22E-02	0.00E+00	ND	1	0.6	0.00	7.80E-01	1	1	0.016	1.00		0.22	0.000
Acenaphthene	Bench NA	Bench NA	NA	NA	2.81E-02	2.81E-02	0.00E+00	ND	1	0.6	0.00	1.80E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	4.21E-03	4.21E-03	0.00E+00	ND	1	0.6	0.00	2.70E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	Bench NA	Bench NA	NA	NA	5.15E-02	5.15E-02	0.00E+00	ND	1	0.6	0.00	3.30E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	7.80E-02	7.80E-02	0.00E+00	ND	1	0.6	0.00	5.00E+00	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.005	0.001	12	48	5.93E-02	5.93E-02	0.00E+00	ND	1	0.6	0.00	3.80E+00	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	5.47E-02	5.47E-02	0.00E+00	ND	1	0.6	0.00	3.50E+00	1	1	0.016	1.00	5.70E-04	0.22	0.002
Benzo[g,h,I] pyrene	Bench NA	Bench NA	NA	NA	2.03E-02	2.03E-02	0.00E+00	ND	1	0.6	0.00	1.30E+00	1	1	0.016	1.00	3.10E-04	0.22	0.003
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	4.84E-02	4.84E-02	0.00E+00	ND	1	0.6	0.00	3.10E+00	1	1	0.016	1.00	3.00E-04	0.22	0.001
Chrysene	Bench NA	Bench NA	NA	NA	7.19E-02	7.19E-02	0.00E+00	ND	1	0.6	0.00	4.60E+00	1	1	0.016	1.00	6.20E-04	0.22	0.002
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	9.52E-03	9.52E-03	0.00E+00	ND	1	0.6	0.00	6.10E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	1.29E-01	1.29E-01	0.00E+00	ND	1	0.6	0.00	8.30E+00	1	1	0.016	1.00		0.22	0.000
Fluorene	Bench NA	Bench NA	NA	NA	2.81E-02	2.81E-02	0.00E+00	ND	1	0.6	0.00	1.80E+00	1	1	0.016	1.00		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	3.28E-02	3.28E-02	0.00E+00	ND	1	0.6	0.00	2.10E+00	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.0001	0.00003	120	598	1.56E-02	1.56E-02	0.00E+00	ND	1	0.6	0.00	1.00E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	1.44E-01	1.44E-01	0.00E+00	ND	1	0.6	0.00	9.20E+00	1	1	0.016	1.00		0.22	0.000
Pyrene	Bench NA	Bench NA	NA	NA	1.11E-01	1.11E-01	0.00E+00	ND	1	0.6	0.00	7.10E+00	1	1	0.016	1.00	1.10E-03	0.22	0.002
4-Methylphenol	0.001	0.0004	385	989	3.67E-01	3.67E-01	6.10E-01	6.10E-01	1	0.6	1.00	5.60E-02	1	1	0.016	0.00		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	4.93E+00	4.93E+00	8.20E+00	8.20E+00	1	0.6	1.00	6.20E-01	1	1	0.016	0.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.87E-02	1.87E-02	0.00E+00	ND	1	0.6	0.00	1.20E+00	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	1.37E-02	1.37E-02	0.00E+00	ND	1	0.6	0.00	8.80E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
ND= Not Detected
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

TABLE D-26
FOOD CHAIN MODEL FOR ACUTE EXPOSURES SHORT-TAILED SHREW ANALYSIS
Floodplain
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water [1] mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	**2**	35.2	341	5.22E+02	5.22E+02	6.00E+02	6.00E+02	1	0.6	0.69	1.04E+04	1	1	0.016	0.31		0.22	0.000
Antimony	Bench NA	Bench NA	NA	NA	1.36E-01	1.36E-01	5.20E-02	5.20E-02	1	0.6	0.23	6.70E+00	1	1	0.016	0.77		0.22	0.000
Arsenic	0.09	0.04	13.1	27.4	1.16E+00	1.16E+00	1.20E+00	1.20E+00	1	0.6	0.62	2.83E+01	1	1	0.016	0.38		0.22	0.000
Barium	0.1	0.05	145	435	1.99E+01	1.99E+01	2.90E+01	2.90E+01	1	0.6	0.88	1.56E+02	1	1	0.016	0.12	2.19E-01	0.22	0.002
Cadmium	0.2	0.06	13.4	40.4	2.44E+00	2.44E+00	4.00E+00	4.00E+00	1	0.6	0.98	2.80E+00	1	1	0.016	0.018		0.22	0.000
Chromium	0.05	0.02	68	143	3.31E+00	3.31E+00	3.00E+00	3.00E+00	1	0.6	0.54	9.68E+01	1	1	0.016	0.46		0.22	0.000
Copper	0.3	0.03	22	220	7.64E+00	7.64E+00	8.50E+00	8.50E+00	1	0.6	0.67	1.63E+02	1	1	0.016	0.33		0.22	0.000
Iron	Bench NA	Bench NA	NA	NA	1.32E+03	1.32E+03	9.80E+02	9.80E+02	1	0.6	0.45	4.68E+04	1	1	0.016	0.55	1.38E+01	0.22	0.002
Lead	0.5	0.05	86	857	4.56E+01	4.56E+01	5.70E+01	5.70E+01	1	0.6	0.75	7.30E+02	1	1	0.016	0.25		0.22	0.000
Manganese	Bench NA	Bench NA	NA	NA	7.89E+01	7.89E+01	1.10E+02	1.10E+02	1	0.6	0.84	8.11E+02	1	1	0.016	0.16	9.50E-01	0.22	0.003
Mercury	0.007	0.003	11.6	24.2	8.00E-02	8.00E-02	9.70E-02	9.70E-02	1	0.6	0.73	1.40E+00	1	1	0.016	0.27		0.22	0.000
Nickel	0.06	Bench NA	57	NA	3.35E+00	3.35E+00	1.30E+00	1.30E+00	1	0.6	0.23	1.65E+02	1	1	0.016	0.77		0.22	0.000
Selenium	0.08	0.07	11.2	12.5	8.65E-01	8.65E-01	1.40E+00	1.40E+00	1	0.6	0.97	1.60E+00	1	1	0.016	0.03		0.22	0.000
Thallium	1	0.1	0.018	0.18	1.79E-02	1.79E-02	2.60E-02	2.60E-02	1	0.6	0.87	1.50E-01	1	1	0.016	0.13		0.22	0.000
Vanadium	0.07	0.03	35	90	2.38E+00	2.38E+00	2.70E+00	2.70E+00	1	0.6	0.68	4.86E+01	1	1	0.016	0.32		0.22	0.000
Zinc	Bench NA	Bench NA	NA	NA	7.92E+01	7.92E+01	1.20E+02	1.20E+02	1	0.6	0.91	4.60E+02	1	1	0.016	0.09		0.22	0.000
1,2-Dichlorobenzene	Bench NA	Bench NA	NA	NA	6.24E-04	6.24E-04	0.00E+00	ND	1	0.6	0.00	4.00E-02	1	1	0.016	1.00		0.22	0.000
2-Methylnaphthalene	Bench NA	Bench NA	NA	NA	1.72E-02	1.72E-02	0.00E+00	ND	1	0.6	0.00	1.10E+00	1	1	0.016	1.00		0.22	0.000
Acenaphthylene	Bench NA	Bench NA	NA	NA	3.74E-03	3.74E-03	0.00E+00	ND	1	0.6	0.00	2.40E-01	1	1	0.016	1.00		0.22	0.000
Anthracene	Bench NA	Bench NA	NA	NA	2.34E-02	2.34E-02	0.00E+00	ND	1	0.6	0.00	1.50E+00	1	1	0.016	1.00		0.22	0.000
Benz[a]anthracene	Bench NA	Bench NA	NA	NA	5.62E-02	5.62E-02	0.00E+00	ND	1	0.6	0.00	3.60E+00	1	1	0.016	1.00		0.22	0.000
Benzo[a]pyrene	0.004	0.0009	12	48	4.21E-02	4.21E-02	0.00E+00	ND	1	0.6	0.00	2.70E+00	1	1	0.016	1.00		0.22	0.000
Benzo[b]fluoranthene	Bench NA	Bench NA	NA	NA	5.00E-02	5.00E-02	0.00E+00	ND	1	0.6	0.00	3.20E+00	1	1	0.016	1.00	5.70E-04	0.22	0.003
Benzo[g,h,I] pyrene	Bench NA	Bench NA	NA	NA	1.04E-02	1.04E-02	0.00E+00	ND	1	0.6	0.00	6.60E-01	1	1	0.016	0.99	3.10E-04	0.22	0.007
Benzo[k]fluoranthene	Bench NA	Bench NA	NA	NA	2.81E-02	2.81E-02	0.00E+00	ND	1	0.6	0.00	1.80E+00	1	1	0.016	1.00	3.00E-04	0.22	0.002
Chrysene	Bench NA	Bench NA	NA	NA	5.32E-02	5.32E-02	0.00E+00	ND	1	0.6	0.00	3.40E+00	1	1	0.016	1.00	6.20E-04	0.22	0.003
Dibenz[a,h]anthracene	Bench NA	Bench NA	NA	NA	2.50E-03	2.50E-03	0.00E+00	ND	1	0.6	0.00	1.60E-01	1	1	0.016	1.00		0.22	0.000
Fluoranthene	Bench NA	Bench NA	NA	NA	3.54E-01	3.54E-01	3.30E-01	3.30E-01	1	0.6	0.56	1.00E+01	1	1	0.016	0.44		0.22	0.000
Indeno[1,2,3-c,d]pyrene	Bench NA	Bench NA	NA	NA	1.12E-02	1.12E-02	0.00E+00	ND	1	0.6	0.00	7.20E-01	1	1	0.016	1.00		0.22	0.000
Naphthalene	0.0001	0.00003	120	598	1.72E-02	1.72E-02	0.00E+00	ND	1	0.6	0.00	1.10E+00	1	1	0.016	1.00		0.22	0.000
Phenanthrene	Bench NA	Bench NA	NA	NA	1.72E-01	1.72E-01	0.00E+00	ND	1	0.6	0.00	1.10E+01	1	1	0.016	1.00		0.22	0.000
Pyrene	Bench NA	Bench NA	NA	NA	2.88E-01	2.88E-01	2.40E-01	2.40E-01	1	0.6	0.50	9.20E+00	1	1	0.016	0.50	1.10E-03	0.22	0.001
4-Methylphenol	0.0003	0.0001	385	989	9.75E-02	9.75E-02	1.60E-01	1.60E-01	1	0.6	0.99	9.30E-02	1	1	0.016	0.01		0.22	0.000
Benzoic acid	Bench NA	Bench NA	NA	NA	2.51E+00	2.51E+00	4.10E+00	4.10E+00	1	0.6	0.98	3.30E+00	1	1	0.016	0.02		0.22	0.000
Butylbenzyl phthalate	Bench NA	Bench NA	NA	NA	1.31E-03	1.31E-03	0.00E+00	ND	1	0.6	0.00	8.40E-02	1	1	0.016	1.00		0.22	0.000
Carbazole	Bench NA	Bench NA	NA	NA	1.87E-02	1.87E-02	0.00E+00	ND	1	0.6	0.00	1.20E+00	1	1	0.016	1.00		0.22	0.000
Dibenzofuran	Bench NA	Bench NA	NA	NA	1.06E-02	1.06E-02	0.00E+00	ND	1	0.6	0.00	6.80E-01	1	1	0.016	1.00		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
ND= Not Detected
[1] Neponset River surface water is used since it is the closest site water body to the soil exposure point

Table D-27
Food Chain Model for Chronic Exposures
Muskrat Analysis
Neponset River Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food							Sediment			Water		
Compound	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet[1]	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	0.745	7.45	7.50E+00	7.50E+00	9.80E+00	1.50E+02	0.05	2.42E+00	0.95	0.34	4.44E-01	3.03E+03	0.0014	5.50E-01	4.52E-02	0.98	5.91E-03

Reasonable Maximum							Food							Sediment			Water		
Compound	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet[1]	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	0.745	7.45	7.50E+00	7.50E+00	9.80E+00	1.50E+02	0.05	2.42E+00	0.95	0.34	4.44E-01	3.03E+03	0.0014	5.50E-01	4.52E-02	0.98	5.91E-03

Notes:
[1]Only one sample was analyzed for reference invertebrate concentrations. Therefore, the same exposure point concentration is used for the central tendancy exposure and reasonable maximum exposure food chain models.
Chemicals that exceeded their TRVs in the Neponset River and Upper Former Mill Tailrace are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-28
Food Chain Model for Chronic Exposures
Muskrat Analysis
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food							Sediment			Water		
Compound	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet[1]	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**30**	**3**	0.745	7.45	2.49E+01	2.49E+01	1.58E+01	9.85E+01	0.05	1.14E+01	0.95	0.34	2.16E-01	1.43E+04	0.0014	7.82E-01	4.52E-02	0.98	1.78E-03
Nickel	0.4	0.07	2.03	12.1	8.60E-01	8.60E-01	2.43E+00	9.20E-01	0.05	2.51E+00	0.95	0.34	9.61E-01	2.41E+01	0.0014	3.82E-02	8.89E-04	0.98	1.01E-03

Reasonable Maximum							Food							Sediment			Water		
Compound	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet[1]	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**30**	**3**	0.745	7.45	2.49E+01	2.49E+01	1.58E+01	9.85E+01	0.05	1.14E+01	0.95	0.34	2.16E-01	1.43E+04	0.0014	7.82E-01	4.52E-02	0.98	1.78E-03
Nickel	0.4	0.07	2.03	12.1	8.60E-01	8.60E-01	2.43E+00	9.20E-01	0.05	2.51E+00	0.95	0.34	9.61E-01	2.41E+01	0.0014	3.82E-02	8.89E-04	0.98	1.01E-03

Notes:
[1]Only one sample was analyzed for reference invertebrate concentrations. Therefore, the same exposure point concentration is used for the central tendency exposure and reasonable maximum exposure food chain models.
Chemicals that exceeded their TRVs in Lewis Pond are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-29
Food Chain Model For Chronic Exposures
Raccoon Analysis
Neponset River Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet[1]	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**60**	**6**	0.519	5.19	3.19E+01	3.19E+01	4.97E+01	1.24E+01	0.3	1.50E+02	0.3	2.42E+00	0.4	0.3	0.47	3.03E+03	0.0056	0.53	4.52E-02	0.083	0.0001
Vanadium	**2**	0.2	0.097	0.97	1.79E-01	1.79E-01	3.23E-01	1.96E-01	0.3	8.60E-01	0.3	1.61E-02	0.4	0.3	0.54	1.46E+01	0.0056	0.46		0.083	0.000

Reasonable Maximum							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet[1]	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**60**	**6**	0.519	5.19	3.19E+01	3.19E+01	4.97E+01	1.24E+01	0.3	1.50E+02	0.3	2.42E+00	0.4	0.3	0.47	3.03E+03	0.0056	0.53	4.52E-02	0.083	0.0001
Vanadium	**2**	0.2	0.097	0.97	1.79E-01	1.79E-01	3.23E-01	1.96E-01	0.3	8.60E-01	0.3	1.61E-02	0.4	0.3	0.54	1.46E+01	0.0056	0.46		0.083	0.000

Notes:
[1]Only one sample was analyzed for reference invertebrate concentrations. Therefore, the same exposure point concentration is used for the central tendency exposure and reasonable maximum exposure food chain models.
Chemicals that exceeded their TRVs in the Neponset River are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-30
Food Chain Model For Chronic Exposures
Raccoon Analysis
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet[1]	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	0.519	5.19	9.15E+01	9.15E+01	3.78E+01	1.24E+01	0.3	9.85E+01	0.3	1.14E+01	0.4	0.3	0.12	1.43E+04	0.0056	0.88	4.52E-02	0.083	0.00004
Lead	1	0.1	3.98	39.75	5.06E+00	5.06E+00	3.97E+00	1.96E-01	0.3	1.12E+01	0.3	1.38E+00	0.4	0.3	0.24	6.90E+02	0.0056	0.76		0.083	0.000
Nickel	0.3	0.05	2.03	12.1	5.52E-01	5.52E-01	1.39E+00	3.63E-01	0.3	9.20E-01	0.3	2.51E+00	0.4	0.3	0.76	2.41E+01	0.0056	0.24	8.89E-04	0.083	0.0001
Vanadium	**5**	0.5	0.097	0.97	5.17E-01	5.17E-01	4.49E-01	1.96E-01	0.3	1.20E+00	0.3	7.51E-02	0.4	0.3	0.26	6.83E+01	0.0056	0.74		0.083	0.000

Reasonable Maximum							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet[1]	Proportion Invert In Diet	Plant Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	0.519	5.19	9.15E+01	9.15E+01	3.78E+01	1.24E+01	0.3	9.85E+01	0.3	1.14E+01	0.4	0.3	0.12	1.43E+04	0.0056	0.88	4.52E-02	0.083	0.00004
Lead	1	0.1	3.98	39.75	5.06E+00	5.06E+00	3.97E+00	1.96E-01	0.3	1.12E+01	0.3	1.38E+00	0.4	0.3	0.24	6.90E+02	0.0056	0.76		0.083	0.000
Nickel	0.3	0.05	2.03	12.1	5.52E-01	5.52E-01	1.39E+00	3.63E-01	0.3	9.20E-01	0.3	2.51E+00	0.4	0.3	0.76	2.41E+01	0.0056	0.24	8.89E-04	0.083	0.0001
Vanadium	**5**	0.5	0.097	0.97	5.17E-01	5.17E-01	4.49E-01	1.96E-01	0.3	1.20E+00	0.3	7.51E-02	0.4	0.3	0.26	6.83E+01	0.0056	0.74		0.083	0.000

Notes:
[1]Only one sample was analyzed for reference invertebrate concentrations. Therefore, the same exposure point concentration is used for the central tendency exposure and reasonable maximum exposure food chain models.
Chemicals that exceeded their TRVs in Lewis Pond are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-31
Food Chain Model For Chronic Exposures
Kingfisher Analysis
Ingestion of Fish in Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, MA

Central Tendency							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
SVOCs														
bis(2-Ethylhexyl)phthalate	NC	Bench NA	1.1	NA	NC	NC	NC	ND	1	0.5	NC		0.11	0.00

Reasonable Maximum							Food					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue Concentration mg/kg wet	Proportion Fish In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
SVOCs														
bis(2-Ethylhexyl)phthalate	NC	Bench NA	1.1	NA	NC	NC	NC	ND	1	0.5	NC		0.11	0.00

Notes:
NA = not available
NC = not calculated (bis[2-ethylhexyl]phthalate was not detected in fish from the Lewis Pond reference area)
ND = not detected
Bench NA = Benchmark not available
Chemicals that exceeded their TRVs in Lewis Pond are shown on this table.
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

TABLE D-32
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
ROBIN ANALYSIS
Soil Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil				Water		
Contaminant	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**4**	Bench NA	109.7	NA	479	479.3	327	326.67	1	0.9	0.61	1.03E+04	1	0.018	0.39	4.52E-02	0.14	0.00001
Arsenic	0.6	0.2	5.14	12.84	3.1	3.1	2.9	2.94	1	0.9	0.87	2.26E+01	1	0.018	0.13		0.14	0.000
Cadmium	0.7	0.05	1.45	20.03	1.0	1.0	1.1	1.05	1	0.9	0.99	3.09E-01	1	0.018	0.006		0.14	0.000
Chromium	0.7	0.1	1	5	0.7	0.7	0.5	0.52	1	0.9	0.65	1.42E+01	1	0.018	0.352		0.14	0.000
Lead	**30**	**3**	1.13	11.3	31	31	34	33.67	1	0.9	0.99	8.19E+01	1	0.018	0.008		0.14	0.000
Selenium	**2**	1	0.4	0.8	0.9	0.9	1.0	0.97	1	0.9	0.95	2.48E+00	1	0.018	0.049		0.14	0.000
Zinc	**2**	0.2	14.5	131	30	30	32	32.00	1	0.9	0.97	4.62E+01	1	0.018	0.028		0.14	0.000

Reasonable Maximum							Food					Soil				Water		
Contaminant	NOAEL Hazard Index	LOAEL Hazard Index	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg dry	Ave. Percent Solids in Soil	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**6**	Bench NA	109.7	NA	617	617.3	480	480	1	0.9	0.70	1.03E+04	1	0.018	0.30	4.52E-02	0.14	0.00001
Arsenic	1	0.4	5.14	12.84	5.0	5.0	5.1	5.1	1	0.9	0.92	2.26E+01	1	0.018	0.08		0.14	0.000
Cadmium	0.7	0.05	1.45	20.03	1.0	1.0	1.1	1.1	1	0.9	0.99	3.09E-01	1	0.018	0.006		0.14	0.000
Chromium	0.9	0.2	1	5	0.9	0.9	0.7	0.7	1	0.9	0.70	1.42E+01	1	0.018	0.298		0.14	0.000
Lead	**50**	**5**	1.13	11.3	56	56	62	62	1	0.9	1.00	8.19E+01	1	0.018	0.005		0.14	0.000
Selenium	**4**	**2**	0.4	0.8	1.6	1.6	1.8	1.8	1	0.9	0.97	2.48E+00	1	0.018	0.028		0.14	0.000
Zinc	**3**	0.3	14.5	131	37	37	40	40	1	0.9	0.98	4.62E+01	1	0.018	0.023		0.14	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Chemicals that exceeded their TRVs in the terrestrial exposure areas are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

TABLE D-33
FOOD CHAIN MODEL FOR CHRONIC EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Soil Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

Central Tendency							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	2.3	23	357	357	326.7	326.67	1	0.6	0.55	1.03E+04	1	1	0.016	0.45	4.52E-02	0.22	0.00003
Arsenic	0.4	Bench NA	5.50	NA	2	2	2.9	2.94	1	0.6	0.83	2.26E+01	1	1	0.016	0.17		0.22	0.000
Lead	1	0.1	17.6	176	21	21	34	34	1	0.6	0.94	8.19E+01	1	1	0.016	0.06		0.22	0.000
Selenium	1	0.9	0.4	0.73	0.6	0.6	1.0	0.97	1	0.6	0.94	2.48E+00	1	1	0.016	0.06		0.22	0.000
Vanadium	**3**	0.3	0.43	4.3	1.4	1.4	1.4	1.38	1	0.6	0.59	3.72E+01	1	1	0.016	0.41		0.22	0.000

Reasonable Maximum							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**200**	**20**	2.3	23	449	449	480.0	480	1	0.6	0.64	1.03E+04	1	1	0.016	0.36	4.52E-02	0.22	0.00002
Arsenic	0.6	Bench NA	5.50	NA	3	3	5.1	5.1	1	0.6	0.90	2.26E+01	1	1	0.016	0.10		0.22	0.000
Lead	**2**	0.2	17.6	176	38	38	62	62	1	0.6	0.97	8.19E+01	1	1	0.016	0.03		0.22	0.000
Selenium	**2**	**2**	0.4	0.73	1.1	1.1	1.8	1.75	1	0.6	0.96	2.48E+00	1	1	0.016	0.04		0.22	0.000
Vanadium	**4**	0.4	0.43	4.3	1.8	1.8	2.0	2.0	1	0.6	0.67	3.72E+01	1	1	0.016	0.33		0.22	0.000

Notes:
NA=Not available/applicable
Bench NA = Benchmark not available
Chemicals that exceeded their TRVs in the terrestrial exposure areas are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.
Since 95% UCLs could not be calculated for earthworm concentrations, average concentrations are used in the central tendency exposure and maximum concentrations are used in the reasonable maximum exposure.

Table D-34
Food Chain Model for Acute Exposures
Muskrat Analysis
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**3**	0.4	11.4	111	3.90E+01	3.90E+01	2.24E+01	9.85E+01	0.05	1.84E+01	0.95	0.34	1.96E-01	2.30E+04	0.0014	8.03E-01	6.03E-02	0.98	1.52E-03

Notes:
Chemicals that exceeded their TRVs in Lewis Pond are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-35
Food Chain Model for Acute Exposures
Muskrat Analysis
Neponset River Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food							Sediment			Water		
Compound	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Time and Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Invertebrate Concentration mg/kg wet	Proportion Invertebrate In Diet	Plant Concentration mg/kg wet	Proportion Plant In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	0.7	0.07	11.4	111	8.11E+00	8.11E+00	1.01E+01	1.50E+02	0.05	2.72E+00	0.95	0.34	4.23E-01	3.40E+03	0.0014	5.70E-01	6.03E-02	0.98	7.29E-03

Note:
Chemicals that exceeded their TRVs in the Neponset River and Upper Former Mill Tailrace are shown on this table.
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-36
Food Chain Model For Acute Exposures
Raccoon Analysis
Neponset River Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plants Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**4**	0.4	8.0	77	3.42E+01	3.42E+01	5.06E+01	1.52E+01	0.3	1.50E+02	0.3	2.72E+00	0.4	0.3	0.44	3.40E+03	0.0056	0.56	6.03E-02	0.083	0.0001

Notes:
Chemicals that exceeded their TRVs in the Neponset River are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

Table D-37
Food Chain Model For Acute Exposures
Raccoon Analysis
Lower Pond Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food									Sediment			Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/d	LOAEL Benchmark Dose mg/kg/d	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Fish Tissue mg/kg wet	Proportion Fish In Diet	Invertebrate Concentration mg/kg wet	Proportion Invert In Diet	Plants Concentration mg/kg wet	Proportion Plants In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Sediment mg/kg dry	Dry Sediment Ing. Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**20**	**2**	8.0	77	1.41E+02	1.41E+02	4.15E+01	1.52E+01	0.3	9.85E+01	0.3	1.84E+01	0.4	0.3	0.09	2.30E+04	0.0056	0.91	6.03E-02	0.083	0.00004
Lead	0.3	0.03	19	194	5.94E+00	5.94E+00	4.13E+00	3.40E-01	0.3	1.12E+01	0.3	1.68E+00	0.4	0.3	0.21	8.40E+02	0.0056	0.79		0.083	0.000

Notes:
Chemicals that exceeded their TRVs in Lewis Pond are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

TABLE D-38
FOOD CHAIN MODEL FOR ACUTE EXPOSURES
SHORT-TAILED SHREW ANALYSIS
Soil Reference Area
Blackburn and Union Privileges Site
Walpole, Massachusetts

							Food					Soil					Water		
Contaminant	NOAEL Hazard Quotient	LOAEL Hazard Quotient	NOAEL Benchmark Dose mg/kg/day	LOAEL Benchmark Dose mg/kg/day	Forage Area Normalized Exposure Dose mg/kg/day	Exposure Dose mg/kg/day	Total Conc. in Food mg/kg wet	Earthworm Tissue mg/kg wet	Proportion Worm In Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Soil mg/kg	Ave. Percent Solids in Soil	Percentage Soil in Diet	Ingestion Rate kg/kg/day	Proportion of Dose	Conc. in Water mg/l	Ingestion Rate l/kg/day	Proportion of Dose
Aluminum	**10**	1	35.2	341	5.06E+02	5.06E+02	4.80E+02	4.80E+02	1	0.6	0.57	1.40E+04	1	1	0.016	0.43	6.03E-02	0.22	0.00003

Notes:
Chemicals that exceeded their TRVs in the terrestrial exposure areas are shown on this table.
Highlighted bold values indicate a Hazard Quotient greater than 1
Inputs and intermediate values used to calculate the Hazard Quotient are not rounded to minimize errors. The final Hazard Quotient is rounded to one significant figure.

TABLE D-39
Calculation of the Area Use Factor for the Great Blue Heron
Blackburn and Union Privileges Site
Walpole, Massachusetts

9 largest waterbodies that are less than 3.1 km from the Site:	**Rough Estimate of Area (ft^2)**
Turner Pond	900000
Memorial Pond	450000
Diamond Pond	320000
Clarks Pond	480000
Plimpton Pond	270000
Cobbs Pond	750000
Rainbow Poond	180000
Unknown Name Golf Course Pond	280000
Neponset River (off-site portion)	750000
Total Area	**4380000**

Site Waterbodies	
Lewis Pond	312500
Neponset River (on-site portion)	300000
Total Area	**612500**

Great Blue Heron Area Use Factor	**0.14**