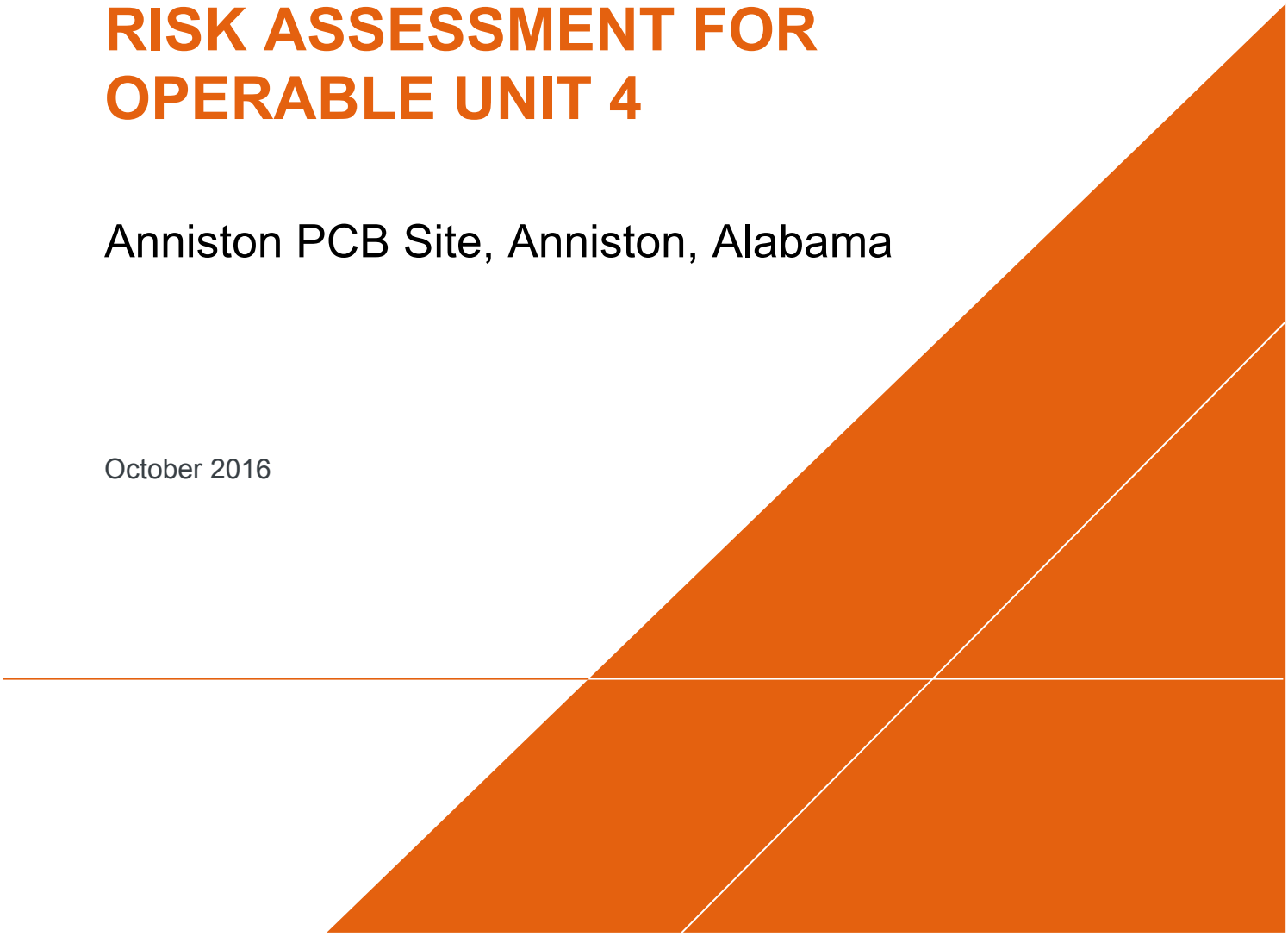
ARCADIS Design & Consultancy for natural and built assets

Pharmacia LLC and Solutia Inc.

BASELINE ECOLOGICAL RISK ASSESSMENT FOR OPERABLE UNIT 4

Anniston PCB Site, Anniston, Alabama

October 2016



CONTENTS

Acronyms and Abbreviations xvii

Executive Summary ES-1

1 Introduction 1-1

1.1 OU-4 Baseline Risk Assessment Process 1-2

1.2 Document Organization 1-2

2 Problem Formulation 2-1

2.1 Ecological Setting 2-2

2.1.1 Aquatic Habitat 2-3

2.1.1.1 Benthic Invertebrates 2-4

2.1.1.2 Fish 2-5

2.1.1.3 Aquatic/Semi-Aquatic Wildlife Observations 2-5

2.1.2 Terrestrial and Riparian Habitat 2-7

2.1.2.1 Plants 2-8

2.1.2.2 Terrestrial Invertebrates 2-9

2.1.2.3 Terrestrial Wildlife Observations 2-9

2.1.2.4 Terrestrial Reptiles and Amphibians 2-11

2.1.3 Summary 2-11

2.2 COPC Selection 2-11

2.3 Conceptual Site Model 2-13

2.3.1 Source and Mechanism 2-13

2.3.2 Fate and Transport of COPCs 2-13

2.3.2.1 PCBs and PCDD/PCDFs 2-14

2.3.2.2 Barium 2-14

2.3.2.3 Chromium 2-15

2.3.2.4 Cobalt 2-15

2.3.2.5 Lead 2-16

2.3.2.6 Mercury 2-16

2.3.2.7 Vanadium 2-17

2.3.3 Exposure Media, Receptors and Exposure Pathways 2-17

2.4 Assessment Endpoints 2-19
2.5 Measurement Endpoints and Risk Questions 2-19
2.6 Representative Receptors 2-21
3 Data Summary 3-1
3.1 Sediment Data 3-2
3.2 Soil Data 3-4
3.3 Surface Water Data 3-6
3.4 Biota Data 3-7
3.4.1 Aquatic Tissue Data 3-8
3.4.2 Terrestrial Tissue Data 3-9
3.5 Sediment Toxicity Testing Data 3-10
3.6 Ecological Community Data 3-11
4 Exposure Assessment 4-1
4.1 Exposure Units 4-2
4.1.1 Reaches for Exposure Units and Assessment Areas 4-3
4.1.2 Exposure Units Within Each Reach 4-6
4.2 Exposure Point Concentrations 4-8
4.2.1 Sediment EPCs 4-9
4.2.2 Soil EPCs 4-12
4.2.3 Surface Water EPCs 4-14
4.2.4 Measured Tissue (Biota) EPCs 4-14
4.3 Exposure Scenarios 4-14
4.4 Dietary Exposure Model 4-15
4.4.1 Prey Tissue Concentration Estimates 4-15
4.4.1.1 Measured Tissue Concentration Estimates 4-15
4.4.1.2 Modeled Tissue Concentration Estimates 4-16
4.4.1.3 Datasets for BAF Development 4-16
4.4.1.4 Sediment to Biota Uptake for PCBs and Mercury 4-17
4.4.1.5 Soil to Biota Uptake for PCBs and Mercury 4-18
4.4.1.6 Uptake Factors for Non-Mercury Metals and PCDD/PCDFs 4-19
4.4.1.7 Bioaccumulation Factors for Uptake into Bird Eggs 4-20

4.5 Exposure Parameters 4-20
4.5.1 Body Weight 4-21
4.5.2 Dietary Composition 4-21
4.5.2.1 Birds 4-22
4.5.2.2 Mammals 4-24
4.5.3 Ingestion Rates 4-26
4.5.4 Home/Foraging Ranges 4-26
5 Effects Assessment 5-1
5.1 Benthic Community Toxicity Thresholds 5-3
5.1.1 Site-Specific Sediment Toxicity Thresholds for PCBs and Mercury 5-4
5.1.2 Literature-Based Sediment Benchmarks 5-8
5.2 Soil Benchmarks 5-9
5.3 Surface Water Benchmarks 5-9
5.4 Dietary TRVs for Birds and Mammals 5-10
5.4.1 Avian Dietary TRVs for PCBs 5-11
5.4.2 Avian Dietary TRVs for Mercury 5-12
5.4.3 Avian Dietary TRVs for Other Metals 5-13
5.4.4 Avian Dietary TRVs for Dioxin-Like Compounds 5-13
5.4.5 Non-Mink Mammalian Dietary TRVs for PCBs 5-13
5.4.6 Mink Dietary TRVs for PCBs 5-14
5.4.7 Mammalian Dietary TRVs for Mercury 5-15
5.4.8 Mammalian Dietary TRVs for Other Metals 5-15
5.4.9 Mammalian Dietary TRVs for Dioxin-Like Compounds 5-15
5.5 Tissue-based CTCs 5-16
5.5.1 Avian Tissue-based CTCs 5-16
5.5.1.1 Avian Egg-Based CTCs for PCBs 5-16
5.5.1.2 Avian Egg-Based CTCs for Mercury 5-17
5.5.2 Mammalian Tissue-based CTCs 5-18
5.5.2.1 Small Mammal PCB Tissue-Based CTCs 5-18
5.5.3 Fish Tissue-Based CTCs 5-18
5.5.3.1 Fish Tissue-Based CTCs for PCBs 5-19

5.5.3.2 Fish Tissue-Based CTCs for Mercury 5-19
5.5.3.3 Fish Tissue-Based CTCs for Non-Mercury Metals 5-20
5.5.3.4 Fish Tissue-based CTCs for Dioxin-Like Compounds 5-21
5.5.4 Invertebrate Tissue-Based CTCs 5-21
5.5.4.1 Oligochaetes (Aquatic Worms) CTCs 5-21
5.5.4.1.1 Oligochaete CTCs for PCBs 5-21
5.5.4.1.2 Oligochaete CTCs for Mercury 5-22
5.5.4.2 Aquatic Emergent Insect CTCs 5-22
5.5.4.2.1 Aquatic Emergent Insect CTCs for PCBs 5-22
5.5.4.2.2 Aquatic Emergent Insect CTCs for Mercury 5-22
5.5.4.3 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs 5-23
5.5.4.3.1 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs for PCBs 5-23
5.5.4.3.2 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs for Mercury 5-23
5.5.4.4 Aquatic Molluscs CTCs 5-23
5.5.4.4.1 Aquatic Molluscs CTCs for PCBs 5-23
5.5.4.4.2 Aquatic Molluscs CTCs for Mercury 5-24
5.5.4.5 Aquatic Crayfish CTCs 5-24
5.5.4.5.1 Aquatic Crayfish CTCs for PCBs 5-24
5.5.4.5.2 Aquatic Crayfish CTCs for Mercury 5-25
5.5.4.6 Terrestrial Earthworms CTCs 5-25
5.5.4.6.1 Terrestrial Earthworms CTCs for PCBs 5-25
5.5.4.6.2 Terrestrial Earthworms CTCs for Mercury 5-25
5.5.4.7 Terrestrial Crickets / Grasshoppers CTCs 5-26
5.5.4.7.1 Terrestrial Crickets / Grasshoppers CTCs for PCBs 5-26
5.5.4.7.2 Terrestrial Crickets / Grasshoppers CTCs for Mercury 5-26
5.6 Effects on Ecological Communities 5-26
5.6.1 Plant Communities 5-28
5.6.2 Benthic Invertebrate Communities 5-29
5.6.3 Soil Invertebrate Community 5-31
5.6.4 Fish Community 5-31
5.6.5 Bird Community 5-32

5.6.6 Mammal Community....5-33

6 OU-4 Risk Characterization....6-1

6.1 Risk Estimation and Description....6-2

6.1.1 AE 1: Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities....6-6

6.1.1.1 ME 1a: Concentrations of COPCs in OU-4 soils (including floodplain soils), surface water, and sediments relative to literature-based toxicity benchmarks for survival, growth, or reproduction....6-6

6.1.1.2 ME 1b: Body burdens of COPCs in OU-4 plant tissue as compared to reference area(s) plant tissue....6-7

6.1.1.3 ME 1c: Qualitative observations of plant condition and discoloration in OU-4 as compared to the reference area(s)....6-8

6.1.1.4 ME 1d: Comparison of aquatic/terrestrial plant community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- for each habitat type in OU-4 to the reference area(s)....6-9

6.1.2 AE 2: Survival, Growth, and Reproduction of Benthic Invertebrate Communities....6-9

6.1.2.1 ME 2a: Concentration of COPCs in OU-4 surface sediments compared to site-specific toxicity thresholds derived from the OU-4 sediment bioassay program for PCBs and mercury, and literature-derived toxicity benchmarks....6-9

6.1.2.1.1 Sediment....6-9

6.1.2.1.2 Surface Water....6-10

6.1.2.2 ME2b: Measured body burdens of COPCs in OU-4 benthic invertebrate tissue as compared to reference area(s) benthic invertebrate tissue and literature-derived CTCs, as available....6-11

6.1.2.2.1 Comparison to Tissue CTCs....6-11

6.1.2.2.2 Comparison to Reference....6-11

6.1.2.3 ME 2c: Comparison of benthic invertebrate community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s)....6-13

6.1.3 AE 3: Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities....6-13

6.1.3.1 ME 3a: Concentrations of COPCs in OU-4 surface soils compared to literature-derived toxicity benchmark values....6-13

6.1.3.2 ME 3b: Measured body burdens of COPCs in OU-4 terrestrial invertebrate tissue as compared to reference area(s) terrestrial invertebrate tissue and literature-derived tissue-based CTCs, as available....6-14

6.1.3.2.1 Comparison to Tissue CTCs....6-14

6.1.3.2.2 Comparison to Reference 6-14

6.1.3.3 ME 3c: Comparison of terrestrial invertebrate community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s). 6-15

6.1.4 AE 4: Survival, Growth, and Reproduction of Fish Communities 6-15

6.1.4.1 ME 4a: Concentration of COPCs in OU-4 surface water and sediment compared to literature-derived toxicity benchmark values. 6-15

6.1.4.2 ME 4b: Body burdens of COPCs in selected fish species from OU-4 as compared to those in the reference area(s) and tissue-based CTCs as available. 6-16

6.1.4.2.1 Comparison to Tissue CTCs 6-16

6.1.4.2.2 Comparison to Reference 6-17

6.1.4.3 ME 4c: Comparison of fish community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s). 6-18

6.1.4.4 ME 4d: Fish health assessment using anomaly codes similar to those in the Rapid Bioassessment Protocol (Barbour et al. 1999). Observations may include disease, deformities, external parasites, fin erosion, lesions, tumors, sex ratio, and age structure. 6-18

6.1.5 AE 5: Survival, Growth, and Reproduction of Birds 6-19

6.1.5.1 ME 5a and 5c: Compare an estimated dietary daily dose of COPCs in prey base in OU-4 to relevant dietary TRVs and Compare predicted OU-4 egg COPC concentrations to egg-based TRVs and predicted concentrations in the reference area(s). 6-19

6.1.5.1.1 Hazard Quotients 6-19

6.1.5.1.2 Comparison to Reference 6-26

6.1.5.2 ME 5b: Comparison of avian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to reference area(s) or among OU-4 assessment areas. 6-27

6.1.6 AE 6: Survival, Growth, and Reproduction of Mammals 6-27

6.1.6.1 ME 6a and 6b: Compare an estimated dietary daily dose of COPCs in prey base in OU-4 to relevant dietary TRVs and those in the reference area(s) and compare estimated body burdens of COPCs in selected mammal species in OU-4 to those in mammals from the reference area(s) and CTCs as available. 6-28

6.1.6.1.1 Hazard Quotients 6-28

6.1.6.1.2 Comparison to Reference 6-32

6.1.6.2 ME 6c: Comparison of mammalian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to the reference area(s) or among OU-4 assessment areas. 6-33

6.1.6.3 ME 6d: Evaluate habitat suitability for the mink (Allen 1986) and river otter using habitat suitability index models or other methods as available. 6-34

6.1.7 Survival, Growth, and Reproduction of Amphibians or Reptiles 6-35

6.1.7.1 ME 7a: Concentration of COPCs in surface water, sediment, and soil in OU-4 compared to benchmarks and/or literature-derived toxicity threshold values. 6-35

6.1.7.2 ME 7b: Body burden of COPCs in selected reptile and amphibian receptor tissue in OU-4 as compared to those in the reference area(s). 6-35

6.2 Uncertainty Analysis 6-37

6.2.1 Exposure Assumptions 6-38

6.2.1.1 Environmental Sampling and Analysis 6-39

6.2.1.2 Exposure Point Concentration Estimation 6-41

6.2.1.3 TEQs Calculated for Sediments and Soils 6-42

6.2.1.4 Habitat Quality/Food Availability 6-44

6.2.1.5 Site Use 6-44

6.2.1.6 Receptor Exposure Parameters 6-44

6.2.2 Bioaccumulation Factors 6-45

6.2.2.1 Sediment BAFs for PCBs and Mercury 6-45

6.2.2.2 Soil and Sediment BAFs for Non-Mercury Metals 6-49

6.2.2.3 Soil and Sediment BAFs for TEQ 6-50

6.2.3 Toxicity Benchmarks and Toxicity Reference Values 6-51

6.2.3.1 PCB Sediment Thresholds and Benchmarks for Benthic Invertebrate Communities 6-51

6.2.3.2 PCB Sediment Toxicity Threshold Interpretation 6-54

6.2.3.3 TECs and PECs for Sediment 6-54

6.2.3.4 Soil Screening Levels 6-56

6.2.3.5 Surface Water Screening Levels 6-57

6.2.3.6 Avian Dietary TRVs 6-58

6.2.3.7 Mammalian Dietary TRVs 6-61

6.2.3.8 Amphibian and Reptile Benchmarks and TRVs 6-64

6.2.3.9 Use of Methylmercury-based TRVs for Evaluation of Total Mercury 6-65

6.2.3.10 Avian Egg Tissue CTCs 6-66
6.2.3.11 Mammalian Tissue CTCs 6-68
6.2.3.12 Fish Tissue CTCs 6-68
6.2.3.13 Amphibians and Reptiles Tissue CTCs 6-70
6.2.3.14 Invertebrate Tissue CTCs 6-71
6.2.3.14.1 Invertebrate PCB CTCs 6-71
6.2.3.14.2 Invertebrate Mercury CTCs 6-72
6.2.4 Ecological Community Evaluations 6-72
6.3 Risk Findings 6-76
6.3.1 Weight of Evidence Approach 6-77
6.3.1.1 Lines of Evidence 6-77
6.3.1.2 Weight of Evidence Rankings 6-78
6.3.2 AE 1: Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities 6-79
6.3.3 AE 2: Survival, Growth, and Reproduction of Benthic Invertebrate Communities 6-80
6.3.4 AE3: Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities 6-82
6.3.5 AE 4: Survival, Growth, and Reproduction of Fish Communities 6-83
6.3.6 AE 5: Survival, Growth, and Reproduction of Birds 6-84
6.3.6.1 Aquatic Birds 6-85
6.3.6.2 Terrestrial Birds 6-88
6.3.7 AE 6: Survival, Growth, and Reproduction of Mammals 6-92
6.3.7.1 Aquatic Mammals 6-93
6.3.7.2 Terrestrial Mammals 6-95
6.3.7.3 Mammals with Mixed Aquatic and Terrestrial Diet 6-97
6.3.8 AE 7: Survival, Growth, and Reproduction of Amphibians or Reptiles 6-97
7 Remedial Goal Options 7-1
8 Conclusions 8-1
9 References 9-1

TABLES

Table 2-1 Ecological Data Survey Events

Table 2-2 Summary of Benthic Macroinvertebrates Collected from the Assessment and Reference Areas

Table 2-3 Summary of Fish Sampling Results

Table 2-4 Bird Species Observed During Aquatic Habitat Surveys

Table 2-5 Mammal Species Observed During Aquatic Habitat Surveys

Table 2-6 Reptile and Amphibian Species Observed During Aquatic Habitat Surveys

Table 2-7 Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain - Fall 2001 and Spring 2002

Table 2-8 Floodplain Vegetation Species Observed During Terrestrial Transect Surveys

Table 2-9 Floodplain Dominant Vegetation Species Observed During Terrestrial Transect Surveys

Table 2-10 Terrestrial Soil Macroinvertebrate Survey Results

Table 2-11 Bird Species Observed During Terrestrial Transect Surveys

Table 2-12 Mammal Species Observed During Terrestrial Transect Surveys

Table 2-13 Terrestrial Small Mammal Survey Results

Table 2-14 Reptile and Amphibian Species Observed During Terrestrial Transect Surveys

Table 2-15 OU-4 Constituents of Potential Concern List

Table 2-16 Assessment and Measurement Endpoints Summary

Table 3-1 Sample Counts for Total Polychlorinated Biphenyls in Abiotic and Biotic Media

Table 3-2 Sample Counts for Mercury in Abiotic and Biotic Media

Table 3-3 Sample Counts for Non-Mercury Metals in Abiotic and Biotic Media

Table 3-4 Fish Tissue Summary for PCBs

Table 3-5 Fish Tissue Summary for Mercury

Table 3-6 Fish Tissue Summary for Metals

Table 3-7 Terrestrial Biota Tissue Summary for PCBs

Table 3-8 Aquatic Biota (non-fish) Tissue Summary for PCBs (mg/kg wet weight)

Table 3-9 Terrestrial Biota Tissue Summary for Mercury

Table 3-10 Aquatic Biota (non-fish) Tissue Summary for Mercury (mg/kg wet weight)

Table 3-11 Terrestrial Biota Tissue Summary for Metals

Table 3-12 Aquatic Biota (non-fish) Tissue Summary for Metals

Table 3-13 Targeted and Actual Aquatic Community Tissue Sampling

Table 3-14 Targeted and Actual Terrestrial Community Tissue Sampling

Table 4-1a Avian Exposure Parameters

Table 4-1b Avian Exposure Parameters Scenarios

Table 4-2a Mammalian Exposure Parameters

Table 4-2b Mammalian Exposure Parameters Scenarios

Table 4-2c Literature Cited in Tables 4-1a,b and 4-2a,b - Avian and Mammalian Exposure Parameters

Table 4-3 Tissue Sampling Areas (embedded in text)

Table 4-4 EPC Calculation Details Table for PCBs in Surface Sediments

Table 4-5a EPC Calculation Details Table for Mercury in Surface Sediments by Reach

Table 4-5b EPC Calculation Details Table for Mercury in Surface Sediments by Assessment Area

Table 4-6 Summary Statistics for Non-Mercury Metals in OU-4 Sediments

Table 4-7 Summary Statistics for Polychlorinated Biphenyls in OU-4 Floodplain Soils

Table 4-8 Summary Statistics for Mercury in OU-4 Floodplain Soils

Table 4-9 Summary Statistics for Chromium in OU-4 Floodplain Soils

Table 4-10 Summary Statistics for Lead in OU-4 Floodplain Soils

Table 4-11 Summary Statistics for Vanadium in OU-4 Floodplain Soils

Table 4-12 Summary Statistics for Barium in Soil

Table 4-13 Summary Statistics for Cobalt in Soil

Table 4-14 Summary Statistics for COPCs in OU-4 Surface Water

Table 4-15 Summary Statistics by Assessment Area –Aquatic Tissue

Table 4-16 Summary Statistics by Assessment Area –Terrestrial Tissue

Table 4-17 Assessment Area-Specific Exposure Scenarios Evaluated for Ecological Receptors

Table 4-18 Sediment Samples Included in Bioaccumulation Factor Datasets

Table 4-19 Soil Samples Included in the Bioaccumulation Factor Datasets

Table 4-20 Summary of OU-4 Bioaccumulation Factors/Regressions for PCBs and Mercury

Table 4-21 Summary of Median BAFs for PCBs and Metals

Table 5-1 Overview of Toxicity Benchmarks, TRVs, and CTCs Developed or Selected for OU-4

Table 5-2a Site-Specific PCB and Mercury Toxicity Thresholds for Benthic Invertebrates

Table 5-2b Summary of Toxicity Benchmarks, TRVs, and CTCs for Ecological Receptors

Table 5-3	Community Metrics Summary (embedded in text)
Table 5-4a-e	Terrestrial Vegetation Community Measures
Table 5-5	Trends for Terrestrial Vegetation Community
Table 5-6	Summary of Water Quality Parameters by Habitat Type
Table 5-7	General Substrate Composition in Aquatic Habitats
Table 5-8	Benthic Invertebrate Community Measures and Relationship to Assessment Area and PCB Concentration
Table 5-9	Trends for Benthic Invertebrate Community
Table 5-10a-d	Soil Invertebrate Community Measures
Table 5-11	Trends for Soil Invertebrate Community
Table 5-12a-d	Fish Community Measures
Table 5-13	Trends for Fish Community
Table 5-14	Summary of DELT Anomalies in Fish Species
Table 5-15a-d	Aquatic Bird Community Measures
Table 5-16	Trends for Aquatic Bird Community
Table 5-17a-d	Terrestrial Bird Community Measures
Table 5-18	Trends for Terrestrial Bird Community
Table 5-19a-d	Aquatic Mammal Community Measures
Table 5-20	Trends for Aquatic Mammal Community
Table 5-21a-d	Terrestrial Mammal Community Measures
Table 5-22	Trends for Terrestrial Mammal Community
Table 5-23a-d	Small Mammal Community Measures
Table 5-24	Trends for Terrestrial Small Mammal Community
Table 6-1	Summary of Range of Hazard Quotients Calculated for OU-4
Table 6-2a	Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Table 6-2b	Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Table 6-3a	Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Table 6-3b	Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Measured Tissue)

Table 6-4a Percentage of Surface Sediment Samples Exceeding Toxicity Thresholds by Reach

Table 6-4b Percentage of Surface Sediment Samples Exceeding Literature-Based Benchmarks by Reach

Table 6-5a Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)

Table 6-5b Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)

Table 6-6a Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)

Table 6-6b Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)

Table 6-7a Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Modeled Tissue)

Table 6-7b Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Measured Tissue)

Table 6-8a Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Modeled Tissue)

Table 6-8b Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Measured Tissue)

Table 6-9 Summary of Terrestrial and Aquatic Bird Egg Tissue NOAEL Hazard Quotients by Exposure Unit

Table 6-10 Summary of Terrestrial and Aquatic Bird Egg Tissue LOAEL Hazard Quotients by Exposure Unit

Table 6-11 Hazard Quotients Based on Measured Tissue and Critical Tissue Concentrations

Table 6-12 Summary of Risk Estimates For Aquatic Life Exposed to Surface Water

Table 6-13 Summary of ANOVA Analysis for Sediment

Table 6-14 Summary of ANOVA Analysis for Soil - PCBs and Mercury

Table 6-15 Summary of ANOVA Analysis for Tissue

Table 6-16a Summary of PCB Risks to Aquatic Birds (Mid-Sensitivity HQs)

Table 6-16b Summary of PCB Risks to Aquatic Birds (High-Sensitivity HQs)

Table 6-16c Summary of Mercury Risks to Aquatic Birds

Table 6-16d Summary of Non-Mercury Metals Risks to Aquatic Birds

Table 6-17a Summary of PCB Risks to Terrestrial Birds (Mid-Sensitivity HQs)

Table 6-17b Summary of PCB Risks to Terrestrial Birds (High-Sensitivity HQs)

Table 6-17c Summary of Mercury Risks to Terrestrial Birds

Table 6-17d Summary of Non-Mercury Metals Risks to Terrestrial Birds

Table 6-18a Summary of PCB Risks to Aquatic+Terrestrial Birds (Mid-Sensitivity HQs)

Table 6-18b Summary of PCB Risks to Aquatic+Terrestrial Birds (High-Sensitivity HQs)

Table 6-18c Summary of Mercury Risks to Aquatic+Terrestrial Birds

Table 6-18d Summary of Non-Mercury Metals Risks to Aquatic+Terrestrial Birds

Table 6-19a Summary of PCB Risks to Aquatic Mammals

Table 6-19b Summary of Mercury Risks to Aquatic Mammals

Table 6-20a Summary of PCB Risks to Terrestrial Mammals

Table 6-20b Summary of Mercury Risks to Terrestrial Mammals

Table 6-20c Summary of Non-Mercury Metals Risks to Terrestrial Mammals

Table 6-21 Summary of PCB Risks to Aquatic+Terrestrial Mammals

Table 6-22 Percentage of Methylmercury in Various Prey Species

Table 6-23 Mercury Risk Calculations for Carolina Wren Based on Measured Tissue and Dietary Toxicity Reference Values for Terrestrial Receptors

Table 6-24 Summary of Potential Risks to Lower Trophic Receptors from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk

Table 6-25 Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk

Table 6-26 Summary of Potential Risks to Mammals from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk

Table 7-1 Polychlorinated Biphenyl Remedial Goal Options for Benthic Invertebrates

Table 7-2 Summary of Aquatic Remedial Goal Options

Table 7-3 Summary of Terrestrial Remedial Goal Options

Table 7-4 Summary of Remedial Goal Options

Table 8-1 Predicted Risk for Lower Trophic Level Receptors Exposed to PCBs in OU-4 based on the WOE (embedded in text)

Table 8-2 Predicted Risk for Birds Exposed to PCBs in OU-4 based on the WOE (embedded in text)

Table 8-3 Predicted Risk for Mammals Exposed to PCBs in OU-4 based on the WOE (embedded in text)

FIGURES

Figure 1-1 Site Location Map

Figure 2-1a Key for Floodplain and Riparian Habitat Figures

Figure 2-1b-k OU-4 Floodplain and Riparian Habitat

Figure 2-2a-b Bayne (1997) and 2000 RFI Sampling Locations

Figure 2-3 Ecological Receptor Food Web

Figure 2-4 Conceptual Site Model

Figure 3-1a Key for Soil and Sediment Locations by Program

Figure 3-1b-k Soil and Sediment Locations by Program

Figure 3-2 OU-4 Whole Water Surface Water Sampling Locations

Figure 3-3a Biological Sample Areas and Locations Upper Assessment Area - EUA-01, EUT-01, EUT-02, and EUT-03

Figure 3-3b Biological Sample Areas and Locations Upper Assessment Area - EUA-02, EUT-04, EUT-05, EUT-06, and EUT-07

Figure 3-3c Biological Sample Areas and Locations Upper Assessment Area - EUA-03, EUT-08, and EUT-09

Figure 3-3d Biological Sample Areas and Locations Middle Assessment Area - EMA-01, EMA-02, EMA-03, EMT-01, EMT-02, EMT-03, EMT-04, EMT-05, EMT-06, EMT-07, and EMT-08

Figure 3-3e Biological Sample Areas and Locations Middle Assessment Area - EMT-09, EMA-03, and EMT-08

Figure 3-3f Biological Sample Areas and Locations Lower Assessment Area - ELA-01, ELT-01, and ELT-02

Figure 3-3g Biological Sample Areas and Locations Lower Assessment Area - ELA-02, ELA-03, ELT-03, ELT-04, ELT-05, ELT-06, ELT-07, ELT-08, and ELT-09

Figure 3-3h Biological Sample Areas and Locations Reference Area 1 - ERA-01 and ERT-01

Figure 3-3i Biological Sample Areas and Locations Reference Area 2 - ERA-02 and ERT-02

Figure 3-3j Biological Sample Areas and Locations Reference Area 3 - ERA-03 and ERT-03

Figure 4-1 OU-4 Ecological Reaches

Figure 4-2a Key for PCB Soil and Sediment Results by Exposure Unit

Figure 4-2b PCB Soil and Sediment Results for C1-East EU and C1-West EU

Figure 4-2c PCB Soil and Sediment Results for C2-North-EU, C2-Central EU, and C2-South EU

Figure 4-2d PCB Soil and Sediment Results for C3-North EU and C3-South EU

Figure 4-2e PCB Soil and Sediment Results for C4-North EU and C4-South EU

Figure 4-2f PCB Soil and Sediment Results for C5-North EU and C5-South EU
Figure 4-2g PCB Soil and Sediment Results for C6-North EU and C6-South EU
Figure 4-2h PCB Soil and Sediment Results for C7-North EU and C7-South EU
Figure 4-2i PCB Soil and Sediment Results for C8-North EU and C8-South EU
Figure 4-2j PCB Soil and Sediment Results for C9-North EU and C9-South EU
Figure 4-2k PCB Soil and Sediment Results for C10
Figure 4-3a Key for Mercury Soil and Sediment Results by Exposure Unit
Figure 4-3b Mercury Soil and Sediment Results for C1-East and C1-West EU
Figure 4-3c Mercury Soil and Sediment Results for C2-North-EU, C2-Central EU, and C2-South EU
Figure 4-3d Mercury Soil and Sediment Results for C3-North EU and C3-South EU
Figure 4-3e Mercury Soil and Sediment Results for C4-North EU and C4-South EU
Figure 4-3f Mercury Soil and Sediment Results for C5-North EU and C5-South EU
Figure 4-3g Mercury Soil and Sediment Results for C6-North EU and C6-South EU
Figure 4-3h Mercury Soil and Sediment Results for C7-North EU and C7-South EU
Figure 4-3i Mercury Soil and Sediment Results for C8-North EU and C8-South EU
Figure 4-3j Mercury Soil and Sediment Results for C9-North EU and C9-South EU
Figure 4-3k Mercury Soil and Sediment Results for C10
Figure 4-4 Regression Plots for Selected Bioaccumulation Models for Sediment PCBs
Figure 4-5 Regression Plots for Selected Bioaccumulation Models for Sediment Mercury
Figure 4-6 Regression Plots for Selected Bioaccumulation Models for Soil PCBs
Figure 4-7 Regression Plots for Selected Bioaccumulation Models for Soil Mercury
Figure 5-1 Plant Cover and Species Richness by Floodplain Reach
Figure 5-2a Mean Benthic Measures by Habitat and Season: Fall 2006
Figure 5-2b Mean Benthic Measures by Habitat and Season: Spring 2007
Figure 5-3 Trends in Means in Fish Metrics Between OU-4 and Reference by Year and Habitat
Figure 5-4 Aquatic Mammal Community - Abundance by Reach
Figure 6-1 Total PCBs in Sediment by River Mile and Sediment Toxicity Thresholds
Figure 6-2 Mercury in Sediment by River Mile and Sediment Toxicity Thresholds
Figure 6-3 Metals in Sediment by River Mile and Sediment Toxicity Benchmarks
Figure 6-4 Summary of OU-4 and Reference PCB Concentrations in Soil and Sediment
Figure 6-5a-c Summary of OU-4 and Reference PCB Concentrations in Aquatic Tissues

Figure 6-6 Summary of OU-4 and Reference PCB Concentration in Terrestrial Tissues

Figure 6-7 Summary of OU-4 and Reference Mercury Concentrations in Soil and Sediment

Figure 6-8a-c Summary of OU-4 and Reference Mercury Concentrations in Aquatic Tissues

Figure 6-9 Summary of OU-4 and Reference Mercury Concentration in Terrestrial Tissues

Figure 6-10 Summary of OU-4 and Reference Barium Concentrations in Sediment

Figure 6-11 Summary of OU-4 and Reference Chromium Concentrations in Soil and Sediment

Figure 6-12 Summary of OU-4 and Reference Cobalt Concentrations in Sediment

Figure 6-13 Summary of OU-4 and Reference Lead Concentrations in Soil and Sediment

Figure 6-14 Summary of OU-4 and Reference Vanadium Concentrations in Soil and Sediment

Figure 6-15 Mean Barium Concentrations for Tissue Data by Ecological Area

Figure 6-16 Mean Chromium Concentrations for Tissue Data by Ecological Area

Figure 6-17 Mean Cobalt Concentrations for Tissue Data by Ecological Area

Figure 6-18 Mean Lead Concentrations for Tissue Data by Ecological Area

Figure 6-19 Mean Vanadium Concentrations for Tissue Data by Ecological Area

Figure 6-20 Mean PCDD/PCDF TEQ Concentrations for Tissue Data by Ecological Area

Figure 6-21 Comparison of PCB Concentrations Measured as Aroclors and Homologs

Figure 6-22 Total PCB Concentrations in Surface Sediment with Distance from Lake Logan Martin by Collection Program

Figure 6-23 Regression Analysis of Fines Normalized PCB Concentrations in Sediment and Field Collected Benthic Invertebrate Tissue (embedded in text)

Figure 6-24 Weight-of-Evidence Approach for Integrating Risk Findings for PCBs

Figure 8-1 Summary of Benthic Invertebrate Toxicity Threshold Exceedance Analysis (embedded in text)

APPENDICES

A Species Profiles for Wildlife

B Bioaccumulation Factor/Uptake Model Development

C Analysis of Operable Unit 4 Sediment Toxicity Test Results and Development of Site-Specific Risk-Based Concentrations for Polychlorinated Biphenyls in Sediment

D Development of Benchmarks and Toxicity Reference Values

E Data Summary Tables and Risk Estimates Calculated for Operable Unit 4

F Dioxin Toxic Equivalent Assessment

G Indicators of Recovery in the Stream Minnow, *Campostoma oligolepis*, Inhabiting Snow Creek, Calhoun County, Alabama

ACRONYMS AND ABBREVIATIONS

95%UCL	95% upper confidence limit
AA	assessment area
ADEM	Alabama Department of Environmental Management
AE	assessment endpoint
AHR	arylhydrocarbon receptor
ANCOVA	analysis of covariance
ANOVA	analysis of variance
Arcadis	Arcadis U.S., Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
AVS-SEM	acid volatile sulfide and simultaneously extractable metals
BAF	bioaccumulation factor
BAZ	biologically active zone
BBL	Blasland, Bouck & Lee, Inc.
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BSA	biological sampling area
BSAF	biota-soil or biota-sediment accumulation factor
CalEPA	California Environmental Protection Agency
CERC	Columbia Environmental Research Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeters
COPC	constituent of potential concern
CSM	conceptual site model
CTC	critical tissue concentration
DELTs	deformities, erosions, lesions, and tumors
DF	dietary fraction
DL-PCB	dioxin-like polychlorinated biphenyls
DTSC	California Department of Toxic Substances Control
dw	dry weight

EAV	emergent aquatic vegetation
EC*	effective concentration relative to the lowest reference effect
EcoSSL	Ecological Soil Screening Level
EPC	exposure point concentration
EPT	Ephemeroptera, Trichoptera, and Plecoptera
EqP	equilibrium partitioning
ERA	ecological reference area
ERDC	Engineer Research and Development Center
ESR	ecological survey report
ESVs	ecological screening values
EU	exposure unit
FCV	Final Chronic Value
FEMA	Federal Emergency Management Agency
f_{OC}	fraction of sediment OC
FSP	field sampling plan
g	gram
GLM	generalized linear models
HHFL	Human Health Fish Locations
HSI	Habitat Suitability Index
HQ	hazard quotient
IR	ingestion rate
kg	kilogram
kg dw/kg BW-d	kilograms dry weight prey tissue/kilograms body weight per day
km	kilometers
Koc	soil organic carbon-water partitioning coefficient
LAA	lower assessment area
LOAEL	lowest observed adverse effect level
LOE	line of evidence
LOEC	low observed effect concentration
m	meters
MAA	middle assessment area

ME	measurement endpoint
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg-d	milligrams per kilogram per day
mg/kg dw	milligrams per kilogram dry weight
mg/kg ww	milligrams per kilogram wet weight
mg/kg BW-d	milligrams per kilogram body weight per day
mg/L	milligrams per liter
mmol/kg ww	millimoles per kilogram wet weight
NAWQC	National Ambient Water Quality Criteria
ND	nondetect
NFESC	Naval Facilities Engineering Service Center
ng/g	nanograms per gram
ng/kg BW-d	nanograms per gram body weight per day
ng/kg	nanograms per kilogram
NIR	normalized ingestion rate
NOAEL	no observed adverse effect level
NRC	National Research Council
OC	organic carbon
OEHHA	California's Office of Environmental Health Hazard Assessment
ORNL	Oak Ridge National Laboratory
OU	operable unit
OU-1	Operable Unit 1
OU-2	Operable Unit 2
OU-3	Operable Unit 3
OU-4	Operable Unit 4
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCD	Partial Consent Decree
PCDD	polychlorinated dibenzo-*p*-dioxin
PCDF	polychlorinated dibenzofuran

PEC	probable effects concentration
PEL	probable effects level
P/S	Pharmacia LLC/Solutia Inc.
PSCSR	Preliminary Site Characterization Summary Report
RBP	Rapid Bioassessment Protocol
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RGOs	remedial goal options
RI/FS	remedial investigation/feasibility study
RL	reporting limit
RM	river mile
SERA	streamlined ecological risk assessment
Site	Anniston PCB Site
SLERA	screening-level ecological risk assessment
SPME	solid phase micro-extraction
SQG	sediment quality guideline
SUF	site use factor
TCDD	2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
TCos	transfer coefficients
TEC	threshold effect concentration
TEF	toxic equivalency factor
TEL	threshold effects level
TEQ	toxic equivalent
TOC	total organic carbon
TRV	toxicity reference value
UAA	upper assessment area
$UCL95_{sw}$	spatially-weighted 95 percent upper confidence limit
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WHO	World Health Organization

WOE	weight of evidence
WQS	water quality standards
ww	wet weight
µg/g	micrograms per gram
µg/L	micrograms per liter
µg/kg egg ww	micrograms kilogram egg wet weight
µg/kg dw	micrograms per kilogram dry weight
%	percent



Baseline Ecological Risk Assessment for Operable Unit 4 Anniston PCB Site, Anniston, Alabama Executive Summary

Key Findings of the OU-4 BERA

- PCBs, or polychlorinated biphenyls, are the primary driver of potential risk in OU-4, and concentrations decline from upstream to downstream.
- OU-4 is divided into ten reaches with aquatic, riparian, and terrestrial exposure units within each reach.
- Risk in OU-4 was evaluated for a wide range of ecological receptors using a detailed weight-of-evidence approach.
- A range of hazard quotients (HQs) provide the primary quantitative lines of evidence in the BERA, and are supported by a site-specific ecological community analysis.
- The HQ is the ratio of the potential exposure to a substance, and the level at which no or low adverse effects are expected. If the ratio is greater than 1, adverse health effects are possible.
  - The highest HQs for aquatic receptors are for piscivorous mammals, for which high risk is predicted throughout OU-4.
  - The highest HQs for terrestrial receptors indicate moderate risk for invertivorous and carnivorous birds in the upper assessment area (UAA).
- Predicted risk based on HQs is highest in reaches C1 and C2 – the two most upstream reaches – and to a lesser degree in C3 and C4.
- Downstream of reach C4, the predicted risks for non-piscivorous species are low to moderate.
- Ecological community analysis indicates that impacts to ecological communities from PCBs or other constituents of potential ecological concern are unlikely.
- A range of Remedial Goal Options related to PCBs was calculated for the receptors evaluated. The results, which span more than two orders of magnitude, will be considered within the context of the overall risk management process.

Pharmacia LLC and Solutia Inc. (P/S), as parties to the Partial Consent Decree for the Anniston Polychlorinated Biphenyl (PCB) Site (the Site), have prepared this Baseline Ecological Risk Assessment for Operable Unit 4 (OU-4 BERA). The Site is located in portions of Calhoun and Talladega counties in the north-central part of Alabama, near the City of Anniston, and has been investigated for the past 20 years to evaluate PCBs and other chemical constituents that may be present in various Site media. The Site is not on the Superfund National Priorities List, but is being addressed through the Superfund Alternative Approach. The Site was divided into three operable units (OUs) to facilitate parallel evaluation efforts in the different areas, facilitate early actions, and streamline closure in specific locations, as appropriate.

OU-4 encompasses the length of Choccolocco Creek and its floodplain from the confluence with Snow Creek downstream to the confluence of the Coosa River (Figure ES-1, attached). OU-4 covers approximately 6,000 acres and includes a wide range of distinct habitats. At the downstream boundary of OU-4, Choccolocco Creek transitions from riverine to lacustrine conditions. OU-4 also includes the lower portion of Snow Creek and its floodplain between Highway 78 and the confluence of Snow Creek and Choccolocco Creek. This small area was included in OU-4 because it is more characteristic of Choccolocco Creek than the urbanized upper reaches of Snow Creek. The backwater area of Choccolocco Creek, located at the confluence with Snow Creek, is also included in OU-4. This OU-4 BERA is focused on key ecological receptors that may reside or forage within the terrestrial and aquatic habitat in OU-4.

P/S prepared this OU-4 BERA using a wide range of scientific data and information, including ecological community data, habitat and land use studies, chemical data from abiotic media (surface water, sediment, and soil), a range of biotic tissue data collected over the course of the last 15 years, and the outcomes of site-specific sediment toxicity and bioaccumulation studies. The results of these studies and data collection activities provide a great deal of information that results in a robust, site-specific risk assessment. Literature-based information has also been incorporated into this OU-4 BERA along with the site-specific information to formulate the weight-of-evidence to support the conclusions for potential risk to ecological receptors that may reside or forage within OU-4.

This OU-4 BERA follows the eight-step process outlined in the United States Environmental Protection Agency (USEPA) *Ecological Risk Assessment Guidance for Superfund* (USEPA 1997). A Screening Level Ecological Risk

Assessment (SLERA; BBL 2005) was completed for OU-4 and included Steps 1 and 2 of USEPA process (i.e., screening level problem formulation and effects evaluation and preliminary exposure estimates and risk calculations). This assessment builds on the information provided in the SLERA, and incorporates site-specific data collected after completion of the SLERA. The focus of this document is Step 3 through Step 7, which include a baseline problem formulation[1], data assessment, exposure and effects assessment, and risk characterization. The results of this OU-4 BERA will also be used by USEPA to support the risk management process (Step 8).

Problem Formulation

The problem formulation identified constituents of potential ecological concern (COPCs). While PCBs are considered the primary COPC, seven other constituents (barium, chromium, cobalt, lead, mercury, vanadium, and polychlorinated dibenzo-p-dioxins and furans [PCDD/PCDFs]) were identified as being potentially elevated above background concentrations, and were also included as COPCs.

In addition, the problem formulation included a description of the ecological habitat present in OU-4 and a review of the wide range of aquatic and terrestrial ecological community and habitat data collected on five occasions between 1996 and 2009. The results of the aquatic habitat studies suggest that, except for some nutrient enrichment and sedimentation issues in the upper portions of Choccolocco Creek related to urbanization, agriculture, and grazing, no widespread impairment is evident in Choccolocco Creek, its associated tributaries, or receiving waters. The terrestrial habitat studies indicate that the prominent habitat types in the floodplain of OU-4 include maintained fields, successional fields, and forested floodplain. Approximately 600 acres of riparian area are present within the OU-4 floodplain. Within the riparian areas (operationally identified as the 100-foot buffer on either side of the creek), the majority (517 acres of 595 total acres) of the area is characterized as forested floodplain. This riparian corridor, which is diverse and highly functional along most of the creek, is densely forested and forms an important buffer zone between terrestrial/human maintained areas and the creek. In most areas, the corridor contains a substantial number of large, older, well established trees dominated primarily by box elder (*Acer negundo*) and sycamore (*Platanus occidentalis*). These trees, along with the other diverse vegetation in the riparian corridor, provide important canopy cover for the creek, support shoreline stability and creek habitat viability, and provide nesting habitat, locations to hide, thermal cover, and food for a variety of bird and mammal species. Moreover, contiguous riparian zones create important corridors for wildlife that link a variety of ecosystems together and help maintain critical biodiversity[2]. Because of the recognized importance of the riparian habitat within OU-4, a conservation corridor was formalized in 2005 as part of a broader watershed framework for areas surrounding Choccolocco Creek. The program is in the land/easement acquisition phase, and as of October 2016 approximately 1,400 acres have been preserved with the goals of protecting and enhancing water quality in Choccolocco Creek. These goals will be achieved by limiting development and agricultural practices directly adjacent to the creek and implementing long-term management practices that are consistent with the overall watershed management guidelines being implemented nationwide. Protecting the existing riparian corridors and buffers within the watershed is a critical goal of the conservation corridor program.

[1] While a baseline problem formulation was conducted in 2006, it has been refined herein based on data collected during the Phase 1 ecological survey work conducted in 2006/2007 and Phase 2 ecological tissue sampling conducted in 2009, as well as input from USEPA received since 2006.

[2] http://cowsandfish.org/pdfs/biodiversity.pdf

Conceptual Site Model

Both the aquatic and terrestrial habitats (including the riparian areas) support a wide range of ecological species, and the presence of these species is closely related to the quality of the habitat. The results of the aquatic and terrestrial studies were used to support refinement of the conceptual site model (CSM).

The CSM identified the primary complete exposure pathways as direct contact with soil/sediment/surface water for lower trophic level receptors, and ingestion of food and incidental ingestion of soil/sediment/surface water during foraging activities for upper trophic level receptors (i.e., birds and mammals). Based on the CSM, seven assessment endpoints (AEs) were identified for OU-4 and are evaluated in this OU-4 BERA. The AEs represent plants, invertebrates, reptiles, and amphibians as well as multiple trophic levels (i.e., herbivores, insectivores, omnivores, piscivores, and carnivores) of birds and mammals in both the aquatic and terrestrial environments. For each AE, multiple lines of evidence in the form of measurement endpoints (MEs) were evaluated to formulate conclusions about possible risk to ecological receptors within OU-4. A range of HQs provide the primary quantitative lines of evidence for each AE and are supported by secondary lines of evidence, which include a quantitative comparison of site-specific biological community data between OU-4 and reference areas, and comparison of OU-4 and reference COPC concentrations in tissue. HQs represent a modeled or measured exposure estimate compared to a literature-based or – in the case of PCBs and benthic invertebrates – site-specific toxicity threshold representative of a conservative no effect level or a lowest observed effect level. The community data provide an estimate of effects based on observed conditions within OU-4. In addition, qualitative lines of evidence include comparison of OU-4 and reference observations of plant and fish condition and habitat suitability evaluations for mink and otter. The AEs, risk questions, and MEs are summarized in Table ES-1, attached.

Species Evaluated, OU-4 Subunits

For the HQ line of evidence, eight terrestrial wildlife species, eight aquatic wildlife species, and one mixed aquatic and terrestrial representative receptors were selected for the bird and mammal AEs based on observations within OU-4 and direction from USEPA. The selections focused on species that would likely be most highly exposed or most sensitive to COPCs in OU-4 media. In addition, several wildlife receptors were evaluated assuming alternate dietary exposure scenarios (e.g., all aquatic exposure and mixed terrestrial and aquatic). This OU-4 BERA also includes evaluation of ecological communities of plants, invertebrates, fish, reptiles, and amphibians present in Choccolocco Creek and the floodplain areas. In the absence of threatened and endangered species, protection of populations or communities of the selected receptors will generally govern risk conclusions in this OU-4 BERA. Threatened or endangered species are evaluated as individuals.

Because of the large size of OU-4 (37 creek miles and 6,000 floodplain acres) and high degree of habitat variability, OU-4 was divided into smaller subunits for assessment purposed. These include Snow Creek and three Choccolocco Creek assessment areas (AAs), as well as smaller exposure units (EUs) where data are available to support these smaller groupings. Small groupings were developed to provide for more conservative exposure estimates for HQ calculations, particularly for smaller ranging receptors. To develop the exposure areas, the length of OU-4 was segmented into areas that were subdivided into the smaller reaches that serve as the basis for individual EUs. The reaches are based on logical break points using a combination of natural and manmade features within OU-4 that could affect the transport mechanisms of solids to and from the floodplain and the introduction of non-PCB containing suspended solids through tributary creek inputs. For example, major roads and bridges, confluence points associated with tributaries and creeks, the physical attributes of the backwater area, and significant changes in the width of the floodplain were taken into account in identifying the break points between reaches. The reaches (C1 through C10) are used as EUs for aquatic receptors. Reach C1, which is the segment of Snow Creek included in OU-4, is evaluated

independently. The UAA is comprised of reaches C2 through C4, the middle AA includes reaches C5 and C6, and the lower AA includes reaches C7 thorough C10. (see Figure ES-1)

For terrestrial or semi-aquatic receptors, two types of EUs were selected. For those receptors that feed in association with Choccolocco Creek, a riparian corridor EU was established that includes the area from the creek bank to 100 feet into the floodplain on both sides of the creek. For terrestrial receptors, north and south EUs were established from the creek bank to the edge of the 100-year floodplain. This approach is similar to the inner and outer EUs developed to support the human health risk assessment for OU-4. The EUs are shown on Figure ES-1.

Summary of Approach

To estimate risk to the range of receptors identified in the problem formulation, a range of HQs or toxicity threshold/benchmark comparisons were used. The four types of HQs calculated in the OU-4 BERA include 1) HQs based on abiotic media exposure point concentrations (EPCs) compared to media-based toxicity benchmarks, 2) HQs calculated based on modeled prey tissue concentrations and dietary toxicity reference values (TRVs), 3) HQs calculated based on measured prey tissue concentrations and dietary TRVs, and 4) HQs based on measured tissue concentrations and tissue-based critical tissue concentrations (CTCs). For benthic invertebrates, comparisons to literature-based toxicity benchmarks or site-specific toxicity thresholds were made on an individual sample point basis. For PCBs and mercury in sediment for receptors other than benthic invertebrates, a probabilistic approach was used to calculate a 95th percentile on the spatially-weighted boot strap mean within each reach and AA. The spatially-weighted EPC calculation methodology for Choccolocco Creek sediments accounts for different sampling intensities, spatial extent of textural classes, and PCB or mercury concentrations observed across fine, coarse, and gravel areas sampled in the RCRA Facility Investigation and Field Sampling Plan collection programs. For metals other than mercury, sufficient data were not available to estimate spatially-weighted concentrations. Thus, sediment EPCs for these COPCs as well as all tissue EPCs and soil EPCs for floodplain and riparian EUs for all COPCs were based on the lower of the maximum detected concentrations or 95% Upper Confidence Limit (UCL) concentrations for an AA and/or an EU, when data were sufficient for calculation of this statistic. PCDD/PCDFs were evaluated in a similar manner, but for each sample, toxic equivalent (TEQ) concentrations were estimated by applying toxic equivalency factors to the PCDD/PCDF and dioxin-like PCB congener data and summing the values. UCLs were then calculated for TEQs.

The four types of HQs were calculated as appropriate for the various receptors. Exposure to lower trophic-level receptors was estimated using abiotic media-based EPCs as well as tissue-based EPCs when appropriate effects data were available for comparison. For birds and mammals, exposure was estimated for each receptor using two dietary exposure models: one using measured prey tissue to estimate a daily dose, and one using uptake models or bioaccumulation factors (BAFs) to estimate prey tissue concentrations. The uptake model and BAFs were developed using proximally located soil/sediment and tissue data collected within OU-4. When OU-4-specific data were not available or limited, tissue estimates were based on uptake models from the literature. In addition to the dietary exposure models, a tissue-based exposure model was employed when sufficient toxicity data were available to develop CTCs for comparison. Exposure parameters, toxicity benchmarks (for lower trophic level receptors), dietary TRVs, and CTCs were selected based on the best available science and discussions with USEPA. The resulting media-based, dietary, and tissue-based HQs provide quantitative estimates of risk in each of the OU-4 EUs and/or AAs.

Effects to ecological communities based on the site-specific data collected were quantitatively evaluated, where applicable, for abundance (total number of individual organisms), taxa richness (total number of individual species), EPT Index (sum of taxa in Ephemeroptera, Plecoptera, and Trichoptera), diversity (Shannon Diversity Index; Shannon

1948), tolerance (Hilsenhoff Biotic Index, Hilsenhoff 1988), dominance (Simpsons Dominance; Gotelli and Chao 2013), and plant cover. Although there is variability in the ecological communities for the two years evaluated (2006 and 2007), overall results suggest no adverse effect of PCBs or other COPCs on communities of benthic invertebrates, soil invertebrates, fish, birds, or mammals; and overall conditions within OU-4 appear to be comparable to reference areas.

Statistical comparisons between OU-4 and reference areas, and among OU-4 AA soil, sediment, and tissue concentrations were conducted for PCBs and mercury. In most cases, concentrations of PCBs and mercury in OU-4 media are higher than in reference areas, although it is important to recognize that these comparisons do not specifically indicate risk. Comparisons among AAs indicate that for mercury, there was no upstream to downstream trend in concentrations in sediment or biotic tissue. There was a detectable up to downstream trend in soil for mercury, similar to that of PCBs. Sediment data were also sufficient for statistical evaluation of non-mercury metals. Reach C1 was different from reference conditions, but the UAA, MAA, and LAA were not. For other COPCs in soil and tissue, sample size was sufficient only for qualitative comparison. In most of the qualitative comparisons, no apparent upstream to downstream trend was observed in media concentrations, indicating that these COPCs are not likely site-related.

In conducting the weight of evidence analysis, the range of HQs estimated was considered, and the one with the highest confidence was selected as the primary line of evidence. Ecological community analysis and other lines of evidence were used as secondary or supporting evidence. Uncertainties and the level of conservatism associated with each approach were considered to provide a confidence rank for each approach that are collectively considered to formulate weight of evidence conclusions, as presented on Figure ES-2 (attached). Although HQs for COPCs other than PCBs are greater than 1 in some parts of OU-4, there is no apparent upstream to downstream trend in concentrations of other COPCs in OU-4 media, indicating that the other COPCs are not site-related and PCBs are the primary site-related COPC. The only exception is mercury in soil where there was a detectable upstream to downstream trend; however, the trend was similar to that of PCBs. Therefore, the weight of evidence is focused on predicted risks for PCBs. The potential for risk is determined for all lines of evidence, and the relative conservatism and uncertainty associated with each line of evidence was considered to determine overall confidence. The line of evidence with the highest confidence was employed to determine an overall risk finding. Other lines of evidence were also considered in final weight of evidence decision making, particularly when there was disagreement between multiple lines of evidence with similar confidence. The elements of the weight of evidence are:

- Potential for risk: To identify the potential for risk for the HQ line of evidence for all receptors except benthic invertebrates, the weight of evidence analysis assigns ranks to HQs based on the TRV or toxicity benchmark (no observed adverse effect level [NOAEL] or lowest observed adverse effect level [LOAEL]) and magnitude of the HQ. Predicted risk is considered negligible or *de minimis* when the HQs are less than or equal to 1 using NOAEL TRVs or NOAEL-equivalent toxicity benchmarks, and low when NOAEL HQs are greater than 1 but LOAEL or LOAEL-equivalent HQs are less than or equal to 1. When LOAEL HQs are greater than 1 but lower than 10, predicted risk is considered moderate, and when LOAEL HQs are greater than 10, predicted risk is considered high. For benthic invertebrates, sediment concentrations were compared to site-specific toxicity thresholds and literature-based toxicity benchmarks on an individual sample point basis. Results are discussed as a percentage of samples in each EU that exceed a toxicity threshold. Comparisons for risk characterization are made based on the most sensitive reproductive endpoint. The categories include:
    - Concentrations primarily less than the no site-related effect concentration (EC0*) = predicted risk is considered negligible.
    - Concentrations primarily greater than the EC0*, but less than the EC10* = risk is considered low.
    - Concentrations primarily greater than the EC10*, but do not exceed the EC20* = risk is considered moderate.
    - Concentrations primarily greater than the EC20* = risk is considered high.

Given the high level of uncertainty in the reproductive endpoint relative to potential population level risk, comparisons were also made to the site-specific survival toxicity thresholds for perspective. For the other non-HQ lines of evidence, when no difference was observed between OU-4 and reference conditions or when OU-4 conditions were found to be of higher quality than reference conditions, no adverse effect from PCBs or other COPCs on ecological communities was assumed.

- Conservatism: Conservatism in the lines of evidence are assigned a rank of low, moderate, or high, with higher conservatism being associated with the use of more generic exposure and effects information that have higher potential to overestimate risk.

- Uncertainty: The level of uncertainty associated with the inputs for each line of evidence is considered. All lines of evidence have some level of associated uncertainty, and thus the level of uncertainty is considered relative to the lines of evidence available for a specific assessment endpoint.

- Confidence: Confidence in the risk findings is assigned a rank of high, moderate, or low. The confidence ranking is associated with the level of conservatism as well as uncertainty in the exposure and effects estimates. Increased use of site-specific information in the HQ calculations is assumed to result in more realistic, less conservative, and less uncertain risk estimates in which a higher level of confidence can be placed.

The potential for risk, level of conservatism, and uncertainty in the risk findings were combined to produce an overall confidence rank for each line of evidence for each receptor. The final weight of evidence conclusion for each receptor was based on the line of evidence with the highest confidence, with consideration given to other lines of evidence. For lines of evidence with the same confidence ranking, professional judgment was used to identify the line of evidence used to make the final weight of evidence risk finding.

Key Findings of Potential Risk

The weight of evidence risk results for PCBs are summarized in Figure ES-3 (below) for benthic invertebrates and in Table ES-2 (below) for other lower trophic receptors (i.e., aquatic and terrestrial plants, fish, and terrestrial invertebrates). The predicted risks for ecological receptors exposed to PCBs in OU-4, based on the line of evidence with the highest confidence (i.e., most site-specific and least uncertain), are summarized below.

- PCB risk to lower trophic level receptors is considered to be negligible for aquatic and terrestrial plants and terrestrial invertebrates in all AAs and EUs except for C1[3].

- Risk is considered moderate or low for fish, with predator fish indicating slightly higher risk than forage or bottom fish.

[3] Moderate risk to aquatic and terrestrial plants was indicated for reach C1 (West only for terrestrial plants). This EU was not assessed for the highest confidence line of evidence for terrestrial invertebrates because tissue data were not available. The secondary line of evidence indicated moderate risk to terrestrial invertebrates in this EU.

Table ES-2. Potential Risks Predicted for Lower Trophic Level Receptors Exposed to PCBs in OU-4 based on the Weight of Evidence

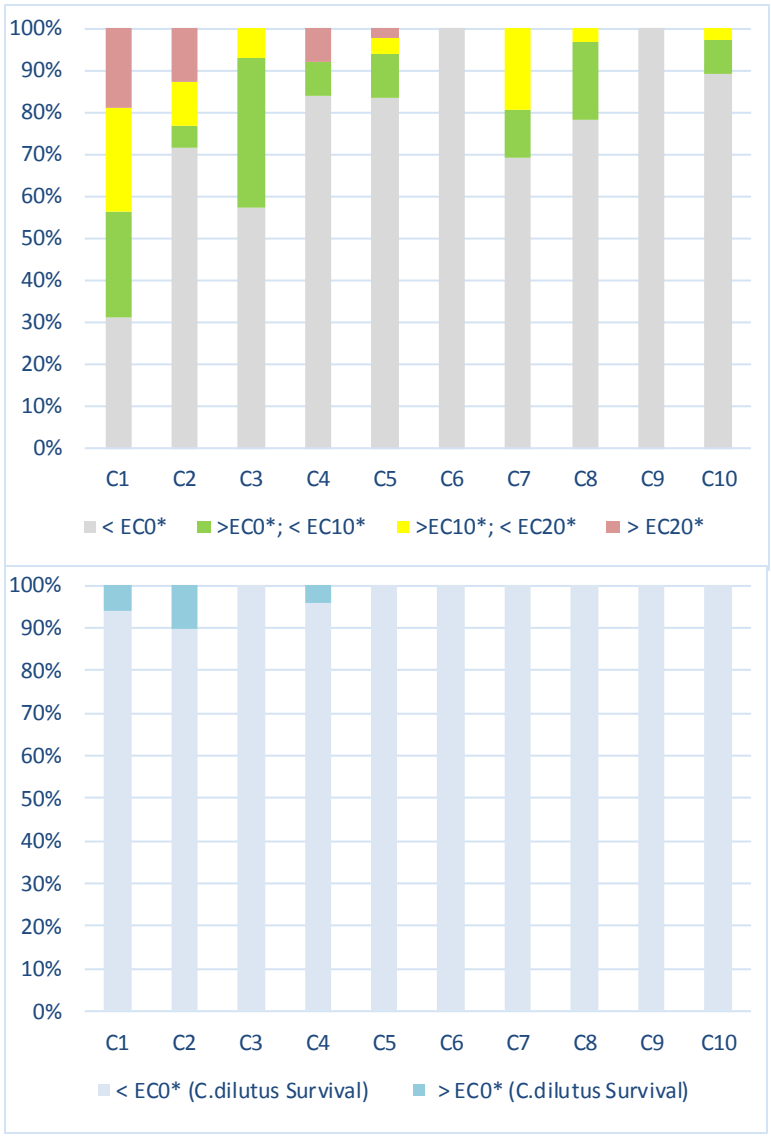
Receptors	OU-4 Reaches									
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10[a]
	UAA				MAA		LAA			
Aquatic Plants[a]	M	N			N		N			
Forage Fish[a]	na	L			L		L			
Bottom Fish[a]	na	M			L		M			
Predator Fish[a]	na	M			M		M			
Terrestrial Plants	M	N	N	N	N	N	N	N	N	N
Terrestrial Invertebrates[a]	na	N			N		N			

[a] results based on assessment area exposure point concentration (EPC) rather than reach EPCs.
L: low risk; M: moderate risk; N: risk is negligible (de minimis)
na: Reach C1 was not assessed based on the line of evidence with highest confidence because tissue data were not collected in this reach. See footnote 3.

- For benthic invertebrates, sediments were compared to the EC0*, EC10*, and EC20* of the most sensitive endpoint (i.e., *H. Azteca* 42-day young/female [normalized to survival]) as well as to the most sensitive survival endpoint for each species tested. For PCBs (mg/kg dry weight), based on the most sensitive reproduction endpoint, risk is considered negligible in 77% of samples, low in 12% of samples, moderate in 8% of samples, and high in 4% of sediment samples, primarily in reaches C1 and C2 (see top chart in Figure ES-3). While there were a small number of individual point exceedances in lower reaches, the numbers were small (i.e., less than 10 samples with moderate risk predicted and one or two with predicted high risk for this endpoint). There is a moderate to high level of uncertainty associated with the 42-day young/female thresholds due to high variability in the controls for that test. For the survival endpoints, 6% of samples in reach C1, 10% in reach C2, and 3% in reach C4 exceeded the lowest survival EC0* and no samples exceeded the EC10* (see bottom chart in Figure ES-3). Thus, risk for a small portion of reaches C1, C2, and C4 is considered low for this endpoint, and risk for all other reaches is considered negligible. Conservatism for the survival endpoint is low and uncertainty is considered low to moderate. The benthic community analysis indicated that there is no difference between the structure, diversity, or abundance of benthic invertebrates in sediments of Choccolocco Creek as compared to reference areas; therefore, there is no apparent relationship between the relatively low range of PCBs in OU-4 sediments and potential risks to these communities. These findings of no impact to the community are consistent with the fact that the site-specific toxicity thresholds for survival are rarely exceeded in OU-4.

  Several threatened or endangered snail and clam species have been identified as potentially occurring in OU-4. HQs specific to molluscs (based on CTC tissue comparisons) were less than 1 for both NOAEL and LOAEL CTCs, indicating that these species are not likely at risk. This is further corroborated when considering that in a study published in 2015, the United States Fish and Wildlife Service (USFWS 2015) found that bivalves are less sensitive to OU-4 sediments than either the midge or amphipod evaluated under the site-specific sediment toxicity program.

Figure ES-3 Summary of Benthic Invertebrate Toxicity Threshold Exceedance Analysis



Notes

[a] EC0*, EC10*, and EC20* are the regression-predicted PCB or mercury concentrations that would cause an additional 0%, 10%, or 20% effect beyond the lowest response measured in the reference sediments. Most sensitive reproduction endpoint is *Hyalella azteca* young per female normalized to survival

Negligible risk when concentration is below EC0* for most sensitive reproduction endpoint
Low risk based on exceedance of EC0* for most sensitive reproduction endpoint
Moderate risk based on exceedance of EC10*for most sensitive reproduction endpoint
High risk based on exceedance of EC20* for most sensitive reproduction endpoint
Risk based on EC0* for most sensitive survival endpoint.

- For birds, risk is considered moderate for piscivorous species throughout OU-4. For insectivorous or invertivorous species as well as receptors with mixed terrestrial and aquatic diets, risk is moderate in the UAA (reaches C1 through C4) and negligible in the lower reaches. Carnivorous birds were found to have high risk in C1 West, low to moderate risk in the remaining EUs in reaches C1 through C5, and negligible risk in the lower reaches. Table ES-3 (below) summarizes the weight of evidence finding for each receptor group. These weight of evidence risk estimates are based primarily on high to moderate confidence in the dietary HQs based on mid-sensitivity avian TRVs using measured prey tissue. Carnivorous birds are the primary exception, with the dietary HQs estimated using modeled tissue having slightly higher weight than measured tissue.

- For mammals, weight of evidence risk estimates follow a similar pattern to birds (Table ES-3). Mammals consuming fish tend to have higher predicted risk than other non-piscivorous wildlife. Risk for piscivorous mammals is predicted to be high throughout OU-4 based on dietary HQs estimated using measured tissue from the three AAs, while predicted risk for aerial insectivores is moderate in the UAA and negligible in lower reaches. For carnivores, predicted risk is moderate in reach C1 West, low in reaches C1 East, C3, and C4, and negligible in the remaining reaches based on modeled prey tissue. Omnivorous mammals (which are assumed to consume fish) with mixed terrestrial and aquatic diets have low estimated risk throughout OU-4. For invertivorous mammals, the weight of evidence results are for tissue-based HQs and predicted risk is negligible throughout OU-4.

Table ES-3. Potential Risks Predicted for Birds and Mammals Exposed to PCBs in OU-4 based on the Weight of Evidence

	OU-4 Reaches									
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10[a]
		UAA			MAA		LAA			
Aquatic Birds										
Piscivores (heron)	M	M	M	M	M	M	M	M	M	M
Insectivores/Invertivores (sandpiper)	L	L	N	N	N	N	N	N	N	N
Aerial Invertivores (swallow)	M	M	M	M	N	N	N	N	N	N
Terrestrial Birds										
Herbivores (dove)	N (e) & M (w)	N	N	N	N	N	N	N	N	--
Insectivores/Invertivores (wren)	M	M	M	M	N	N	N	N	N	--
Omnivores (blue jay)	L (e) & M (w)	L	L	L	N	N	N	N	N	--
Carnivores (hawk)	M (e) & H (w)	M	L	M	N (n) & L(s)	N	N	N	N	--
Birds with Mixed Aquatic and Terrestrial Diet										
Insectivores/Invertivores (wren)	M	M	M	M	N	N	N	N	N	--
Aquatic Mammals										
Piscivores (otter/mink)	H	H	H	H	H	H	H	H	H	H
Aerial Invertivores (bat)	M	M	M	M	N	N	N	N	N	N
Terrestrial Mammals										
Herbivores (deer)	N	N	N	N	N	N	N	N	N	--
Insectivores/Invertivores (shrew)	N	N	N	N	N	N	N	N	N	--
Carnivores (weasel)	L (e) & M (w)	N	L	L	N	N	N	N	N	--
Mammals with Mixed Aquatic and Terrestrial Diet										
Omnivore – sediment/ riparian/floodplain (raccoon)	L	L	L	L	N	N	N	N	N	--
Omnivore – sediment/riparian (raccoon)	L	L	L	L	L	L	L	L	L	--

H: high risk (LOAEL HQ > 10); M: moderate risk (1 < LOAEL HQ ≤ 10); L: low risk (LOAEL HQ ≤ 1 and NOAEL HQ > 1); N: risk is negligible (*de minimis* [NOAEL HQ ≤ 1])

S: South; c: Central; n: North; r: Riparian; e: East; w: West

a: Floodplain soil/riparian soil not evaluated in reach C10; HQs not estimated for terrestrial and mixed diet receptors (--).

- Toxicity data for evaluation of PCB exposure to amphibians and reptiles are limited – as a result, HQs were not calculated for these receptors. Comparison of sediment, surface water, and tissue concentrations of PCBs measured in OU-4 media to the limited toxicity data available indicates that concentrations are similar to or below no or low effect concentrations observed. While there are uncertainties associated with this evaluation, the results suggest that risk to amphibians and reptiles exposed to PCBs in OU-4 is unlikely.

Uncertainty

In most cases, uncertainties associated with risk findings have been mitigated by selecting conservative inputs or approaches. Key uncertainties associated with HQ-based findings are associated with the TRVs, the spatial coverage of the measured tissue EPCs, the uptake models or BAFs, and site use assumptions. Site use was assumed to be 100% for each receptor in each EU and AA, and the EPCs for each EU and AA are based on an upper-bound estimate (i.e., maximum or 95% UCL). As such, this likely overestimates potential exposure. For birds and mammals, both mid-range and high sensitivity TRVs were developed based on the low end of the range of toxicity data, an approach that is designed to be protective of the most sensitive receptors, and therefore may overestimate toxicity for many species. However, for the most highly-sensitive bird species, because the weight of evidence findings are based on the mid-range sensitivity TRVs rather than the high sensitivity TRVs, risk to any highly sensitive species may be under estimated. While the vast majority of wild birds that have been evaluated for sensitivity have been found to have mid-range or low sensitivity to PCBs, several wild species have been identified as having high sensitivity. Three wild species with high sensitivity to PCBs – European starling (*Sturnis vulgaris*), ruby-throated hummingbird (*Archilochus colubris*), and the gray catbird (*Dumetella carolinensis*) – have been observed within OU-4. The high-sensitivity TRVs (based on domestic chicken toxicity studies) would predict risk approximately an order of magnitude higher than the mid-range sensitivity values.

For the majority of the HQ results, the HQ estimated using measured tissue was given highest weight. The primary uncertainty beyond the TRVs or CTCs employed for these HQs is the degree to which the collected tissue samples capture the full range of tissue concentrations across OU-4. The use of the 95% UCL was selected to mitigate this uncertainty in the measured tissue HQs. The soil-to-small mammal uptake model employed for carnivores also introduces uncertainty due to the lack of precisely co-located soil and tissue data used to derive the model. However, because a significant predictive relationship was found between soil and small mammal tissue, this model is considered to have low uncertainty relative to other BAFs employed in the BERA. Collectively, the uncertainties associated with the HQ results were considered to have moderate conservatism, and the HQ line of evidence was given a rank of moderate to high for the weight of evidence analysis.

Biological community analyses are always accompanied by some level of uncertainty. Key sources of uncertainty include 1) adequacy of sample size, which affects statistical power to detect differences, 2) similarity of reference locations to OU-4 locations, 3) seasonal or annual variability, and 4) detectability. These uncertainties were considered in the weight of evidence ranking of this line of evidence as low for most receptors.

Conclusions

PCBs are the primary risk driver in OU-4. This conclusion is based on the assessment completed for a wide range of COPCs and receptors, and supported by a robust set of site-specific data collected over the past two decades, supplemented by literature-based inputs when necessary and when recommended by USEPA. Concentrations of mercury are higher in OU-4 than in the reference areas; however, there is no upstream to downstream trend in mercury concentrations in either sediment or biotic tissue. In addition, while there is an upstream to downstream trend in mercury concentrations in floodplain soil, it was similar to that of PCBs. Considering other COPCs, there is no apparent upstream to downstream trend in the concentrations, indicating that those other COPCs are not likely site-related.

For aquatic receptors, predicted risks are highest for piscivorous birds and mammals exposed to PCBs in OU-4. These risks are driven by fish tissue PCB concentrations, which are similar throughout the site, demonstrating no clear upstream to downstream trend. Risk estimates with the highest confidence for all aquatic birds are moderate for all reaches, while for the aquatic mammals (mink and otter), predicted risks are high in all reaches. After the piscivorous birds and mammals, the greatest aquatic risk was predicted for fish, followed by invertivorous birds and mammals, and benthic invertebrates, in that order. These predicted risks decreased from upstream to downstream, similar to PCB concentrations in sediment and several biotic tissue types. For terrestrial receptors, carnivorous birds (represented by the red-tailed hawk) have the highest estimated risk, followed by insectivorous birds, carnivorous mammals, omnivorous mammals, and herbivorous birds and mammals.

The ecological community analyses for birds and mammals, used as a secondary line of evidence, compare favorably to reference areas. As a supporting line of evidence, the ecological community evaluation for birds and mammals within OU-4 indicates that receptor communities were either similar to reference, or there was no upstream to downstream trend in community conditions to indicate that any differences are attributable to PCBs or other COPCs. However, since small datasets and other uncertainties associated with the sampling design for community metrics makes this line of evidence uncertain, this information is provided as a secondary line of evidence.

For benthic invertebrates, predicted **r**isks are generally low. Risk to benthic invertebrate communities was evaluated based on individual sample point concentrations compared to site-specific toxicity thresholds. Based on the most sensitive reproduction endpoint, risk is considered negligible across the majority of samples, with a few samples indicating localized low, moderate, or high risk, primarily in reaches C1 and C2. Because of the uncertainty associated with the reproductive endpoint, survival endpoints were also considered, and results indicate negligible risk for the majority of samples and possible low risk for a small number of samples in reaches C1, C2, and C4 (see lower graph, Figure ES-3). The benthic community analysis indicated that there is no difference between the structure, diversity, or abundance of benthic invertebrates in sediments of Choccolocco Creek as compared to reference areas – therefore, there is no apparent relationship between the relatively low range of PCBs in OU-4 sediments and potential risks to these communities. These findings of no impact to the community are consistent with the fact that the site-specific toxicity thresholds for survival are rarely exceeded in OU-4.

A wide range of remedial goal options were estimated for OU-4 based on the results for the receptors evaluated in this OU-4 BERA (Table ES-4, below). For birds and mammals, the RGOs are specifically based on the food web model inputs employed for HQ calculations for all COPCs for which possible risk was indicated. For benthic invertebrates, RGOs are based on the site-specific sediment toxicity thresholds. The range of RGOs for PCBs based on the receptors evaluated in this OU-4 BERA spans more than two orders of magnitude. RGOs and their associated uncertainty will be considered in the feasibility study for OU-4 within the context of the overall risk management process.

Table ES-4. Summary of Remedial Goal Options

Constituent	Range of Sediment RGOs (mg/kg dw)			Range of Soil RGOs (mg/kg dw)	
	Benthic Invertebrates	Birds	Mammals [1,2]	Birds	Mammals
NOAEL-Based Remedial Goal Options (mg/kg)					
Total PCB (mid-range sensitivity) [1]	1.4 - 152	0.6 – 7.6	0.9 - 0.9	0.9 – 21	3.0 - 7.0
Total PCB (high sensitivity) [2]	--	0.06 – 0.7	0.3 - 0.4	0.09 - 2.0	--
Mercury	0.2	0.7 – 12	53 - 101	0.08 - 4.3	15 - 29
Barium	NC	221 – 3426	4431 - 12561	--	--
Chromium	43	13 – 132	16 - 185	22 - 105	118 - 202
Cobalt	NC	19 – 1846	65 - 1136	--	--
Lead	36	31 – 2122	1977 - 7288	3.5 - 143	563 - 1026
Vanadium	NC	5.3 – 56	552 - 1704	4.2 - 17	222 - 410
LOAEL-Based Remedial Goal Options (mg/kg)					
Total PCB (mid-range sensitivity)	1.4 - 152	1.8 – 23	2.8 - 2.8	2.8 - 64	20 - 45
Total PCB (high sensitivity)	--	0.2 – 2.1	0.3 - 0.8	0.3 - 6.0	--
Mercury	1.1	2.0 – 36	107 - 201	0.2 - 13	31 - 58
Barium	NC	443 – 6869	10351 - 29342	--	--
Chromium	111	14 – 139	19 - 218	23 - 110	139 - 237
Cobalt	NC	20 – 1893	89 - 1550	--	--
Lead	128	61 – 4243	3744 - 13801	7.0 - 286	1066 - 1943
Vanadium	NC	11 – 114	1102 - 3404	8.6 - 34	443 - 818

Notes:

[1]. For aquatic mammals, the PCB RGOs in the mid-sensitivity rows are for bat based on the small mammal TRVs.
[2]. For aquatic mammals, the PCB RGOs in the high-sensitivity rows are for mink and otter based on the mink reproduction and growth endpoint TRVs

-- : RGO not calculated; risk not predicted for this receptor group
LOAEL: lowest observed adverse effect level
mg/kg: milligrams per kilogram
mg/kg dw: milligrams per kilogram dry weight
NA: not applicable; constituent not evaluated in soil
NC: toxicity criteria unavailable; value not calculated
NOAEL: no observed adverse effect level
PCB: polychlorinated biphenyl
RGO: remedial goal option
TRV: toxicity reference value

References

BBL. 2005. Screening-Level Ecological Risk Assessment (SLERA) for Operable Unit 4 of the Anniston PCB Site, Revision 1. October 2005.

Gotelli, Nicholas J., and Robert K. Colwell. 2001. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. Ecology letters 4.4 (2001): 379-391.

Hilsenhoff, W.J. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc, 7(1):65-68.

Shannon, C.E. 1948. A mathematical theory of communication. Bell System Technical Journal, 27, 379–423.

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA 540 R 97 006. Office of Solid Waste and Emergency Response. June 5.

USFWS. 2015. Evaluation of the Toxicity of Sediments from the Anniston PCB Site to the Mussel *Lampsilis siliquoidea*. Version 2.0. Prepared for US Fish and Wildlife Service Alabama Field Office – Birmingham Suboffice, but MacDonald Environmental Sciences Ltd. and US Geological Survey Columbia Environmental Research Center. September 2015. Available online at https://www.fws.gov/daphne/contaminants/Anniston%20Mussel%20Tox%20Report_Final_2016-01-11.pdf

Table ES-1. Assessment and Measurement Endpoints
Summary Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
1) Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities	Are the levels of COPCs in soils (including floodplain soils), surface water, and sediments from OU-4 greater than toxicity benchmarks for the survival, growth, or reproduction of aquatic/terrestrial plants?	1a) Concentrations of COPCs in OU-4 soils (including floodplain soils), surface water, and sediments relative to benchmarks for survival, growth, or reproduction.
	Are the levels of COPCs in plant tissue from OU-4 greater than reference concentrations or CTCs protective of survival, growth, or reproduction of aquatic/terrestrial plants?	1b) Measured body burdens of COPCs in OU-4 plant tissue as compared to reference area(s) plant tissue and literature-derived CTCs, as available.
	Is the health of aquatic/terrestrial plant species collected in OU-4 outside the normal range for aquatic/terrestrial plant communities in the reference area(s)?	1c) Qualitative observations of plant condition and discoloration in OU-4 as compared to the reference area(s).
	Is the structure of aquatic/terrestrial plant communities in OU-4 outside the normal range for aquatic/terrestrial plant communities in the reference area(s)?	1d) Comparison of aquatic/terrestrial plant community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, for each habitat type in OU-4 to the reference area(s) or among OU-4 assessment areas.
2) Survival, Growth, and Reproduction of Benthic Invertebrate Communities	Are the levels of COPCs in sediments (including pore water) from OU-4 greater than benchmarks or toxicity thresholds for survival, growth, or reproduction of benthic invertebrates?	2a) Concentration of COPCs in OU-4 sediments (including pore water) compared to literature-derived toxicity benchmarks and site-specific toxicity thresholds.
	Are the levels of COPCs in benthic invertebrate tissue from OU-4 greater than reference concentrations or CTCs for survival, growth, or reproduction of benthic invertebrates?	2b) Measured body burdens of COPCs in OU-4 benthic invertebrate tissue as compared to reference area(s) benthic invertebrate tissue and literature-derived CTCs, as available.
	Is the survival, growth, or reproduction of laboratory-cultured benthic invertebrates exposed to sediments (including pore water and overlying water) from OU-4 significantly lower than those exposed to reference area(s) sediments?	2c) Survival, growth, and reproduction of Hyalella azteca and Chironomus dilutus.
	Is the structure of benthic macroinvertebrate communities in OU-4 outside the normal range for benthic invertebrate communities in the reference area(s)?	2d) Comparison of benthic invertebrate community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s) or among OU-4 assessment areas.
3) Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities	Are the levels of COPCs in soil (including floodplain soils) from OU-4 greater than toxicity benchmarks for survival, growth, or reproduction of terrestrial invertebrates?	3a) Concentrations of COPCs in OU-4 surface soils compared to literature-derived toxicity benchmarks.
	Are the levels of COPCs in terrestrial invertebrate tissue from OU-4 greater than CTCs for survival, growth, or reproduction of terrestrial invertebrates?	3b) Measured body burdens of COPCs in OU-4 terrestrial invertebrate tissue as compared to reference area(s) terrestrial invertebrate tissue and literature-derived tissue-based CTCs, as available.
	Is the structure of terrestrial invertebrate communities in OU-4 outside the normal range for terrestrial invertebrate communities in the reference area(s)?	3c) Comparison of terrestrial invertebrate community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s).

Table ES-1. Assessment and Measurement Endpoints
Summary Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
4) Survival, Growth, and Reproduction of Fish Communities	Are the levels of COPCs in surface water and/or sediments from OU-4 greater than literature-derived toxicity benchmarks for survival, growth, or reproduction of fish?	4a) Concentration of COPCs in OU-4 surface water and sediment compared to literature-derived toxicity benchmarks.
	Are the levels of COPCs in fish tissue from OU-4 greater than CTCs for survival, growth, or reproduction of fish?	4b) Body burdens of COPCs in selected fish species from OU-4 as compared to those in the reference area(s) and CTCs, as available.
	Is the structure of fish communities in OU-4 outside the normal range for fish communities in the reference area(s)?	4c) Comparison of fish community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s).
	Are fish health assessment results (e.g., external parasites, fish erosion, lesions, sex ration, age structure) comparable between OU-4 and the reference area(s)?	4d) Fish health assessment using anomaly codes similar to those in the Rapid Bioassessment Protocol (Barbour et al. 1999). Observations may include disease, deformities, external parasites, fin erosion, lesions, tumors, sex ratio, and age structure.
5) Survival, Growth, and Reproduction of Birds	Do daily doses of COPCs received by aquatic-dependent and terrestrial birds (including piscivorous birds, sediment-probing birds, invertivorous birds, carnivorous birds, and omnivorous birds) from consumption of/exposure to food and other media from OU-4 exceed toxicity reference values (TRVs) for survival, growth, or reproduction?	5a) Compare an estimated dietary daily dose of COPCs in prey based in OU-4 to relevant literature-based dietary TRVs. Daily dose estimated using modeled and measured prey tissue concentrations.
	What is avian community structure and habitat use in OU-4 and the reference area(s)?	5b) Comparison of avian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to reference area(s) or among OU-4 assessment areas.
	Do the predicted concentrations of COPCs in bird eggs exceed CTCs for bird eggs?	5c) Comparisons of predicted OU-4 egg COPC concentrations to literature-derived egg-based CTCs, as available.
6) Survival, Growth, and Reproduction of Mammals	Do daily doses of COPCs received by aquatic-dependent and terrestrial mammals (including carnivorous mammals, piscivorous mammals, invertivorous mammals [including shrews and bats], omnivorous mammals, and herbivorous mammals) from consumption of/exposure to food and other media from OU-4 exceed TRVs for survival, growth, or reproduction?	6a) Compare an estimated dietary daily dose of COPCs in prey based in OU-4 to relevant literature-based dietary TRVs. Daily dose estimated using modeled and measured prey tissue concentrations.
	Are levels of COPCs in tissues of small mammals from OU-4 greater than tissue-based TRVs protective of survival, growth, or reproduction or reference area(s) tissue concentrations?	6b) Measured body burdens of COPCs in selected mammal species in OU-4 as compared to those in mammals from the reference area(s) and CTCs, as available.
	What is the mammalian community structure and habitat use in OU-4 and the reference area(s)?	6c) Comparison of mammalian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to the reference area(s) or among OU-4 assessment areas.
	What is the habitat suitability of OU-4 and the reference area(s) for mink and river otter?	6d) Evaluate habitat suitability for the mink and river otter using habitat suitability index models or other methods as available.

Table ES-1. Assessment and Measurement Endpoints
Summary Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
7) Survival, Growth, and Reproduction of Amphibians or Reptiles	Are the levels of COPCs in surface water, sediment, and/or soil (including floodplain soil) from OU-4 greater than toxicity thresholds for survival, growth, or reproduction of amphibians and reptiles?	7a) Concentration of COPCs in surface water, sediment, and/or soil in OU-4 compared to literature-derived toxicity benchmarks, as available.
	Are the levels of COPCs in amphibian or reptile tissue from OU-4 greater than CTCs for survival, growth, or reproduction or reference area(s) tissue concentrations?	7b) Measured body burden of COPCs in selected herptile receptor tissue in OU-4 as compared to those in the reference area(s) and to tissue-based CTCs, as available.

Notes:

COPCs: constituents of potential concern

CTC: critical tissue concentration

OU-4: Operable Unit 4

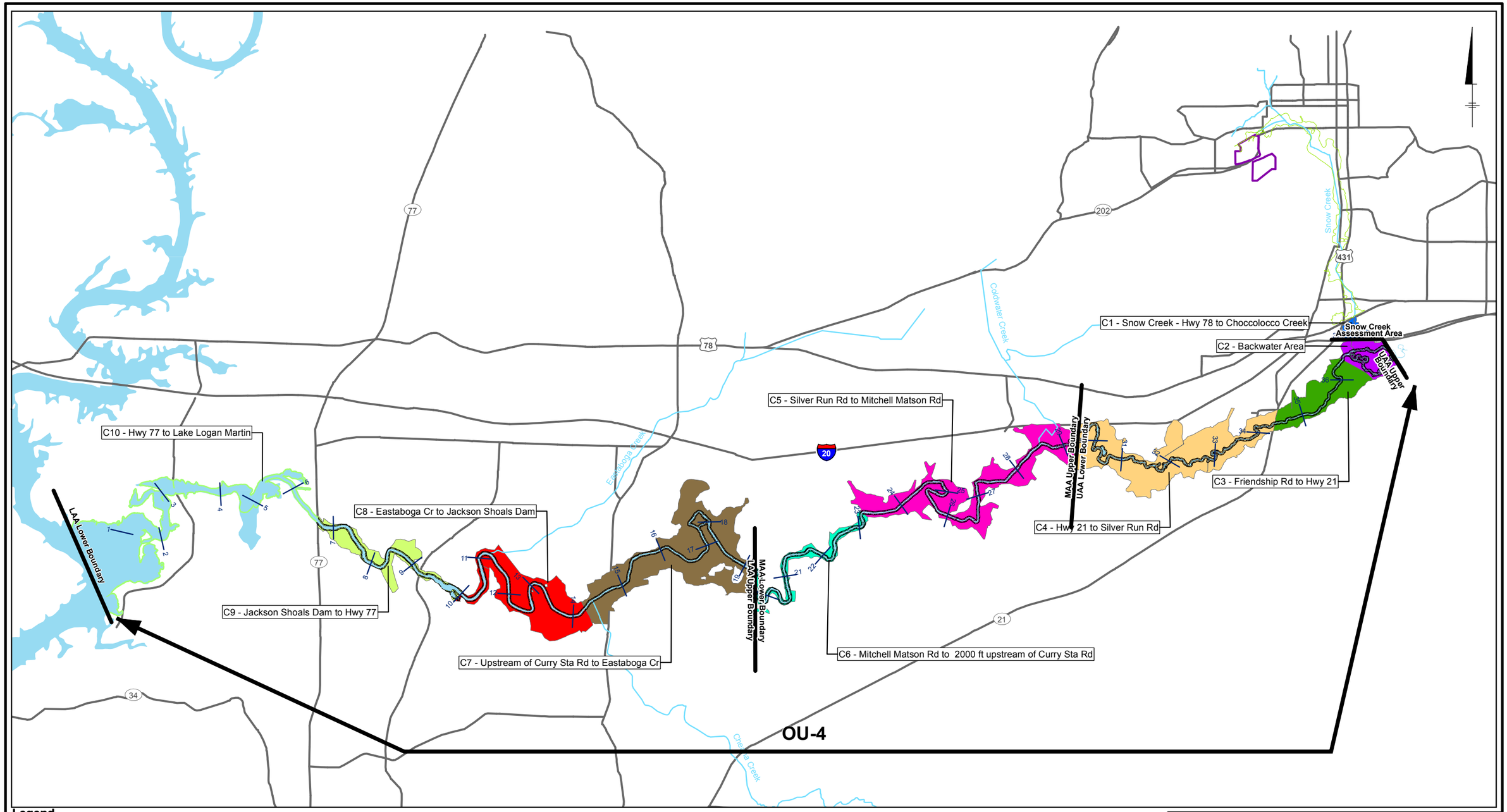
PCB: polychlorinated biphenyl

TRV: toxicity reference value

USEPA: United States Environmental Protection Agency

References:

Barbour, MT, J Gerritsen, BD Snyder, and JB Stribling. 1999. Rapid bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C..



Legend

- Assessment Area Boundary
- River Mile
- Other Tributaries
- Major Roadway
- Riparian Corridor
- OU-1/OU-2 Downgradient Floodplain
- OU-3 Boundary
- Choccolocco Creek

Ecological Reaches

- C1- Snow Creek - Hwy 78 to Choccolocco Creek
- C2 - Backwater Area
- C3 - Friendship Rd to Hwy 21
- C4 - Hwy 21 to Silver Run Rd
- C5 - Silver Run Rd to Mitchell Matson Rd
- C6 - Mitchell Matson Rd to 2000 ft upstream of Curry Sta Rd
- C7 - Upstream of Curry St Rd to Eastaboga Cr
- C8 - Eastaboga Cr to Jackson Shoals Dam
- C9 - Jackson Shoals to Hwy 77
- C10 - Hwy 77 to Lake Logan Martin

0 7,500 15,000 Feet

Graphic Scale

Acronyms:
Cr: creek
ft: feet
Hwy: highway
OU: operable unit
Rd: road
Sta: station

Anniston PCB Site
Anniston, Alabama

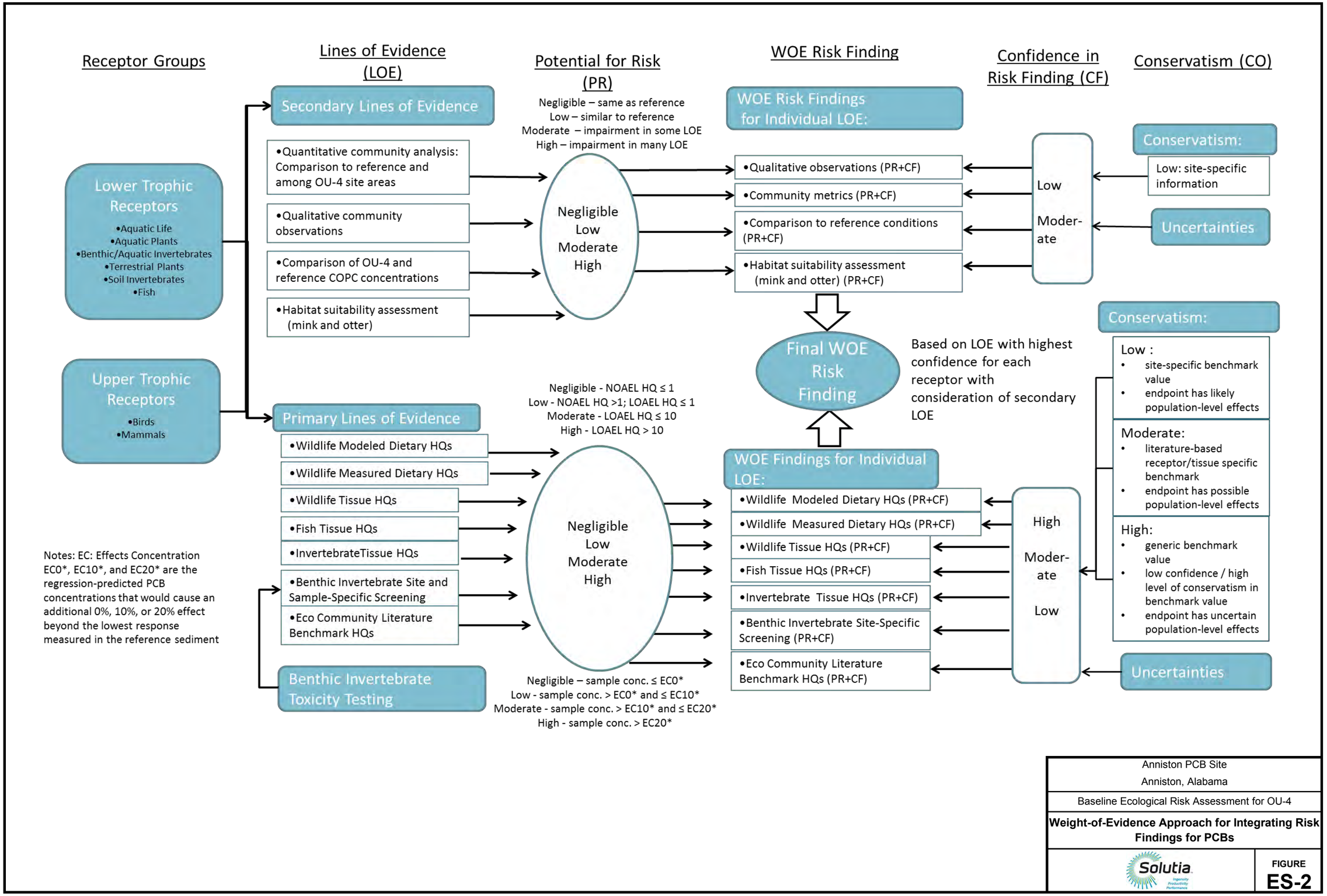
Baseline Ecological Risk Assessment for OU-4

OU-4 Ecological Reaches

Solutia

Figure
ES-1

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\EcoReaches_ES-1_v2.mxd 10/18/2016 5:19:54 PM



Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Weight-of-Evidence Approach for Integrating Risk Findings for PCBs

Solutia

FIGURE
ES-2

1 INTRODUCTION

This Baseline Ecological Risk Assessment (BERA) has been prepared by Arcadis U.S., Inc. (Arcadis) on behalf of Pharmacia LLC and Solutia Inc. (together Pharmacia LLC and Solutia Inc. are referred to as P/S) for Operable Unit 4 (OU-4), located at the Anniston Polychlorinated Biphenyl (PCB) Site (the Site). The Site is located in portions of Calhoun and Talladega counties in the north-central part of Alabama, near the City of Anniston. The Site has been investigated for the past 20 years based on the presence of PCBs and other chemical constituents that occur in various Site media. Geographically extensive, the Site encompasses the Solutia Inc. (formerly Monsanto) Anniston Plant (the plant) and grounds, residential and non-residential properties, and stretches of both Choccolocco Creek and Snow Creek and their floodplains. The Anniston PCB Site is not on the Superfund National Priorities List, but is being addressed through the Superfund Alternative Approach. The Site was divided into three operable units (OUs) to facilitate parallel evaluation efforts in the different areas, facilitate early actions, and streamline closure in specific locations, as appropriate (Figure 1-1).

The Operable Unit 1/Operable Unit 2 (OU-1/OU-2) area generally consists of both residential and non-residential properties within the Site upstream of Highway 78, up to and surrounding the On-Facility Area (OU-3). A *Streamlined Ecological Risk Assessment for the OU-1/OU-2 Portion of Snow Creek* (SERA) was conducted and finalized in September 2014. This document was approved by the United States Environmental Protection Agency (USEPA) in January 2015.

OU-4 encompasses the length of Choccolocco Creek and its floodplain from the confluence with Snow Creek downstream to the confluence of the Coosa River (Figure 1-1). OU-4 covers approximately 6,000 acres and includes a wide range of distinct habitats. At the downstream boundary of OU-4, Choccolocco Creek transitions from riverine to lacustrine conditions. OU-4 also includes the lower portion of Snow Creek and its floodplain between Highway 78 and the confluence of Snow and Choccolocco Creeks. This small area was included in OU-4 because it is more characteristic of Choccolocco Creek than the urbanized upper reaches of Snow Creek. The backwater area of Choccolocco Creek, located at the confluence with Snow Creek, is also included in OU-4. This area was identified in the *Resource Conservation and Recovery Act (RCRA) Facility Investigation for the Off-Facility Portion of the Site* (RFI; Blasland, Bouck & Lee [BBL] 2000b) as requiring additional characterization due to the depositional nature of the basin. This OU-4 BERA is focused on representative ecological receptors that may reside or forage within the terrestrial and aquatic habitat in OU-4.

Potential ecological risks for ecological receptors in OU-4 were initially evaluated in the *Screening-Level Ecological Risk Assessment for Operable Unit 4 of the Anniston PCB Site* (SLERA; BBL 2005b). Since completion of the SLERA, several reports and working technical memoranda have been prepared and submitted to the USEPA in preparation for this OU-4 BERA; these include:

- Baseline Problem Formulation for OU-4 of the Anniston PCB Site (Arcadis BBL 2006b)
- Phase 2 Field Sampling Plan for OU-4, including Development of Toxicity Reference Values for OU-4 as Appendix A (Arcadis 2009)
- Streamlined Ecological Risk Assessment for the OU-1/OU-2 Portion of Snow Creek (Arcadis 2014)

- Preliminary Site Characterization Summary Report for Operable Unit 4 of the Anniston PCB Site (PSCSR; ENVIRON 2014)

Comments received from the USEPA on these reports/memoranda have been considered and addressed in this OU-4 BERA.

1.1 OU-4 Baseline Risk Assessment Process

The purpose of this OU-4 BERA is to evaluate the likelihood that adverse ecological effects are occurring or may occur for local receptor populations as a result of exposure to constituents of potential concern (COPCs) in OU-4.

This OU-4 BERA follows the eight-step process outlined in the USEPA *Ecological Risk Assessment Guidance for Superfund* (USEPA 1997). The SLERA (BBL 2005b) completed for OU-4 includes Steps 1 and 2 in the USEPA's process (e.g., Step 1 – screening level problem formulation and effects evaluation and Step 2 – preliminary exposure estimates and risk calculations). This OU-4 BERA begins with Step 3 – baseline problem formulation[1]. The problem formulation (described in Section 2) includes the refinement of the OU-4 conceptual site model (CSM), and identification of assessment endpoints (AEs), measurement endpoints (MEs), and representative receptors that will be evaluated. The data quality objective portion of Step 4 (study design and data quality objective process) is addressed in Section 3. Study design (Step 4) and field verification of sampling design (Step 5) were not conducted for this OU-4 BERA because additional sampling was not required. Exposure and effects assessments (Step 6) to estimate potential exposure to the identified representative receptors and to identify appropriate toxicity and/or effects data are included in Sections 4 and 5, respectively. The risk characterization (Step 7), presented in Section 6, combines the exposure and effects components to evaluate risk for each receptor and exposure unit (EU) (Section 6). The risk characterization also includes an uncertainty analysis. Following these elements, a risk summary is provided based on the complete interpretation of all lines of evidence. Site-specific remedial goal options (RGOs) are also calculated for each receptor/COPC for which elevated risk was indicated (Section 7). It is expected that these RGOs along with the available ecological habitat and species community data will inform risk management decisions in the Feasibility Study for OU-4.

1.2 Document Organization

The remainder of this OU-4 BERA includes the following sections:

- Section 2 – Problem Formulation
- Section 3 – Data Summary
- Section 4 – Exposure Assessment
- Section 5 – Effects Assessment

[1] The baseline problem formulation conducted in 2006 was refined in this OU-4 BERA based on data collected during the Phase 1 ecological survey work conducted in 2006/2007 and Phase 2 ecological tissue sampling conducted in 2009, and technical input received from the USEPA since 2006.

- Section 6 – OU-4 Risk Characterization
- Section 7 – Remedial Goal Options
- Section 8 – Conclusions
- Section 9 – References

Several technical components supporting this OU-4 BERA are also provided as appendices. These include:

- Appendix A – Species Profiles for Wildlife
- Appendix B – Bioaccumulation Factor/ Model Development
- Appendix C – Analysis of Operable Unit 4 Sediment Toxicity Test Results and Development of Site-Specific Risk-Based Concentrations for Polychlorinated Biphenyls in Sediment
- Appendix D – Development of Benchmarks and Toxicity Reference Values
- Appendix E – Data Summary Tables and Risk Estimates Calculated for Operable Unit 4
- Appendix F – Dioxin Toxic Equivalent Assessment
- Appendix G - Indicators of Recovery in the Stream Minnow, *Campostoma oligolepis*, Inhabiting Snow Creek, Calhoun County, Alabama

Additionally, background information related to site characterization supporting this OU-4 BERA is provided in the PSCSR (ENVIRON 2014). The PSCSR contains details of all data collection for OU-4 including multiple habitat assessments which are appended to the PSCSR.

2 PROBLEM FORMULATION

Section 2 Summary

The problem formulation for this OU-4 BERA is presented in this section and includes the following information/components:

- Ecological Setting: OU-4 encompasses a variety of distinct habitats suitable for ecological receptors, including aquatic habitat within Choccolocco and lower Snow Creek, riparian corridor corresponding to the forested canopy along the creek edges, and terrestrial floodplain habitat consisting predominantly of maintained fields and successional fields, as well as some forested floodplain areas. These habitats were characterized during several independent site assessments conducted since 1997, and support a variety of aquatic, semi-aquatic, and terrestrial organisms.
- COPC Selection: Soil and sediment are the primary environmental media of interest in OU-4 and PCBs are the primary COPC. Seven other constituents in soil and sediment that may be present at elevated concentrations were also selected as COPCs and include barium (sediment only), cobalt (sediment only), chromium, lead, mercury, vanadium, and polychlorinated dibenzo-*p*-dioxin/ polychlorinated dibenzofuran (PCDDs/PCDFs)/dioxin-like-PCBs.
- CSM: Complete and significant exposure pathways evaluated in this OU-4 BERA include:
  - Soils/sediment and ecological communities of plants and invertebrates;
  - Surface water and aquatic life (aquatic plants, aquatic invertebrates, fish, and amphibians); and
  - Ingestion of prey associated with soil/ sediment or soil/sediment/surface water by direct ingestion and herbivorous, insectivorous, invertivorous, piscivorous, omnivorous, and carnivorous birds and mammals.
- AEs and MEs: Seven AEs were identified representing plants, invertebrates, reptiles, and amphibians as well as multiple trophic levels of birds and mammals in both the aquatic and terrestrial environments. Multiple MEs were evaluated for each AE. MEs include:
  - A range of hazard quotients (HQs) (based on dietary and tissue-based exposure models);
  - Site-specific sediment toxicity testing. Evaluated by comparing site sediment sample COPC concentrations to site-specific toxity thresholds and/or literature-derived toxicity benchmarks;
  - Quantitative evaluation of site-specific biological community data within OU-4 and compared to reference conditions;
  - Comparisons between OU-4 and reference conditions and/or and spatial trend analysis for abiotic and biotic media; and
  - Qualitative observations of ecological communities.
- Representative Receptors: Eight mammals and nine birds were selected as representative receptors. In addition, plants, invertebrates, reptiles/amphibians, and fish were evaluated in this OU-4 BERA.

Problem formulation defines the goals and establishes the scope and focus of an ecological risk assessment. The problem formulation for this OU-4 BERA includes an overview of the ecological setting, selection of COPCs, the aquatic and terrestrial ecological CSMs, the selection of AEs and MEs, and the identification of representative receptors. Each of these elements is discussed below.

2.1 Ecological Setting

OU-4 is the most geographically expansive of the three OUs delineated at the Site. It encompasses the majority of suitable habitat for ecological receptors and includes a variety of distinct habitats. Five investigations that characterized ecological conditions within OU-4 were performed between 1996 and 2008. These include:

1. *Intensive Water Quality and Biological Study of Choccolocco and Snow Creeks, Coosa River Basin* – this study included aquatic habitat characterization (including analysis of water quality) and benthic macroinvertebrate surveys and was conducted between 1995 and 1997 (Bayne 1997).
2. Off-Site RFI Habitat and Biological Assessment – the methods for this assessment were detailed in the *Supplemental RCRA Facility Investigation Work Plan for the Off-Site Portion of the RFI/CS Program* (Off-Site RFI Work Plan; BBL 1999a). The work was conducted in 1999, and the results were initially reported in the RFI Report (BBL 2000b). Land use and aquatic habitat characterization and benthic macroinvertebrate surveys were conducted.
3. Off-Site RFI Phase II Floodplain Surveys – the methods for these surveys were detailed in the *Phase II Off-Site (Floodplain) RFI/CS Investigation Work Plan* (BBL 2000a) and conducted in 2001 and 2002. Aquatic and floodplain habitat was characterized, and species counts for vegetation and wildlife were conducted in the floodplain areas. Results from these surveys were summarized in the *Phase I Conceptual Site Model Report for the Anniston PCB Site* (BBL 2003) and presented in more detail in the *Data Summary Report for Operable Unit 4* (BBL 2005a).
4. Remedial Investigation/Feasibility Study (RI/FS) Phase 1 Ecological Surveys – the methods for these surveys were detailed in the *Phase 1 Field Sampling Plan for OU-4 of the Anniston PCB Site, Revision 3* (OU-4 Phase 1 FSP; Arcadis BBL 2006a) and the work was conducted in 2006 and 2007. The 2006-2007 Phase 1 ecological surveys included observations of vegetation, aquatic benthic and terrestrial soil macroinvertebrate counts, fish species counts, wildlife observations, and species counts (including birds, mammals, and reptiles/amphibians). Results from these surveys were presented in the *Operable Unit 4 Phase 1 Ecological Survey Report* (ESR; Arcadis BBL 2007).
5. RI/FS Phase 1 Supplemental Ecological Surveys – in spring 2008, Arcadis performed focused reptiles and amphibian surveys within OU-4 and at the reference locations. Methods included terrestrial hand-searching (e.g., waded pond margins, swept vegetation, and turned logs, rocks, and debris within the floodplain), dusk choral surveys, and aquatic floats within creek and riparian corridor. Results were used to refine RI/FS Phase 2 Biological Sampling and the food web model for this OU-4 BERA and are presented in the OU-4 PSCSR (ENVIRON 2014), but are not formally presented in this OU-4 BERA.

In addition to the ecological characterization work, as a part of the RI/FS Phase 2 Biological Sampling, tissue samples (aquatic plants, emergent insects, benthic macroinvertebrates, whole fish, crayfish, molluscs, frog, snake, terrestrial plants, soil invertebrates, terrestrial insects, and small mammal) and

proximally located soil or sediment were collected for analysis of select metals, PCBs, and polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofuran (PCDD/PCDF) concentrations. Results from this sampling program are presented in the OU-4 PSCSR (ENVIRON 2014) and summarized in Section 3.4 of this OU-4 BERA.

The types of data collected and the associated studies in which the data were collected are summarized in Table 2-1. The rationale, activities performed, and the resulting data from these investigations are discussed in the sections below. A series of 11 figures are provided that show the sample and transect locations from each of these biological sampling areas (BSAs) within OU-4: upper assessment area (UAA; river mile [RM] 29 to RM 37), middle assessment area (MAA; RM 20 to RM 28), lower assessment area (LAA; RM 10 to RM 19) (Figures 2-1a through 2-1k). Figure 2-1a provides a key to the specific areas covered on each of the subsequent figures. Note that Snow Creek was assessed separately as a fourth area due to differences in habitat, hydraulic connectivity; and data collection activities (Reach C1; RM 37 to RM 37.4).

2.1.1 Aquatic Habitat

The aquatic habitats and benthic substrates and communities of Choccolocco Creek were characterized by Bayne (1997), by BBL (2000a, 2005b), and by Arcadis BBL (2007). The assessments were performed to evaluate the habitat and biological communities within and along the length of Choccolocco Creek.

Five general habitat types were identified, which include riffle, run, emergent aquatic vegetation (EAV), depositional, and backwater. In-stream habitat observations were dominated by riffles and EAV. The majority of both the riffle areas and EAV occur in the middle reaches of Choccolocco Creek, followed by the upper reaches (Figures 2-1b through 2-1k). Approximately 71 percent (%) of the total area of EAV and 62% of the total riffle area occurs between RM 18 and RM 26 (primarily in the MAA). No submerged aquatic vegetation was observed in the creek at the time the surveys were conducted. Snags are also present throughout the creek, but are not as abundant as deadfalls occurring along the shoreline (there are approximately 107 deadfalls compared to 46 snags). There are approximately 32 depositional islands surrounded by EAV. The majority of in-stream depositional areas are concentrated within the upstream reaches of Choccolocco and Snow Creeks (between RM 27 and RM 37 in C1 and the UAA); however, the majority of locations are depositional islands associated with EAV that occur within the middle reaches of the creek, similar to the general trend of EAV, as stated above.

The dominant creek bank features are characterized by a naturally vegetated shoreline, which accounts for approximately 85% of the total length of the creek bank within the study area. Following in abundance are areas where the creek bank is eroded. Erosional areas dominate the upstream (RM 27 to RM 37) and downstream (RM 9 to RM 17) reaches of the study area and are less abundant in the middle reaches. Deadfall is also abundant throughout the creek's reaches with the greatest number of deadfalls within the most upstream portions of the creek (between RM 27 and RM 37). Similar to in-stream depositional locations, areas of sediment deposition along the creek bank as point bars or beaches are also abundant in the upstream reaches, between RM 27 and RM 37. At least 21 tributaries or backwaters of various sizes can be identified along the creek, 11 of which occur in the upstream reaches between RM 27 and RM 37. Downstream of Jackson Shoal, Choccolocco Creek is under the hydraulic influence of Lake Logan Martin. The habitat in this reach of the creek is similar to the lake in that the velocity of the creek is greatly reduced, water depths increase, and the thickness of the sediment bed increases.

The predominant in-stream habitat at the lower end of Snow Creek between Highway 78 and the confluence of Snow and Choccolocco Creeks is characterized as a long run with virtually no sinuosity, and riffles are limited to small areas near bridge abutments associated with Highway 78 and Recreation Drive. Creek banks are almost always vegetated, and sediment deposits (and often, debris) are most noticeable around bridge abutments and are often vegetated. Deadfall was observed primarily along forested reaches of the creek. Figures 2-1b through 2-1k show the locations of the various aquatic habitat types and elements within OU-4.

2.1.1.1 Benthic Invertebrates

Benthic invertebrate communities were assessed as part of the 1996 Bayne (1997) ecological assessment of Choccolocco Creek and Snow Creek. A wide range of study sites were surveyed, including five creek locations within OU-4 and three reference creek locations (Figures 2-2a and 2-2b). At each benthic macroinvertebrate location, available microhabitats (e.g., rocks, logs, vegetation) were sampled. Biocriteria were calculated for each sample per the specification in Plafkin et al. (1989). The principal biocriteria metrics included taxa richness, the Ephemeroptera-Plecoptera-Trichoptera (EPT) Index, and the Hilsenhoff Biotic Index. Each location was then classified as severely impaired, moderately impaired, slightly impaired, or nonimpaired based on how it compared to its respective reference location. The results of the Bayne study (1997) indicate that the physical conditions in Snow Creek and sections of Choccolocco Creek have been greatly altered compared to the reference areas identified for the study. Human and agricultural activities—most notably agriculture, grazing, and inputs from wastewater treatment plants— have adversely impacted the physical habitat (e.g., due to disturbance from grazing animals to access drinking water) as well as the water quality in some areas. As a result, there are a number of areas within OU-4 and upstream of OU-4 that are impaired and have reduced ability to support biological communities relative to undisturbed reference locations.

Benthic invertebrates were also surveyed in September 1999 on Choccolocco Creek and in several tributaries, including Snow Creek (BBL 2000a) in conjunction with the Off-Site RFI program (Figures 2-2a and 2-2b). Quantitative ratings of aquatic habitat at the sampling locations were developed using the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (RBP; Barbour et al. 1999). Overall, most of the locations analyzed in Choccolocco Creek indicate a functional ecology typical of small, slow-flowing streams. These findings are consistent with the findings of Bayne (1997)—locations within Choccolocco Creek were slightly to moderately impacted (relative to unimpacted reference creeks), and based on instream habitat attributes, were partially or fully suited to support aquatic life.

Benthic invertebrate communities were most recently characterized during the Phase 1 ecological surveys during fall 2006 and spring 2007 for five different aquatic habitat types: backwater, depositional, EAV, riffle, and run within OU-4 and at reference locations. Survey methods followed general protocols detailed in the RBP guidance (Barbour et al. 1999), to include habitat assessment and non-chemical water quality measurements in conjunction with the benthic community. A sample and a replicate sample were collected at each location during the fall 2006 and spring 2007 surveys (Table 2-2). Mean total PCB concentrations for each habitat type in the area surrounding the sampling locations (i.e., upstream and downstream within ½ mile for a given sampling location) are also summarized in Table 2-2.

The dominant species within OU-4 was somewhat variable by season but generally included rock snails (*Leptoxis* sp.), mayflies (*Isonychia* sp.), caddisflies (*Cheumatopsyche* sp.), dipterans (primarily midges of

Chironomidae family and black fly larvae of *Simulium* sp.), clams, and damselflies (*Enallagma* sp.). The benthic community within reference location habitats was primarily dominated by rock snails, mayflies (*Baetis* sp. and *Stenonema* sp.), midges (Chironomidae family), dipterans, and water beetles (Coleoptera order). Dipterans were more dominant in both OU-4 and reference areas during spring surveys. In general, rock snails, caddisflies, and mayflies were primarily associated with harder substrates within riffle and run habitats amongst both OU-4 and reference locations. A wider variety of organisms including primarily tube worms (*Limnodrilus* sp.) and midges, along with pill clams (*Pisidium* sp.) were found in softer substrates. Communities associated with EAV habitats were more variable, but generally supported similar community assemblages (dominated by damselflies, rock snails, and tube worms) in both OU-4 and reference locations.

Survey locations within OU-4 and the reference locations for each study are shown on Figures 2-1b through 2-1k. A more detailed discussion of specific survey results is provided in the PSCSR (ENVIRON 2014).

2.1.1.2 Fish

Fish community surveys were performed during Phase 1 in fall 2006 and summer 2007 within OU-4 and reference locations consisting of four habitat types (riffle, run, backwater, and EAV). Results are summarized in Table 2-3. RBP guidance (Barbour et al. 1999) was used to assess general metrics for the evaluation of fish community structure, including: total number of species, total abundance, number of darter species, number of sunfish species, and number of sucker species. See Section 5.6.4 for analysis of fish community structure.

Species assemblages were similar between OU-4 and reference areas and between seasons. Dominant species (by number observed) within OU-4 riffles were tricolor shiner (C*yprinella trichroistia*), emerald shiner (*Notropis atherinoides*), and largescale stoneroller (*Campostoma oligolepis)* with Alabama hog sucker (*Hypentelium etowanum*) largescale stoneroller, and banded sculpin (*Cottus carolinae*) in reference riffles. Dominant species within OU-4 EAV habitats include bluegill (*Lepomis macrochirus*), mimic shiner (*Notropis volucellus*), and largescale stoneroller. Dominant species in reference EAV habitats were bluegill, longear sunfish (*Lepomis megalotis*), and largescale stoneroller. Dominant species within OU-4 runs included silverstripe shiner (*Notropis stilbius*), bluegill, longear sunfish, and blacktail redhorse (*Moxostoma poecilurum*), while dominant reference species were Alabama hogsucker, redbreast sunfish (*Lepomis auritus*), black redhorse (*Moxostoma duquesnei*), bluegill, and blacktail shiner (*Cyprinella venusta*). Similar number of darter, sunfish, and sucker species were observed between OU-4 and reference run habitats. Riffle habitat within the backwater reference locations was not readily available, making comparisons to OU-4 riffle habitat conditions generally limited. Dominant species within OU-4 backwaters that were accessed included bluegill, western mosquitofish (*Gambusia affinis*), and longear sunfish, while reference backwaters included bluegill and juvenile spotted suckers (*Minytrema melanops*).

2.1.1.3 Aquatic/Semi-Aquatic Wildlife Observations

Aquatic bird and mammal surveys and also reptile and amphibian surveys were conducted from canoes in 2006 and 2007. Additionally, focused reptile and amphibian surveys were performed in late March to early April 2008 to obtain further information on community presence and to refine both Phase 2 biological tissue sampling and food web model for this OU-4 BERA. These included terrestrial and aquatic survey

methods: terrestrial hand-searching (e.g., waded pond margins, swept vegetation, and turned logs, rocks, and debris within the floodplain), dusk choral surveys, and aquatic floats within the creek and riparian corridor. During spring 2007, aquatic bird and mammal surveys were performed at each of the reference locations and limited species observations were noted. While the intent of the surveys was to evaluate the aquatic species associated with the creek, a number of terrestrial species were also observed along banks. This discussion focuses on aquatic and semi-aquatic species and the full list of observations can be found in the ESR (Arcadis BBL 2007).

During the four seasonal (fall 2006 to summer 2007) float surveys performed within each assessment area (AA) of OU-4, at least 26 bird species (22 identified at the species level) were observed within the aquatic and riparian corridor habitats (Table 2-4). Based on local conditions (e.g., low light, distance) during the float surveys, several birds were not identified to species level, but were noted generally to family level (i.e., ducks, hawks, owls, and swallows). Of the 22 identified bird species, a total of 11 species are common to aquatic habitats. The most common aquatic species observed included the great blue heron (*Ardea herodias*), belted kingfisher (*Megaceryle alcyon*), and wood duck (*Aix sponsa*). The heron was observed with similar frequency in a range of habitats. The kingfisher was most commonly observed in canopy and overhang areas, while the duck was most commonly observed in run and depositional areas. Additional aquatic bird species included American anhinga (*Ahninga anhinga*), Canada goose (*Branta canadensis*), great egret (*Ardea alba*), green heron (*Butorides virescens*), hooded merganser (*Lophodytes cucullatus*), mallard (*Anas platyrhynchos*), American osprey (*Pandion haliaetus*), and snowy egret (*Egretta thula*).

During the four seasonal (fall 2006 to summer 2007) float surveys performed within each AA of OU-4, at least 14 mammal species (13 identified at the species level) were observed within the aquatic and riparian corridor habitats (Table 2-5). Based on local conditions (e.g., low light, track condition [i.e., red fox (*Vulpes vulpes*) versus grey fox (*Urocyon cinereoargenteus*)]) during the float surveys, a fox track within reference area 1 was not identified to species level. Four aquatic or semi-aquatic mammal species were observed by sight, sign, or track. The beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and raccoon (*Procyon lotor*) were most commonly observed (or signs/tracks were observed) in a variety of habitats, but all were commonly seen around deposition and mudflat/bank areas. The American mink (*Neovison vison*) was observed by track only in depositional, bank, or run habitats. Beaver, muskrat, raccoon, and white-tailed deer (*Odocoileus virginianus)* were the most common species between OU-4 and reference habitats. Additionally, evidence of river otters has been noted within OU-4 during site visits occurring after the 2006 and 2007 surveys (Truchon 2014, personal communication).

As part of the Phase 1 surveys, observations of reptiles and amphibians were recorded during the seasonal aquatic wildlife surveys conducted by kayak in 2006 and 2007 and the focused reptile and amphibian surveys in spring 2008. Observations were made in the creeks, along the banks and overhanging vegetation, as well as in habitats near the creek that were actively hand-searched by the crew. Results of the aquatic reptile and amphibian surveys are presented in Table 2-6. In total, 23 distinct species were observed along with four groups (unidentified tadpole, turtle, snake, and frog) that were observed, but were not able to be positively identified in the field. The most commonly recorded species during the aquatic surveys was the common map turtle (*Graptemys geographica*) being observed in 10 transects. In general, turtles were the most commonly recorded group having the top four most commonly observed species (common map turtle, common musk turtle [*Sternotherus odoratus*], river cooter [*Pseudemys concinna*], and snapping turtle [*Chelydra serpentina*]). The greatest number of reptile and

amphibian species observed in a single location was in the UAA in spring 2008 with 16 distinct species and three unidentified groups (unidentified frog, snake, and turtle) followed by the MAA also in spring 2008 with six species plus unidentified snake and turtle. More species were recorded in the spring than in other seasons which could be due to different survey methods and level of effort in the focused spring 2008 surveys, but could also be due to the greater reptile and amphibian activity level in the spring (many reptile and amphibian species breed in the spring; therefore, are more vocal and active and thus likely to be recorded then). More species were observed per transect in the AA (n=3) than the reference (n=0.8).

2.1.2 Terrestrial and Riparian Habitat

Habitat delineation and assessments in the floodplain of OU-4 were performed in 2001, 2002, 2006, and 2007. The prominent habitat types in the floodplain of OU-4 include two open land habitat types (maintained fields and successional fields) as well as forested floodplain. Figures 2-1b through 2-1k show the distribution of the three primary habitat types within the floodplain. Maintained fields include landscaped property, rights-of-way, mowed lawn, agriculture/silviculture/hay, and grazing by livestock or horses. Successional fields include areas in which herbaceous plants are dominant with little or no scrub/shrub layer; and areas with well represented scrub/shrub layer, intermixed herb layer and some larger saplings. Forested floodplain includes areas with canopy of varying density, with associated understory absent/sparse to well-developed. Other floodplain habitats include a small number of wetlands and open water areas that are separated from the creek and persistent.

The habitat assessments indicated that the floodplains along Choccolocco Creek are primarily comprised of a mix of second-growth forest and human-maintained areas. The distribution of these floodplain habitat types is relatively even between the confluence with Snow Creek and RM 19. The floodplain corresponding to RM 19 through RM 23 is narrow and bank slopes are extremely steep. The floodplain habitat in this area is primarily comprised of floodplain forest within the riparian corridor. Downstream of this area up to Jackson Shoals, a traditional floodplain is not present due to the control of the lake level through operation of the dams located on the upstream and downstream ends of Lake Logan Martin--the Neely Henry Dam and the Logan Martin Dam, respectively--along this lower portion of Choccolocco Creek (downstream of Jackson Shoals). In this area, the lateral extent of OU-4 is bounded by the water line of Lake Logan Martin under normal pool conditions (elevation 465 feet above mean sea level).

Agricultural and pasture land compose the majority of the non-forested land within the floodplain. Agricultural fields and pasture land were dominated by goldenrod (*Solidago* sp.), Japanese honeysuckle (*Lonicera japonica*), asters (*Aster* sp.), and various grasses during the survey of the 2001/2002 transects, while grasses and clover were most commonly observed during the survey of the 2006 transects. Early successional fields were the least frequently observed open land habitat. Open land habitats consistently showed lower diversity of vegetation and wildlife than forested areas likely due to the presence of vegetative monocultures and reduction in available habitat types for wildlife. The majority of forest habitats were categorized as forest edge habitats, both along the creek bank and field margins. Forested habitats were predominantly deciduous; frequently observed species included sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), American elm (*Ulmus americana*), and hickories (*Carya* sp.). Forest edge and small patch forests were more common than large, contiguous forest areas. Vegetation and wildlife observations were abundant in forested habitats. Isolated wetlands and open water made up the remaining habitat observations. With the exception of Choccolocco Creek itself, these habitats were not

frequently observed, and did not encompass large areas where observed. Alligator weed (*Alternanthera philoxeroides*) and switch grass (*Panicum virgatum*) were common species in these areas.

Approximately 600 acres of riparian area are present within the OU-4 floodplain (Figures 2-1a through 2-1k). Within the riparian areas (identified as the 100-foot buffer on either side of the creek[2]), the majority (517 acres of the approximately 600 total acres) of the area is characterized as forested floodplain. A diverse and highly functional riparian corridor exists along most of the creek. In some areas, the corridor is narrow and abutted by maintained fields (e.g., RM 35 to RM 36) while in others the riparian area is adjacent to other quality habitat such as forested floodplain (e.g., RM 30 to RM 31). The riparian corridor, while variable in width, is densely forested and forms an important buffer zone between terrestrial/human maintained areas and the creek. In most areas, the corridor contains a substantial number of large, older, well-established trees dominated primarily by box elder and sycamore. These trees provide an important canopy of cover for the creek and its bank habitats, and are an important factor in maintaining shoreline stability and creek habitat viability. Although these water-influenced habitats occupy approximately 10% of the project area, they are used by a disproportionate number of wildlife and plant species. The diversity of structure and cover provides nesting habitat, hiding and thermal cover, and food (insects, seeds, and vegetation) for a variety of bird and mammals species. The adjacent water provides a source of free water and food for aerial insectivores. In addition, riparian habitat also helps regulate light and temperature regimes and is a source of large woody debris, which can provide important instream habitat and stream stability. The riparian habitat also helps regulate water flow and nutrient load from upland areas (Naiman and Decampls 1990). Moreover, contiguous riparian zones create important corridors for wildlife that link a variety of ecosystems together and help maintain critical biodiversity (http://cowsandfish.org/pdfs/biodiversity.pdf).

Because of the recognized importance of the riparian habitat within OU-4, a conservation corridor was formalized in 2005 as part of a broader watershed framework for areas surrounding Choccolocco Creek. The program is in the land/easement acquisition phase and, currently, there are more than 1,200 acres under long-term easements established with a goal to protect and enhance water quality in Choccolocco Creek. These goals will be achieved by limiting development and agricultural practices adjacent to the creek and implementing long-term management practices that are consistent with the overall watershed management guidelines being implemented nationwide. Protecting the existing riparian corridors and buffers within the watershed will be a critical goal of the conservation corridor program.

2.1.2.1 Plants

Vegetation surveys were conducted in fall 2001 and spring 2002 (BBL 2005a) as summarized in Table 2-7. These investigations were conducted to characterize and categorize the various types of habitats present within Choccolocco Creek, the adjoining riparian areas along the banks of the creek, and the corresponding floodplain areas. During the surveys, roughly one-third to one-half of the floodplain habitats observed were categorized as maintained or unmaintained fields, with agriculture and pasture land comprising the majority of the nonforested land. The number of forest habitats, which were primarily deciduous forest patches and edge habitats, was similar to that of the open field habitats. Isolated wetlands and open water made up the remaining habitat observations.

[2] The riparian area along either side of the creek is variable and the 100-foot designation is an operational definition employed for the exposure assessment to insure that receptors that reside or forage within this zone are adequately evaluated.

In addition, during the course of the Phase 1 and 2 ecological surveys, general observations for the terrestrial plant community were made for OU-4 and reference areas based upon habitat types. These results are summarized in Table 2-8. During Phase 2 biological sampling, at each BSA, observations of dominant vegetation were made within each habitat to identify trees, shrubs, and herbaceous species in support of selecting the most suitable edible vegetation to support the food web model. Dominant vegetation within OU-4 and reference areas is summarized in Table 2-9.

For forested floodplain habitats, dominant tree and shrub species totaled 12 in common, while the herbaceous layer indicated three species in common. Green ash (*Fraxinus pennsylvanica*), box elder, and tulip tree (*Liriodendron tulipifera*) were the most common tree species observed. Chinese privet (*Ligustrum sinense*), common greenbriar (*Smilax rotundifolia*), eastern hophornbean (*Ostrya virginiana*), and red maple (*Acer rubrum*) seedlings were the most common shrub species observed. Clearweed (*Pilea pumila*), false nettle (Boehmeria), and Japanese stilt grass (*Microstegium vimineum*) were the most common herbaceous plant species observed.

For successional field habitats, dominant shrub species totaled five in common, while the herbaceous layer indicated 10 species in common. Blackberry (*Rubus fruticosus*) and elderberry (*Sambucus* sp.) were most common amongst the shrubs observed. Yellow foxtail **(***Setaria pumila*), goldenrod, ironweed (*Vernonia* sp.), and little bluestem (*Schizachyrium scoparium*) were the most common herbaceous plant species observed.

For maintained field habitats, dominant herbaceous plant species totaled five in common. Yellow foxtail, bahia grass (*Paspalum notatum*), and crabgrass (*Digitaria sanguinalis*) were the most commonly observed between OU-4 and reference areas.

Additionally, EAV within OU-4 and reference areas was generally observed during both the Phase 1 and 2 ecological surveys and tissue sampling. Based on these observations, the aquatic plant community within OU-4 and reference habitats surveyed appeared to be limited in availability and dominated primarily by alligator weed.

2.1.2.2 Terrestrial Invertebrates

Terrestrial soil macroinvertebrate surveys were performed during Phase 1 in spring 2007 within OU-4 and reference habitats using pitfall traps. Forested floodplain, successional field, and maintained field habitats were surveyed. Two locations per habitat type were surveyed within both OU-4 and reference areas. Table 2-10 summarizes the three sample replicate data collected at each location. General taxonomy was performed and common groups of taxon were sorted and counted to provide general observations of the terrestrial soil macroinvertebrate community.

A total of 16 taxon groups were identified across the OU-4 and reference areas surveyed. The most dominant taxon groups observed across all habitat types included Collembola (springtails) and ants. Harvestmen (*Opillionids* sp.), moths and butterflies (*Lepidoptera* sp.), aphids and cicadas (*Hemiptera* sp.), millipedes (*Diplopoda* sp.), and earthworms (*Lumbricina* sp.) were observed infrequently.

2.1.2.3 Terrestrial Wildlife Observations

Wildlife frequency was surveyed within each general habitat type during the fall 2001 and spring 2002 surveys, and the overall number of wildlife observations was similar between the two seasons. In general,

birds were the most commonly observed wildlife, and blue jays (*Cyanocitta cristana*) were observed frequently and in all habitat types. In the fall, wildlife observations were more common in forest and maintained field habitats than in wetland and/or successional field habitats. Wildlife, or signs of wildlife, were observed with similar frequency throughout the range of habitats in the spring, with the exception of observations in wetland habitats.

Wildlife observations made from floodplain transects along Choccolocco Creek included fish (fry), piscivorous birds, waterfowl, and turtles. For example, egrets (*Casmerodius albus*), great blue heron, and ducks (mostly mallard duck and, on occasion, wood duck) were common in the creek and in wet areas of the floodplain. The most common reptile/amphibian observed in the creek was the river cooter. Some of the more common wildlife observed along the creek by sign were white-tailed deer, groundhog (*Marmota monax*), and beaver. Small mammal trapping conducted in 2006 and 2007 provided variable results across habitat type and season. For example, the number of small mammals caught in each habitat type was similar (ranged from 16 to 24), but seasonally, higher numbers were caught in fall compared to winter and spring.

The number of wetland habitats identified during the spring increased approximately threefold compared to observations in the fall, while the number of wildlife observations in wetlands increased by a factor of four in the spring compared to the fall. Within the forest habitat regime, almost half of the observations in the fall were in forest edge habitats, while inner forest wildlife observations were most abundant in the spring. Seasonal fluctuations in habitat use by wildlife are expected, particularly in isolated wetlands. Seasonal observations provide information on the physical constraints of these ecosystems during high water. As a result of rain events, wildlife that were observed along the creeks during low surface water flow conditions in the fall were not observed as frequently during high surface water flow conditions in the spring (BBL 2000a). When considered together, observations of habitat attributes that are constrained by geophysical properties of the creek (e.g., steep banks) and the contrast of wildlife use between low and high surface water flows provide important information necessary to appropriately characterize OU-4 and to establish an accurate assessment of access to the creek by ecological receptors.

During the fall 2006 surveys, a total of 149 observations of 47 bird species were recorded. The winter 2007 survey was more limited than other seasons, and did not include any reference transects. For the spring 2007 surveys, a total of six OU-4 transects and five reference transects were surveyed. During the spring surveys, a total of 31 observations from 18 bird species were recorded. A summary of avian species occurring in each of the habitats is presented in Table 2-11.

During the Phase 1 2006 and 2007 surveys, seasonal observations of terrestrial mammals were conducted for transects in maintained field, floodplain forests, and successional fields. Survey crews of trained scientists recorded wildlife observations while walking along each of the established 200-meter wildlife transects. A total of six reference transects were established and surveyed as part of the terrestrial mammal observations. Wildlife observations included direct sightings as well as observations of calls and sign such as scat or tracks as presented in Table 2-12 for mammals and Table 2-13 for small mammals. The eastern coyote (*Canis latrans*) was the most common species recorded in all surveys. The forested cover type was the most diverse with observations of the armadillo (Cingulata), beaver, chipmunk (Tamias), grey squirrel (*Sciurus carolinensis*), raccoon, white-tailed deer, and long-tailed weasel (*Mustela frenata*) along OU-4 transects. Beaver, chipmunk, eastern cottontail rabbit (*Sylvilagus floridanus*), coyote, grey squirrel, bobcat (*Lynx rufus*), and white-tailed deer were observed in the reference area transects.

Domestic cattle (*Bos taurus*), eastern coyote, grey squirrel, and white-tailed deer were observed in the maintained field covertype within OU-4. Eastern cottontail rabbit, eastern coyote, white-tailed deer, and woodchuck (*Marmota monax*) were observed in the successional field covertype.

2.1.2.4 Terrestrial Reptiles and Amphibians

Similar to mammal and bird surveys, reptile and amphibian species were surveyed throughout OU-4 during the Phase 1 studies. Surveys included visual observations, hand searching, and audible observations of calls. The results of the reptile and amphibian surveys are presented in Table 2-14 and discussed below.

In total, 19 distinct species were recorded as well as three groups (unidentified tadpole, turtle, and frog) that were observed but were not able to be positively identified in the field. The most commonly recorded species in OU-4 were cricket frog (*Acris crepitans*), northern slimy salamander (*Plethodon glutinosus*), river cooter, and southern leopard frog (*Thobates sphenocephalus*) with observations in two transects each. The greatest number of reptile and amphibian species observed in a single event was in the spring 2008 surveys in the LAA (n=10 plus unidentified tadpole) and the UAA (n=8 plus unidentified frog and tadpole). Similar to the aquatic surveys, more species were observed in the spring than in other seasons, but this could be a result of the more focused surveys conducted in spring 2008. In general, more species were observed in the AA (1.9 per transect) than at the reference locations (0.6 per transect).

2.1.3 Summary

A wide range and substantial amount of aquatic and terrestrial ecological community and habitat data have been collected during five sampling events between 1996 and 2009 (Table 2-1). The terrestrial habitat studies indicated that the prominent habitat types in the floodplain of OU-4 include maintained fields, successional fields, and forested floodplain. Both the aquatic and terrestrial habitats support a wide variety of fish and wildlife species and the presence of these species is closely related to the quality of the habitat. The Choccolocco Creek riparian buffer zone is part of a larger conservation corridor currently being executed by the Alabama Land Trust and functions as a continuous habitat corridor through more anthropogenically-developed land types within OU-4. Notably, sensitive species, such as Wicker Ancylid limpet [*Rhodacmea filosa*] previously listed as an extinct species, as well as populations of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) which are organisms that are often most sensitive to pollution have been documented within OU-4 indicating that water quality conditions within Choccolocco Creek are sufficient to support the presence of these sensitive species.

The results of the aquatic and terrestrial habitat studies are used to support refinement of the CSM (Section 2.3), as MEs to evaluate some of the AEs for OU-4 (Sections 2.4 and 2.5) and as a line of evidence (LOE) in the weight of evidence (WOE) risk characterization assessment (Section 6.3).

2.2 COPC Selection

The COPC selection process is focused on constituents associated with Site operations. A total of 28 constituents were identified in the Partial Consent Decree (PCD) for the Site (USEPA 2002), which included 17 organic constituents (organophosphorous pesticides, volatile organic compounds, and semi-volatile organic compounds) and 11 metals (Table 2-15). In 2005, the USEPA requested that future

investigations at the Site include limited analyses (10% of the samples) for a “wider list of constituents” (USEPA 2005a). In addition to the 28 constituents on the PCD list, the wider list included PCDD/PCDF congeners, PCBs (as total of homologs as well as congeners, including the 12 dioxin-like [DL] PCB congeners and PCB congener 153), polycyclic aromatic hydrocarbons (PAHs), and seven additional metals (aluminum, antimony, copper, selenium, silver, titanium, and zinc).

The SLERA compared maximum detected concentrations of these chemicals in soil, sediment, surface water, and fish tissue available at that time to conservative ecological screening values (ESVs) developed for specific media (BBL 2005b). If an ESV was not available for a constituent, that constituent was not eliminated as a COPC. The abiotic data available for screening in the SLERA included data collected from 1999 to 2002 under the Off-Site RFI Work Plans (BBL 1999a and 2000a) and fish tissue collected in 1999 for mercury and from 2003 and 2004 for PCBs, and did not include the complete list of constituents that were defined by the PCD (USEPA 2002) and the USEPA “wider list”. As a result, any constituent for which data were not available was carried forward for further consideration. For soil, data were available for mercury and PCBs and the maximum detected concentrations exceeded respective soil ESVs. For sediment, data were available for all PCD metals and PCBs. The maximum detected concentrations of arsenic, chromium, lead, mercury, nickel, and PCBs exceeded respective sediment ESVs. The maximum detected concentration of cadmium in sediment did not exceed the sediment ESV, and sediment ESVs were not available for barium, beryllium, cobalt, manganese, and vanadium. For surface water, PCB data were available and the maximum detected concentration exceeded the surface water ESV. For fish tissue, mercury and PCB data were available and the maximum detected concentrations exceeded respective tissue ESVs. To summarize, only cadmium in sediment was eliminated from further consideration in the SLERA.

Subsequent to the SLERA, based on discussions and meetings with the USEPA and additional data collected since completion of the SLERA, an updated COPC evaluation was conducted. This evaluation was conducted to identify constituents present at concentrations above applicable screening thresholds in OU-4 and to use the adaptive site management process for COPCs as defined in the OU-4 Phase 1 FSP (Arcadis BBL 2006a) to assess whether the constituents should be carried forward in the RI/FS process. The steps of the adaptive site management process were the basis for the preliminary COPC discussions presented in the OU-4 Phase 1 FSP (Arcadis BBL 2006a) and the *Phase 2 Field Sampling Plan for Operable Unit 4* (OU-4 Phase 2 FSP; Arcadis 2010a). Based on previous investigations and the large amount of data available, the primary media of interest for OU-4 are soil and sediment. Although other media (air, surface water, and/or biota) may be impacted by COPCs, they are not evaluated for COPC selection because concentrations of COPCs in these media are generally a function of their concentrations in soil and sediment (primary exposure media). Based on the data collected from onsite areas (OU-1/OU-2) and the conclusions reached for those areas, air is not considered a medium of concern in OU-4 and therefore, is not evaluated in this OU-4 BERA. Groundwater is also not considered a medium of concern in OU-4 because there is no complete exposure pathway between ecological receptors and groundwater. Any exposure from a groundwater source would be evaluated as surface water.

In further evaluations conducted by the USEPA, which considered background concentrations, bioaccumulation, and the USEPA Region 4 sediment screening values, as discussed in their letter dated June 26, 2012 (USEPA 2012a), five constituents in soil and seven constituents in sediment—in addition to

PCBs—were identified by the USEPA as having potential risk implications (regardless of whether they were site-related). These constituents were carried forward for evaluation in this OU-4 BERA.

In soil, COPCs include PCBs, chromium, lead, mercury, vanadium, PCDDs/PCDFs/DL-PCBs. In sediment, COPCs include PCBs, barium, chromium, cobalt, lead, mercury, vanadium, PCDDs/PCDFs/DL-PCBs[3].

2.3 Conceptual Site Model

The USEPA guidance on conducting ecological risk assessments defines exposure pathways as "the paths of stressors from the source(s) to the receptors" (USEPA 1998). The USEPA (1997) describes a complete exposure pathway in terms of four components:

1. A source and mechanism of chemical release;

2. A relevant transport medium;

3. A receptor at a point of potential exposure to the affected medium; and

4. A route of uptake at the exposure point.

If any one of these four components is not present, a potential exposure pathway is considered incomplete and is not evaluated further in a risk assessment. If all four components are present, a pathway is considered complete. A food web is provided in Figure 2-3 describing the links between COPCs in source media in OU-4 and the receptors at different trophic levels in the food chain. The complete pathways and exposure routes identified for the aquatic and terrestrial food webs are shown in Figure 2-4.

2.3.1 Source and Mechanism

Documented elevated concentrations of PCBs in soil and groundwater at the Facility (OU-3) are the known source for historical deposition of PCBs to OU-1/OU-2 and subsequently to OU-4 primarily via movement of fine-grained particulates in surface water flow. These particulates have settled into OU-4 sediments and were deposited into floodplain soils during periods of overbank flooding. However, the source areas for the Site have largely been controlled, and the potential for ongoing transport into OU-4 is limited. Other COPCs present within OU-4 do not appear to be related to historical Facility releases, but instead are likely associated with the multiple natural and anthropogenic point and non-point sources, consistent with the known commercial and industrial land use in Anniston (ENVIRON 2014).

2.3.2 Fate and Transport of COPCs

The fate and transport properties of the COPCs identified in Section 2.2 are discussed below. For those constituents that are typically bound to soil and sediment (e.g., PCBs), the most important mechanism of fate and transport can be understood by examining erosional and depositional processes for soil and

[3] The detailed evaluation of PCDDs/PCDFs/DL-PCBs is presented in Appendix F to this OU-4 BERA. The general approach for evaluation is consistent with the approaches used herein. The relevant details and findings are presented throughout this OU-4 BERA, and a summary of the risk findings is included in the conclusions of this report.

sediment at the Site. Sediment particles may also be mixed within the sediment column or released to surface water through disturbance by benthic organisms, fish, turtles, or terrestrial organisms (Ingersoll et al. 1995). In addition to sediment transport, surface water transport, and dissolution, other mechanisms may be responsible for the relocation of soils and sediments containing COPCs in OU-4. These mechanisms may include the direct disposal of COPC-containing materials such as foundry sand, or the relocation of existing sediment, foundry sands, or floodplain soils. For other COPCs that are not lipophilic in nature (e.g., metals), surface water may be the primary fate and transport medium.

2.3.2.1 PCBs and PCDD/PCDFs

The majority of PCB or PCDD/PCDF mixtures found in the environment have low solubilities and vapor pressures, and slow rates of chemical, physical, and biological breakdown (World Health Organization [WHO] 1993a). These parameters tend to decrease in magnitude as the number of chlorine atoms in the PCB molecule increases (Mackay et al. 1992). This, together with a high affinity for organic carbon (OC), causes these compounds to be frequently associated with soils and sediments. Moreover, because PCBs and PCDD/PCDFs are persistent in the environment, they are subject to cycling and long-term deposition rather than quick degradation or metabolism.

PCBs and PCDD/PCDFs are readily soluble in various solvents (WHO 1993), including biolipids. PCBs and PCDD/PCDFs accumulate in aquatic organisms because of their high affinity for lipids and slow rate of metabolism and elimination (MacKay et al. 1992). High bioaccumulation potential has been documented for aquatic invertebrates, fish, and especially fish-eating birds and mammals at the highest trophic levels in the food chain where the uptake is enhanced by biomagnification (WHO 1993).

Although the transformation of PCBs and PCDD/PCDFs in aquatic systems can occur via microbial degradation in aerobic surficial sediments, reductive dechlorination in anaerobic sediments, and the metabolic action of organisms that uptake PCBs, these processes are relatively slow and congener-specific (National Research Council [NRC] 2001). For example, less-chlorinated congeners are more likely to biodegrade than those containing a higher number of chlorine atoms. This causes the mixture composition of released PCBs to change over time in favor of the highly chlorinated congeners, which tend to accumulate and biomagnify in biota to a great extent (NRC 2001).

Because PCBs and PCDD/PCDFs bioaccumulate, they are easily passed on to organisms occupying higher levels in the food web (NRC 2001). As a result, the potential exposure of ecological upper-trophic-level receptors to these compounds in aquatic systems is primarily a function of bioaccumulation; although, some organisms, especially the benthos, are exposed via direct contact with, or ingestion of, sediments or porewater.

2.3.2.2 Barium

Relatively little is known about barium's fate in the environment (WHO 1990); although, the limited information available indicates that barium is soluble and has a high affinity for the sulfate ion. Once bonded to sulfate, barium becomes insoluble and precipitates out of the water column. If no sulfate is present, barium remains in its ionic form and remains very mobile (WHO 1990). Both forms of barium, however, can be transported great distances in rivers, lakes, and streams. A similar interaction between barium and sulfate takes place in soil and sediment (WHO 1990). Barium salts may be subsequently sorbed by argillaceous (fine silt) elements. Barium in soils would normally not be expected to be mobile

because of the formation of water-insoluble salts and its inability to form soluble complexes with humic and fulvic materials. However, if colloidal clays are present, they may decompose the insoluble barium sulfate by sequestering the metal. Also acidic conditions may cause insoluble barium to become mobile by breaking down any salts (WHO 1990). Given the absence of any major removal mechanisms, the residence time of barium in aquatic systems is counted in hundreds of years (WHO 1990). The ultimate fate of barium is deposition onto the ocean floor or in available geologic faults. No information is available on barium levels in wildlife, and it is not possible to judge its bioaccumulation or biomagnification potential. Barium accumulates little in plants, even when the plants are exposed to high concentrations of this metal. The main emissions of barium to the environment are via the combustion of coal and diesel oil, waste incineration, and mining (WHO 1990).

2.3.2.3 Chromium

Mining and the combustion of fossil fuels and other materials may cause releases of chromium to air, surface water, and soil. These anthropogenic activities lead to the production of hexavalent chromium, which is very mobile and relatively stable in air and pure water, and therefore may be subject to long-distance transport. However, upon contact with organic matter or biota, hexavalent chromium is reduced to its trivalent form (WHO 1988a). That form clings to particles, which may be deposited onto soil or sediment. Once in soil, chromium tends to be immobile due to the formation of stable organic complexes. Even low pH is not able to leach chromium from soil. Trivalent chromium in water may form polynucleate complexes that are no longer soluble and precipitate out of the water column. As a result, soluble chromium generally accounts for a very small percentage of total chromium. Chromium compounds cannot volatilize from water, so most of the chromium released into water will ultimately be deposited in the sediment. Plants and animals may absorb both the hexavalent and trivalent forms of chromium (WHO 1988a); however, the hexavalent form is taken up in preference to the trivalent form. Once absorbed, hexavalent chromium is reduced to the stable, trivalent state. Although readily absorbed by various species, chromium is not expected to biomagnify in the aquatic food chain. There is some evidence that plants will take up chromium from soil via the root system; however, only a small fraction of the absorbed amount is translocated in the aboveground part of plants. Therefore, plant consumers may not be highly exposed. There is no indication of biomagnification of chromium along the terrestrial food chain (WHO 1988a).

2.3.2.4 Cobalt

The particulate form of cobalt is emitted to the atmosphere mainly as a result of power plant coal combustion (Agency for Toxic Substances and Disease Registry [ATSDR] 2004). Cobalt may be deposited onto land surfaces or surface water via precipitation and/or dry deposition. Cobalt can be transported as suspended sediment or as dissolved metal by rivers, streams, and lakes. Like most other trace metals, cobalt finds its way into sediment and soil where it accumulates. Re-mobilization from soil/sediment is possible, but only under special conditions (ATSDR 2004). Cobalt released into waterways may sorb onto suspended particles or transfer directly into the sediment. This process may be significantly reduced when competing dissolved organic substances, such as humic acids, are present. Humic substances naturally present in aquatic environments are capable of strongly sorbing many substances, including cobalt (ATSDR 2004). The strength of this association, however, is influenced by the pH, the nature of the humic material, and the concentration of the adsorbed substance. Cobalt present

in sediment may also be affected by redox conditions, and ionic strength. For example, cobalt transitions from the water column to sediment with increasing pH (from 5 to 7.5 standard units). In soil, cobalt may sorb to mineral oxides such as iron and manganese oxide and crystalline materials such as aluminosilicate and goethite (ATSDR 2004). Clay has a relatively low capacity to retain cobalt. Cobalt may be taken up by terrestrial plants, phytoplankton, zooplankton, aquatic invertebrates, and fish; however, cobalt levels generally diminish with increasing trophic level so biomagnification is not a problem with this metal. Any quantities of cobalt that may be retained in tissues enter the organism via dermal uptake rather than food. The metal largely accumulates in the viscera and the skin rather than muscle or lipid tissue (ATSDR 2004).

2.3.2.5 Lead

Particulate, non-organic forms of lead present in the atmosphere may be removed by wet or dry deposition (ATSDR 1999a). The wet deposition dominates this process with 40% to 70% of the total deposition attributable to wet fallout. The precipitated lead may be deposited onto surface water or soil. Once in water, the amount of lead that remains in solution depends on the pH and the dissolved salt content (ATSDR 1999a). However, in most surface waters with normal pH, the concentration of dissolved lead is low because lead is present as hydroxides, carbonates, sulfates, and phosphates characterized by low water solubility. These complexes tend to precipitate out of the water column (ATSDR 1999a), thus the major fraction of lead carried by rivers and streams is likely to be in the form of colloidal particles sorbed to mineral or organic particles or undissolved lead carbonate, lead oxide, or lead hydroxide. The fate of lead in soil and sediment is affected by adsorption to mineral interfaces, precipitation of insoluble forms of lead, and the formation of complexes with organic matter (ATSDR 1999a). In turn, these processes are dependent on such factors as pH, substrate type, particle size, organic matter content, the presence of inorganic colloids and iron oxides, cation exchange capacity, and the concentration of lead in soil or sediment (ATSDR 1999a). For example, as pH increases, the dissolved concentration of lead increases as well, leading to elevated availability and mobility of this metal. However, most lead is retained strongly in soil and sediment, and very little is transported into surface water. High organic matter content of soil and sediment reduces the mobility of lead. Plants and animals may bioconcentrate lead, but biomagnification has not been reported (ATSDR 1999a). In fact, the concentrations of lead in biota decrease with each trophic level. Thus, lead concentrations are usually highest in benthic organisms and algae and lowest in fish (ATSDR 1999a).

2.3.2.6 Mercury

Mercury behaves like many other metals in that it can exist in multiple oxidation states. This includes elemental (Hg^0), monovalent (Hg^+), and divalent mercury (Hg^{2+}) (WHO 1989 and 1991; ATSDR 1999b). All three forms of mercury can be found in any exposure medium including air, water, soil, and sediment. While air contains mostly elemental mercury, water, soil, and sediment are frequently associated with dissolved, particulate, and adsorbed divalent mercury. In the latter condition, stable complexes with OC immobilize mercury in the sediment layer (WHO 1989 and 1991; ATSDR 1999b).

In terms of biological transformation, inorganic mercury can be changed into organic methylmercury by the metabolic action of sediment bacteria (WHO 1989 and 1991; ATSDR 1999b). Organic mercury, although constituting a relatively small proportion of total mercury, is the form of mercury that is important in terms

of toxicity and accumulation in biota (WHO 1989 and 1991; ATSDR 1999b). Bioconcentration factors of methylmercury for aquatic organisms are elevated due to rapid uptake (measured in days) and slow depuration (measured in years) (WHO 1989 and 1991; ATSDR 1999b).

2.3.2.7 Vanadium

Migration, diffusion, and concentration of vanadium in the environment involves natural and anthropogenic releases, modification by physical and chemical parameters, and subsequent extraction by living organisms from water, soil, sediment, and food (WHO 1988b). The atmosphere is not an important transport medium of vanadium, and any quantities deposited via this route are small. The accumulation of vanadium in soils and in all other materials depends directly on its concentration in the soil-forming rocks, the atmosphere, and anthropogenic sources. The main carriers of vanadium in sedimentation include ferric hydroxides and solid bitumens (WHO 1988b). There is a great affinity between the trivalent vanadium and trivalent iron, and this relationship is important in controlling the diffusion of vanadium in sediments. The fate of vanadium dissolved in water is complex. There are two possible pathways in that medium, namely sorption and biochemical processes (WHO 1988b). In surface water, vanadium is mainly transported in the suspended form; however, the migratory qualities of vanadium in water are poor. Thus, very little vanadium is transported via water. In fact, vanadium dissolved in water is continuously removed either by sorption or biochemical processes. In the first case, the main precipitant is hydrated ferric trioxide. In the second case, vanadium is accumulated by plankton, animals, and less commonly by algal and plant organic material (WHO 1988b).

2.3.3 Exposure Media, Receptors and Exposure Pathways

As described in Section 2.1, past ecological investigations in OU-4 provide a great deal of site-specific information regarding the quantity and quality of habitat within OU-4. The delineation and assessment of floodplain and in-stream habitats of Choccolocco and Snow Creeks and corresponding observations on wildlife use provide a scientifically sound basis for identifying complete exposure pathways, evaluating potential risks and informing risk management needs for OU-4.

Based on the identified site sources and the fate and transport of COPCs, the primary exposure media for exposure to OU-4 COPCs are floodplain soil, sediment, and surface water. Once present in the primary abiotic exposure media, biological entities living, foraging, and reproducing in the exposure media may come into contact with COPCs. Depending on their physical and chemical characteristics, the COPCs may adsorb onto or be taken up by bacteria, plants, invertebrates, fish, small mammals, etc. These impacted organisms may then in turn become secondary exposure media (in addition to the primary exposure media) for organisms that may consume them. The lower trophic level organisms most likely to become secondary exposure media – such as algae, plants, invertebrates, and small fish and mammals – have been observed at OU-4; therefore, COPCs may be present in both primary and secondary exposure media.

In terms of direct exposure to primary exposure media, the receptor groups with the exposure potential to COPCs (solid circles in Figure 2-4) include aquatic and terrestrial plants, aquatic and terrestrial invertebrates, fish, reptiles/amphibians, and aquatic and terrestrial birds and mammals. These receptors are considered as potentially exposed because they are either in direct contact with sediment or soil

(benthic and soil invertebrates, fish, reptiles/ amphibians), or may ingest sediment or soil in their habitat or as part of their foraging activities.

In terms of exposure to secondary exposure media (i.e., consumption of impacted prey), almost every receptor group is considered potentially exposed. For example, aquatic insects may be consumed by fish, or if they morph into the emergent stage, by birds (Figure 2-3). The exceptions are the aquatic plants and invertebrates, which do not have a strong direct dietary link to lower level consumers.

Complete exposure pathways can be delineated into those expected to have more significant exposure potential (primary exposure pathways) and those that are complete but are expected to be minimal or insignificant compared to the identified primary exposure pathways. For example, dermal (or direct contact) between OU-4 COPCs and birds is considered an insignificant pathway (marked with a hatched circle on Figure 2-4) and is not quantitatively evaluated. This OU-4 BERA focuses on the complete primary pathways identified between soil, sediment, and surface water and ecological receptors that may reside or forage within OU-4. Primary pathways include direct contact with soil/sediment/surface water for lower trophic level receptors, and ingestion of food and incidental ingestion of soil/sediment/surface water during foraging activities for upper trophic level receptors. As shown in Figure 2-4 and discussed in Section 2.1, reptiles and amphibians have been observed within OU-4 and exposure pathways between these species and environmental media in OU-4 are complete. However, because sufficient toxicity data for reptiles and amphibians are not available, this pathway was not quantitatively evaluated. When possible, qualitative or semi-quantitative evaluation of reptiles and amphibians is included in the uncertainty analysis (Section 6.2).

For the aquatic habitats within OU-4, complete pathways identified as significant and subject to quantitative evaluation are:

- Sediments and benthic invertebrates
- Surface water and aquatic life (aquatic plants, benthic invertebrates, fish, and amphibians)
- Prey associated with sediment and herbivorous, insectivorous, invertivorous, piscivorous, omnivorous, and carnivorous birds and mammals
- Sediment/surface water and herbivorous, insectivorous, invertivorous, piscivorous, omnivorous, and carnivorous birds and mammals (direct incidental ingestion)

For the terrestrial habitats within OU-4, complete pathways identified as significant and subject to quantitative evaluation are:

- Soil and terrestrial invertebrates
- Soil and terrestrial plants
- Prey impacted by soil and herbivorous, invertivorous, omnivorous, and carnivorous birds and mammals
- Soil/surface water and herbivorous, insectivorous, invertivorous, piscivorous, omnivorous, and carnivorous birds and mammals (direct incidental ingestion)

2.4 Assessment Endpoints

The USEPA (1998) defines an AE as an ecological entity and its measurable attributes. AEs are formal expressions of the actual environmental value to be protected from risk (Suter et al. 1993) and are typically tied directly to specific ecological values needing protection. Furthermore, AEs provide a clear, logical connection between regulatory policy goals and ecotoxicological investigations.

The AEs identified for evaluation in this OU-4 BERA are based on the complete and significant exposure pathways identified in the CSM (Section 2.3). Observations of species and prey types present within OU-4 (e.g., vegetation, invertebrates, fish, frogs, snakes, and mammals) were used to refine the CSM and inform selection of specific AEs, including which bird and mammal feeding guilds are likely to have the highest potential exposure. Consistent with Principle No. 1 of the USEPA's Office of Solid Waste and Emergency Response Directive *Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (USEPA 1999), which states that "Superfund's goal is to reduce ecological risks to levels that will result in the recovery and maintenance of healthy local populations and communities of biota," each AE is intended to protect the local populations of the identified resources. Thus, defining appropriate AEs avoids decisions made on the basis of trivial or insignificant effects. Seven AEs were identified for OU-4 and are evaluated in this OU-4 BERA. The AEs represent plants, invertebrates, reptiles, and amphibians as well as multiple trophic levels (i.e., herbivores, insectivores, omnivores, piscivores, and carnivores) of birds and mammals in both the aquatic and terrestrial environments. The AEs are summarized in Table 2-16.

2.5 Measurement Endpoints and Risk Questions

The AEs established for OU-4 cannot be directly measured; therefore, MEs related to each AE were defined based on specific risk questions for each AE. MEs are quantitative expressions of observable or measurable changes that are used to evaluate the effects of chemical stressors on AEs (USEPA 1997). The MEs are used in a WOE approach to make inferences about the potential effects to the AEs.

Individual risk questions (as testable hypotheses) and associated measures of effect for each AE were detailed in the OU-4 Phase 2 FSP (Arcadis 2010a). Subsequently, based on additional input from the USEPA, the AEs, MEs, and risk questions were further refined. A summary of the current AEs, MEs, and risk questions for assessing risk to ecological receptors in OU-4 is provided in Table 2-16.

To answer the risk questions and assess potential risk to ecological receptors that forage and reside in OU-4, site-specific data were collected, where feasible. Otherwise, literature-based inputs/values were used. Some of the risk questions and MEs identified cannot be addressed in a quantitative manner due to a lack of toxicity data (e.g., for reptiles and amphibians) in this OU-4 BERA and are evaluated qualitatively in the uncertainty analysis. The uncertainties associated with the non-site-specific inputs and qualitative evaluation of these risk questions and MEs are addressed in the uncertainty analysis (Section 6.2).

Seven AEs were defined for the survival, growth, and reproduction of the aquatic and terrestrial receptor communities found within OU-4. Risk questions and their associated MEs were used to identify risk analysis plan needs for each AE. MEs include a range of hazard quotients (HQs), site-specific sediment toxicity testing, quantitative evaluation of site-specific biological community data, and comparisons of site media concentrations to reference conditions and among site AAs. HQs represent a modeled or measured exposure estimate compared to a literature-based toxicity value. The community data represent an

estimate of effects based on site-specific community and conditions data from within OU-4. The general MEs are described below and the specific MEs for each AE and risk question are provided in Table 2-16.

1. Comparisons of COPCs in exposure media to relevant literature-derived toxicity benchmarks protective of lower trophic level receptors (e.g., plants and invertebrates).

   This ME consists of HQs calculated as the ratio of the exposure point concentration (EPC) in the relevant exposure media and exposure area to the identified toxicity benchmark. Exposure areas and EPCs are described in Sections 4.1 and 4.2, respectively, and literature-based toxicity benchmarks are discussed in Sections 5.1, 5.2, and 5.3.

2. Survival, growth, or reproduction of laboratory-cultured benthic invertebrates exposed to sediments (including porewater and overlying water) from OU-4 and reference area(s) sediments[4].

   This ME consists of the development of site-specific sediment toxicity thresholds to evaluate survival, growth, and reproduction of site benthic communities using site-specific toxicity tests conducted with *Hyalella azteca* and *Chironomus dilutus* exposed to a range of OU-4 and reference PCB concentrations. Comparisons to site-specific toxicity thresholds for benthic invertebrates are made for individual sample points. The development of site-specific toxicity thresholds is discussed in Section 5.1 and Appendix C.

3. Comparison of COPCs in a modeled daily dietary dose for birds and mammals to literature-based dietary toxicity reference values (TRVs) for survival, growth, or reproduction.

   This ME consists of HQs calculated as the ratio of the modeled daily dose (based on both modeled and measured prey tissue concentrations) for each receptor in each relevant exposure area to the identified dietary TRV. Methods and inputs for daily dose calculation are provided in Sections 4.4 and 4.5. Dietary TRVs are discussed in Sections 5.4.

4. Comparison of measured (for most tissues) or modeled (for bird eggs only) tissue concentrations of COPCs to literature-based critical tissue concentrations (CTC) for survival, growth or reproduction.

   This ME consists of HQs calculated as the ratio of the measured tissue concentration for each receptor in each applicable exposure area to the identified CTC. Methods for estimating tissue body burdens are provide in Section 4.4.1.1. CTCs are discussed in Section 5.5.

5. Tissue concentrations of COPCs compared to reference area(s) tissue concentrations and/or among site areas.

[4] Sediment toxicity tests were not conducted with surface sediments from OU-4 and cannot be applied to estimate conditions in OU-4. Rather the sediment toxicity tests are employed in the development of site-specific toxicity thresholds to evaluate benthicn invertebrate communities within OU-4. Site-specific bioassays were conducted for benthic invertebrates only. While it is recognized that bioassays could have been conducted for other species such as terrestrial invertebrates, the evaluation of the range of other receptors included in this OU-4 BERA were considered sufficient for characterizing and managing possible risks.

This ME consists of a statistical comparison[5] of measured tissue concentrations for each relevant receptor (e.g., plants, invertebrates, and fish) within reach C1 and the three AAs of OU-4 (UAA, MAA, and LAA) and measured tissue concentrations in the reference areas.

6. Quantitative evaluation of community structure within OU-4 compared to reference areas

   This ME provides a quantitative evaluation of community structure and health. Species surveys and counts were used to estimate effects to ecological communities from OU-4 locations in comparison with reference locations and/or to understand upstream to downstream spatial trends. Effects to ecological communities based on the site-specific data collected were evaluated, where applicable, for abundance (total number of individual organisms), taxa richness (total number of individual species), EPT Index (sum of taxa in Ephemeroptera, Trichoptera, and Plecoptera), Percent EPT (number of EPT organisms as a percent of total abundance), diversity (Shannon-Wiener Diversity; Shannon 1948), tolerance (Hilsenhoff Biotic Index; Hilsenhoff 1988), and dominance (Simpsons Dominance; Gotelli and Chao 2013). The specific analyses are described in Section 5.6.

7. Qualitative observations of condition, community structure, and/or habitat suitability within OU-4 compared to reference areas.

2.6 Representative Receptors

As discussed above, the AEs represent the range of feeding guilds or trophic levels for birds and mammals in both the aquatic and terrestrial habitats within OU-4. Because it is not feasible to evaluate all possible species of birds and mammals within each feeding guild and habitat type, specific representative species were selected to represent the AEs for birds and mammals. As indicated by the USEPA (1991), "… to develop a reasonable and practicable evaluation, the investigator focuses on a limited number of receptors for the assessment." Representative species are selected based on the "… endpoints of concern and specific characteristics of the Site under study." Other factors considered in selecting representative species include the following:

- Position in the food web
- High potential for exposure (e.g., based on feeding habits or life history)
- Availability of relevant exposure and toxicity data for the species
- Sensitivity to COPCs
- Occurrence within or in the vicinity of OU-4

To select representative species, observations from the ESR (Arcadis BBL 2007) and direction from the USEPA were used to identify the following representative bird and mammal species for the identified aquatic and terrestrial AEs and feeding guilds. Appendix A describes the species profiles for these and rationale for their selection as representative receptors for this OU-4 BERA.

[5] Statistical evaluation not conducted when insufficient sample size or number of detections. Reference comparisions are qualitative in these cases.

Aquatic:

- The tree swallow *(Tachycineta bicolor*) was selected to represent aquatic aerial-feeding insectivorous birds that reside and forage in the banks of Choccolocco Creek and the riparian corridor.
- The spotted sandpiper (*Actitis macularius*) was selected to represent aquatic ground-feeding invertivorous birds that reside and forage in the banks of Choccolocco Creek and the riparian corridor.
- The belted kingfisher was selected to represent aquatic piscivorous birds that reside and forage in the banks of Choccolocco Creek.
- The great blue heron was selected to represent aquatic wading carnivorous birds that reside and forage in the banks of Choccolocco Creek.
- The American osprey (*Pandion haliaetus*) was selected to represent aquatic piscivorous birds.
- The little brown bat (*Myotis lucifugus*) was selected to represent aerial feeding insectivorous mammals that reside and forage in the banks of Choccolocco Creek and the riparian corridor.
- The American mink was selected to represent aquatic piscivorous mammals that reside and forage in the banks of Choccolocco Creek and the riparian corridor.
- The raccoon was selected to represent aquatic omnivorous mammals that reside and forage in the banks of Choccolocco Creek and the riparian corridor.
- The river otter (*Lontra canadensis*) was selected to represent aquatic piscivorous mammals that reside and forage in the banks of Choccolocco Creek.

As summarized in Section 2.1, the most commonly observed birds in the aquatic habitats were the great blue heron, the belted kingfisher, and the wood duck. The American mink was observed by track only in depositional, bank, or run habitats. The tree swallow and the American osprey were also observed within OU-4 during the ecological surveys. Although the spotted sandpiper, the little brown bat, and the river otter were not directly observed within OU-4, other wildlife in similar guilds were observed and therefore, the receptors selected to represent the wildlife that reside and forage in the aquatic habitats of OU-4 are considered appropriate. While the river otter was not observed during the formal process of inventorying species during the 2006 and 2007 habitat investigations, they have been observed by project personnel working on Choccolocco Creek (Truchon 2014, personal communication).

Terrestrial:

- The mourning dove (*Zenaida macroura*) was selected to represent terrestrial herbivorous birds that reside and forage in the floodplains of OU-4.
- The blue jay was selected to represent terrestrial omnivorous birds that reside and forage in the floodplains of OU-4.
- The Carolina wren (*Thryothorus ludovicianus*) was selected to represent terrestrial and semi-aquatic ground-feeding invertivorous birds that reside and forage in the floodplains of OU-4.
- The red-tailed hawk (*Buteo jamaicensis*) was selected to represent terrestrial carnivorous birds that reside and forage in the floodplains of OU-4.

- The southern short-tailed shrew (*Blarina carolinensis*) was selected to represent terrestrial ground-feeding invertivorous mammals that reside and forage in the floodplains of OU-4.
- The white-tailed deer was selected to represent terrestrial herbivorous mammals that reside and forage in the floodplains of OU-4.
- The long-tailed weasel was selected to represent aquatic-dependent carnivorous mammals that reside and forage in the floodplains of OU-4.
- The red fox was selected to represent terrestrial-dependent carnivorous mammals that reside and forage in the floodplains of OU-4.

As summarized in Section 2.1, birds, and especially the blue jay, were the most commonly observed birds in the terrestrial habitats. Other more common wildlife observed along the creek by sign were white-tailed deer, groundhog, and beaver. The mourning dove, Carolina wren, red-tailed hawk, southern short-tailed shrew, long-tailed weasel, and red fox were also observed within OU-4 during the ecological surveys. Therefore, the receptors selected to represent the wildlife that reside and forage in the aquatic habitats of OU-4 are considered appropriate.

Mixed Aquatic and Terrestrial Diets:

Although the receptors are listed as either aquatic or terrestrial, several are exposed to both media and/or prey (Figure 2-4). These include the spotted sandpiper, great blue heron, red-tailed hawk, American mink, southern short-tailed shrew, Carolina wren, and raccoon. The exposure scenarios for these receptors are discussed in detail in Section 4.

Summary:

Eight mammals and nine birds were selected as representative receptors for OU-4. In addition, lower trophic level receptors including aquatic plants, aquatic invertebrates, benthic sediment invertebrates, fish, terrestrial plants, and terrestrial invertebrates were evaluated in this OU-4 BERA. These lower trophic level receptors were evaluated as general categories because toxicity values used in evaluation of risk for these groups are based on data for multiple species and are based on abiotic media or tissue concentrations that do not incorporate species-specific attributes.

For reptiles and amphibians, representative species were not identified because a lack of available toxicity data prevents species-specific evaluation of this group.

Threatened and endangered species that have been observed within Choccolocco Creek and may be found in OU-4 include the blue shiner (*Cyprinella caerulea*), painted rocksnail (*Leptoxis taeniata*), Cylindrical lioplax (*Lioplax cyclostomaformis*), and Tulotoma snail (*Tulotoma magnifica*). In addition, the United States Fish and Wildlife Service (USFWS; 2014) lists two mammals (Indiana bat [*Myotis sodalist*] and grey bat [*Myotis grisescens*]), one bird (red-cockaded woodpecker [*Picoides borealis*]), four flowering plants, eight clams, and one fish (pygmy sculpin [*Cottus Paulus*]) as potentially occurring within Calhoun County, Alabama. In addition, one sensitive snail species (Wicker Ancylid limpet), formerly thought to be extinct, has been observed in lower Choccolocco Creek (O Foighil et al. 2011). Therefore, a range of risk estimates are provided in this OU-4 BERA to allow evaluation of the potential for adverse effects at both the individual and population levels.

3 DATA SUMMARY

Section 3 Summary

Abiotic media, biotic tissue, site-specific sediment toxicity and bioaccumulation tests, and community survey data evaluated in this OU-4 BERA are presented and summarized in this section. Sample locations are presented on Figures 3-1a through 3-1k and the complete dataset is presented in Appendix E. Data include:

- Abiotic media: soil, sediment, and surface water data collected from nearly 1500 locations within the OU-4 portion of Choccolocco Creek and lower Snow Creek. Samples were analyzed for total PCBs primarily as the sum of Aroclors. Mercury and the remaining COPCs were analyzed in a subset of the samples. Sediment data from up to 0 to 6 inches below ground surface (bgs), soil data collected primarily from 0 to 1 feet bgs, and whole water samples collected over five separate sampling events were evaluated.
- Tissues of plants (aquatic and terrestrial), insects (emergent aquatic insects and terrestrial insects), benthic invertebrates (including odonate larvae, crayfish and molluscs), soil invertebrates, small mammals, amphibians and reptiles were collected in OU-4 and analyzed for PCBs and mercury. A subset of the data was analyzed for other COPCs. Tissue data were collected from nine aquatic BSAs and 27 terrestrial BSAs within OU-4 and from three aquatic and three terrestrial reference locations.
- Sediment toxicity tests were conducted on 26 sediment samples from six OU-4 locations and six reference locations. A range of growth, reproduction, and survival endpoints were evaluated using a freshwater amphipod and midge species. Tests were conducted over a range of PCB sediment concentrations to support development of site-specific sediment toxicity threhsolds.
- The bioaccumulation of PCBs was tested for 14 sediment samples (12 OU-4 and two reference) using the *Lumbriculus variegatus* 28-day bioaccumulation test and solid phase micro-extraction (SPME) passive samplers.
- Ecological community surveys were conducted during five investigations between 1996 and 2008. All survey data are considerd in this OU-4 BERA and the results from the two most current investigations are used to quantitatively evaluate ecological communities within OU-4.

Data inputs needed in this OU-4 BERA to evaluate the AEs and MEs identified in Section 2 include abiotic (i.e., surface sediment, water, and soil) and biotic (i.e., prey tissue) media COPC concentrations, and site-specific toxicity and bioaccumulation tests and ecological community survey data. Abiotic media COPC concentrations are used to estimate exposure to lower trophic level receptors (e.g., benthic and aquatic invertebrates, aquatic and terrestrial plants, and soil invertebrates). In addition, these media concentrations are used in the food web calculations for upper trophic level receptors (e.g., birds and mammals) to estimate incidental ingestion in the diet. Biotic media, or tissue, COPC concentrations are used in three ways in this OU-4 BERA:

1. The available tissue and proximally located soil/sediment data are used to develop site-specific bioaccumulation factors (BAFs)/models that were in turn applied to the soil and sediment concentration estimates to model prey tissue concentrations in the food web models. The development of BAFs is briefly discussed in Section 4.4 of this document with the underlying details presented in Appendix B.

2. Tissue are used directly in the food web models to estimate prey tissue concentrations to which upper trophic level receptors may be exposed. Tissue EPCs are presented in Section 4.4.

3. Tissue data are used to estimate exposure to receptor classes themselves by comparing measured tissue concentrations to CTCs.

The abiotic and biotic tissue data used in this OU-4 BERA including the Appendix B bioaccumulation evaluation are summarized in Sections 3.1 through 3.4 below and provided electronically in Appendix E. Figures 3-1a through 3-1k show sample locations for OU-4 soil and sediment samples. Figure 3-2 shows sample locations for surface water, and Figures 3-3a through 3-3j show biotic tissue and associated soil and sediment sample locations for OU-4 and reference locations. Tables 3-1 through 3-3 summarize the abiotic and biotic data that were available and used in this OU-4 BERA for each COPC, EU, and AA.

In addition to the abiotic and biotic tissue data, site-specific laboratory sediment bioassays were conducted on OU-4 and reference area sediments to identify PCB toxicity thresholds for benthic invertebrates and to evaluate PCB bioaccumulation in invertebrates. The details of this study are discussed in Section 5.1 and Appendix C. The sediment toxicity data collected and used in this OU-4 BERA are summarized in 3.5 below. Multiple field studies were also conducted that included detailed habitat and biological survey data collection. These data are described in detail in Section 2.1 and the data used quantitatively in this OU-4 BERA are summarized in Section 3.6.

3.1 Sediment Data

The sources of sediment data considered for this OU-4 BERA include data collected for the Off-Site RFI program conducted under RCRA, the RI/FS program for OU-4 conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and two other smaller programs. In each program, samples were collected from a surface interval (e.g., either 0 to 6 inches or 0 to 2 inches) as well as multiple depth intervals below the surface. Because the surface (0- to 6-inch) interval encompasses the majority of the biologically active zone to which ecological receptors would be exposed (Charbonneau and Hare 1998, Clarke et al. 2001, Ford 1962, Matisoff et al. 1985, USEPA 2005c, 2015b), only data from the surface interval are included in the dataset for this OU-4 BERA. An assessment comparing the 0- to 2-inch and 0- to 6-inch intervals is included in the uncertainty analysis in Section 6.2.

The RFI sediment cores collected in 1999 as part of the RFI sediment investigation were collected from approximately 180 transects in Choccolocco Creek and from 16 locations across the 28 identified deposits in the portion of Snow Creek downstream of Highway 78 (the OU-4 Portion; BBL 1999a). The surface depth interval for this program was primarily 0 to 2 inches, with a small number of samples collected from a slightly greater depth (e.g., 2.5 to 3.5 inches). The characterization of sediments in Choccolocco Creek included the attempted collection of at least four cores per transect at 180 of the 186 transects proposed in the Off-Site RFI Work Plan (BBL1999a). Successful sediment cores were recovered for 552 of the 740 cores attempted. At 188 locations, no cores were recovered because bedrock, cobles, or boulders were encountered. At each coring location, a determination of sediment texture (fine, coarse, gravel, or no recovery) was made and then a subset of cores from each texture class was selected for chemical analysis. In the lower portion of Snow Creek, the types of deposits encountered were defined (channel, terrace, or bar) and subsets of these types were sampled. The RFI coring program is considered a

geomorphically stratified sampling program. A total of 152 surface samples from the cores collected were analyzed for PCBs and the remaining metal COPCs were analyzed in approximately 10% of samples.

The RFI surface sediment investigation collected 30 discrete samples from fish sampling locations in 1999 and 2000 (BBL 1999a). Surface sediment samples were collected from each of the three fish sampling locations with 10 samples per location (and one field duplicate). The surface depth interval for this program was 0 to 2 inches. The RFI activities were conducted under the Alabama Department of Environmental Management (ADEM) approved Off-Site RFI Work Plan (BBL 1999a). The RFI activities included sampling of sediment, floodplain and creek bank soils, surface water, and fish. These activities were focused on Choccolocco Creek, Snow Creek, and Choccolocco Creek tributaries. All samples were analyzed for PCBs (as Aroclors), and approximately 50% of the samples were also analyzed for mercury.

The RI/FS Phase 1 sampling program was again a transect-based collection program focused on samples collected in 2007 from the backwater area of Choccolocco Creek (adjacent to and upstream of the Snow Creek confluence). Unlike the RFI program, all cores collected as part of this RI/FS Phase 1 program were segmented and analyzed (Arcadis BBL 2006a). All samples were analyzed for PCBs (as Aroclors), and approximately 10% of samples were analyzed for metals, DL-PCB congeners[6], PCB homologs[7], and PCDD/PCDFs. In addition, sediment samples were collected from three reference locations (Figures 3-3h through 3-3j). These locations were selected based on their location outside of the influence of the facility and on similarities in flow and habitat conditions to that of OU-4.

The RI/FS Phase 2 ecological sediment sampling program was conducted in 2009, where discrete sediment samples were collected in the vicinity of biological tissue samples. The surface interval for both Phase 1 and Phase 2 of this program was 0 to 6 inches. These data were intended to assist in the development of site-specific BAFs, as well as support the characterization of nature and extent in sediments (Arcadis 2010a). All samples were analyzed for PCBs measured as Aroclors and mercury. Approximately 10% of the samples were analyzed for other metals, PCB congeners[6] and homologs[4], and PCDD/PCDFs. In addition to the OU-4 samples, 18 surface sediment samples were collected from the three reference locations (Figures 3-3h through 3-3j) described above.

Sediment data were collected from three additional sampling events, but not all data were included in the BERA dataset. Specifically, the RI/FS Human Health Fish Locations (HHFL) sediment sampling program conducted in 2009 included a single composite sediment sample from within each of the HHFL fish collection areas (Arcadis 2010a). These samples were comprised of a 10-point composite sample. These were composite samples that often extended between the ecological reaches and could not be classified as to the textural nature (due to compositing); however, at the request of USEPA, data from the samples collected within OU-4 (HHFL-04 in the LAA and HHFL-05 in the MAA) were included in this OU-4 BERA in the development of BAFs. These data were not used to develop sediment EPCs. The Lake Pointe sediment collection program conducted in 2007 was designed to characterize sediment in the vicinity of the Lake Pointe development project. The samples collected here ranged from 1 to 2 feet in depth and were not analyzed for grain size (used to determine sediment texture). Given the depth of the sample, they were not considered representative of surficial sediment conditions and were not included as part of the

[6] A selected list of PCB congeners (12 dioxin-like PCB congeners and PCB 153) were measured in 10% of samples, as requested by the USEPA (2005a). The congener data were used in estimating TEQs for this OU-4 BERA.
[7] PCBs were also measured in 10% of samples as homologs. The Aroclor data were used preferentially in this OU-4 BERA, as that dataset was more robust than for homologs.

BERA dataset. Sediment data were also collected for the sediment toxicity testing program (described in Section 5.1.1 and Appendix C). These sediments were collected to target a wide range of PCB concentrations and sediment conditions to facilitate development of concentration-response curves for the toxicity tests. As such, many were collected from depth and from locations that are not considered representative of OU-4 surficial sediment exposure areas and were not included in the OU-4 BERA sediment dataset.

In total, surface sediment data (i.e., those samples with a top depth of 0 feet and bottom depth no greater than 1 foot) appropriate for risk assessment are available from 268 locations within OU-4 portions of Choccolocco and the lower portion of Snow Creeks. Data from these locations included total PCBs as the sum of Aroclors. Mercury was analyzed in 89 samples within OU-4, and the remaining metal COPCs were measured in 26 samples (approximately 10% of total samples). PCDD/PCDFs and select PCB congeners were measured in 10 samples (10% of the Phase 1 and Phase 2 RI/FS samples). In addition, 21 sediment samples were collected from three reference areas. Data from these samples are included in the sediment dataset for OU-4.

The resulting data for the investigation of areas beyond the boundaries of the Facility have been validated under applicable USEPA guidelines and, for the RCRA data, the project-specific *Quality Assurance/Supplemental Sampling and Analysis Project Plan* (BBL 1999b). The CERCLA data were validated according to the Site-Wide Quality Assurance Project Plan (Arcadis 2008).

The sediment data were compiled from the programs as described above. The combined data used in this OU-4 BERA are presented in Figures 3-1a through 3-1k with sample locations from each investigation shown as unique symbols. Figure 3-1a provides a key to the specific areas covered on each of the subsequent figures. Data used in this OU-4 BERA for all COPCs are presented electronically in Appendix E.

3.2 Soil Data

The sources of soil data for this OU-4 BERA include data collected for the Off-Site RFI program conducted under RCRA, the RI/FS program for OU-4 conducted under CERCLA, and a collection of other programs to support various characterization efforts for a number of areas that fall within the OU-4 portion of the Anniston PCB Site (e.g., the Anniston Airport and the Anniston Wastewater Treatment Plant). Soil samples collected within the floodplain of OU-4 were used in this OU-4 BERA. The federal emergency management agency (FEMA) 100-year floodplain was not used exclusively for the project as it does not incorporate a significant amount of relevant data that have been collected for the Site. The hydraulic flow model that was used by FEMA to establish the 100-year floodplain was used as an initial starting point and was supplemented with site-specific data for Choccolocco Creek and associated floodplain. These data include surveyed elevations for more than 100 creek-channel transects located along Choccolocco Creek and USGS Digital Elevation models for the floodplain. Other improvements to the FEMA model included a review of the aerial imagery to adjust roughness coefficients, and site photographs were used to improve information at the bridge cross sections. Subsequent to this effort, the floodplain was adjusted in 2010 using updated Digital Elevation models from the USGS and the surface water elevations from the United States Army Corps of Engineers (USACE) hydrologic engineering center-river analysis system surface water flow model developed during the Off-Site RFI program. The overall process to update the floodplain footprint and the resulting minor adjustments are described in Attachment A of the Phase 3 Field Sampling

Plan for Operable Unit 4 (Arcadis 2010). The process of updating the 100-year floodplain in 2010 resulted in the minor expansion of several areas.

The surface interval for the RCRA and RI/FS sampling events was 0 to 6 inches. Surface samples from other events ranged from 0.25 feet to 2 feet. Samples with a bottom depth greater than 2 feet were not considered representative of relevant ecological exposures based on information regarding the presence of soil invertebrates and typical behavior of non-burrowing mammals (Suter 2007, California Department of Toxic Substances Control [DTSC] 1998, Anderson et al. 2010), and are not included in the BERA dataset. Soil samples have been collected from both top-of-bank locations along Choccolocco Creek and out into the creek's floodplain.

The top-of-bank samples were collected in 1999 and 2001 under the Off-Site RFI Work Plan (BBL 1999a). Samples were collected from 35 bank locations that appeared to be subject to extreme erosion and analyzed for PCBs measured as Aroclors. The purpose of these sampling locations was to identify whether there were any areas where further erosion of the bank had the potential to release PCBs to the creek. Floodplain soil samples were collected along 11 transects spaced throughout much of Choccolocco Creek to understand the nature and approximate extent of PCBs in the 100-year floodplain. The transect program included 125 individual surface soil sample locations (125 primary samples and 7 field duplicates) where the samples collected were analyzed for PCBs measured as Aroclors (Figures 3-1b through 3-1k). These data were intended to provide a better understanding of soil PCB trends from upstream to downstream as well as trends with distance from the creek bank.

The RI/FS Phase 1 and Phase 2 Soil investigation conducted from 2007 to 2010 (Arcadis BBL 2006a, Arcadis 2010a) was intended to provide data with sufficient density to characterize the floodplain areas for the purposes of defining nature and extent, as well as supporting both human health and ecological risk assessment activities. These samples were collected using a quasi-random grid to provide both even spatial coverage as well as a degree of randomness. To characterize OU-4, areas were segmented from upstream to downstream as well as laterally in the floodplain, and higher sampling densities were applied in the upstream areas and those areas closer to the creek bank. This density differential was used to provide more data in areas of the creek that exhibited the potential to have accumulated higher and more variable PCB concentrations, and the approach was based on the available RFI datasets. In Phase 1, all samples (742 original samples) were analyzed for PCBs measured as Aroclors. In Phase 2, all samples were analyzed for both PCBs as Aroclors and mercury. In both programs, approximately 10% of samples were analyzed for other metal COPCs, PCB congeners[6] and homologs[4], and PCDD/PCDFs.

The RI/FS Phase 2 ecological soil samples collected in 2009 (Arcadis 2010a) were in close proximity to areas of biological tissue sample collection and were intended to be used in evaluating BAFs for those samples as well as supplementing the data collected to characterize nature and extent. All samples were analyzed for PCBs measured as Aroclors and mercury (54 original samples within OU-4 and 14 within reference locations). Approximately 10% of samples were analyzed for other metal COPCs, PCB congeners[6] and homologs[4], and PCDD/PCDFs. In addition to the OU-4 samples, 14 samples were collected from the three reference areas described above for sediment (Figures 3-3h through 3-3j).

The RI/FS Phase 3 soil sampling program in 2011 was conducted to provide more complete bounding at the outer edge of select portions of the floodplain (Arcadis 2010b; Solutia 2011a, 2011b). The areas of additional sampling were identified in collaboration with the USEPA and samples were placed using a combination of best professional judgment, the existing data for the smaller areas, and the same quasi

random grid approach utilized in the RI/FS Phase 1 and Phase 2 investigation described above for the larger areas. In this sampling effort, all samples were analyzed for PCBs measured as Aroclors and mercury (59 original samples). Approximately 10% of the samples were analyzed for other metals, PCB congeners[6] and homologs[7], and PCDD/PCDFs.

The soil samples collected from 1997 to 2002 as part of other programs were identified for inclusion in this OU-4 BERA following a review of all information collected within OU-4 using established procedures for quality assurance/quality control. The bulk of these samples were collected to support characterization and remediation activities in the vicinity of Oxford Lake Park. Many of the other programs were conducted to support intrusive work in the OU-4 floodplain for specific infrastructure projects including bridge crossings, pipeline work, and other land development activities.

In total, surface soil data (i.e., those samples with a top depth of 0 feet and bottom depth no greater than 2 feet) that are appropriate to support the OU-4 ecological risk assessment are available from 1,204 locations in OU-4 and 14 reference locations. Data from these locations included total PCBs as the sum of Aroclors as well as a subset of samples that were analyzed for a wider list of constituents. The soil data collected as part of these efforts were validated in accordance with the Site-specific *Quality Assurance/Supplemental Sampling and Analysis Project Plan* developed for the Off-Facility investigations (BBL 1999b). Data from these samples are included in the soil dataset for OU-4. Data for COPCs are presented electronically in Appendix E.

3.3 Surface Water Data

The sources of surface water data considered for this OU-4 BERA include data collected from the Off-Site RFI program conducted under RCRA and the RI/FS program for OU-4 conducted under CERCLA. The RFI surface water data collected in 1999 and 2000 (manual sampling) and 1999 through 2002 (automated sampling) are not included in this OU-4 BERA. These data collection activities focused on evaluating sediment transport (BBL 1999a). PCB concentrations were evaluated on the particulate fraction of the water column. As part of this program, there was bias to evaluating high flow conditions during both the manual and automated water collection programs. Because these collection events looked at particulate PCBs instead of whole water PCBs and were biased toward high flow events, these data were not considered appropriate for this OU-4 BERA.

The RI/FS Phase 1 and Phase 2 surface water collection program was conducted as three separate investigations. These investigations included the collection of whole water from Snow Creek in the vicinity of Oxford Park in March and June of 2007, in the backwater area of Choccolocco Creek in June of 2007 during the Phase 1 sediment Investigation (Arcadis BBL 2007), and as part of the Phase 2 ecological sampling program in 2009 and 2010 (Arcadis 2010a). These samples were collected as part of normal flow conditions and data are included in the surface water dataset for OU-4. Samples collected from the same location on the same date were treated as duplicates; all other samples were evaluated as independent field samples. Phase 1 samples were all analyzed for PCBs as Aroclors and homologs, PCB congeners (WHO list plus congener 153), PCDD/PCDFs, and metals. The Phase 2 samples were all analyzed for PCBs measured as homologs and mercury. A subset of Phase 2 samples were analyzed for PCB congeners (WHO list plus congener 153), PCDD/PCDFs, and metals.

In total, surface water data were collected from 40 locations within OU-4 over five separate sampling events generating 49 samples (excluding duplicates) analyzed for total PCB homologs or total PCBs as

the sum of Aroclors and mercury for the surface water dataset for OU-4 (Figure 3-2). A subset of samples were analyzed for a wider list of constituents. Data for the BERA COPCs are provided electronically in Appendix E.

3.4 Biota Data

Based on the range of ecological receptors identified for the food web evaluation in the Phase 2 FSP (Arcadis 2010a), COPC data representing tissues of plants (aquatic and terrestrial), insects (emergent aquatic insects and terrestrial insects), benthic invertebrates (including crayfish and molluscs), soil invertebrates, mammals, and amphibians/reptiles were identified as data needs for the BERA to estimate dietary intakes in the food web models and to evaluate receptor classes based on tissue burdens. These data were collected as a part of the Phase 2 biological sampling program.

The available data were collected from three AAs within OU-4 (Figure 3-3a through 3-3g) and are summarized in Tables 3-4 through 3-12. The UAA, MAA, and LAA were identified within OU-4 based on habitat surveys conducted in the ESR (Arcadis BBL 2007). Three aquatic BSAs and nine terrestrial BSAs were identified within each of these three AAs for a total of nine aquatic BSAs and 27 terrestrial BSAs within OU-4 that were sampled as part of the 2009 Phase 2 sampling. Samples were also collected from three aquatic and terrestrial reference locations (Figures 3-3h through 3-3j). RCRA investigations and Phase 1 community structure surveys (BBL 2005a, Arcadis BBL 2007) revealed three major non-aquatic habitat types and five aquatic habitat types in OU-4. Terrestrial habitat types included forested floodplain, maintained fields, and successional fields. Aquatic habitat types included riffles, runs, EAV, backwaters, and depositional environments (islands, banks/bars), Using the existing series of floodplain transects established during previous habitat assessments, target sampling locations were established in each of the habitat types in each of the three AAs. Efforts were made to collect all biotic tissues in each of the aquatic habitat types targeted. However, specific biota were not always found in each habitat.

The targeted sample counts, species, and organisms for collection were outlined in the Phase 2 FSP (Arcadis 2009). The target species and sample numbers and the species and sample numbers collected are summarized in Tables 3-13 and 3-14 for aquatic and terrestrial tissue types, respectively. Additional detail regarding aquatic and terrestrial tissue collection is provided below.

Sediment, soil, and biotic tissue samples were analyzed for PCBs and mercury in all of the BSAs and reference locations (Figures 3-3a through 3-3j). Tissues were analyzed as Aroclors when possible to be consistent with the analysis conducted for soil and sediment. As described in the OU-4 Phase 2 FSP (Arcadis 2009), PCBs were analyzed for PCB homolog groups using modified (SIM) USEPA Method 8270C in many cases to achieve adequate detection limits in tissues where PCB concentrations may be low or the tissue mass may have been limited. PCBs in fish, molluscs and crayfish were analyzed as Aroclors and PCBs in the remaining tissue types were analyzed as homologs. Sediment and soil samples were also analyzed for total organic carbon (TOC) and percent fines and tissue samples were analyzed for lipid and percent solids (Appendix E). In general, individual biotic tissue samples were not precisely co-located with specific sediment or soil samples, rather tissue collected from specified locations within a BSA and reference area were composited and analyzed for PCBs and mercury. Consistent with the agreed upon sampling approach in the OU-4 Phase 2 FSP (Arcadis 2010a), non-mercury metal COPCs and PCDD/PCDFs were analyzed in a subset of the samples collected. Specifically, non-mercury metals were analyzed in sediment samples from six BSAs and two reference locations and in soil samples from

six BSAs and two reference locations. PCDD/PCDFs were analyzed in sediment samples from seven BSAs and three reference locations and in soil samples from seven BSAs and no reference locations. Non-mercury metals were analyzed in two to three BSA samples and one reference sample for each aquatic biotic tissue type and in four to six BSA samples and one reference sample for each terrestrial biotic tissue type. PCDD/PCDFs were analyzed in three to four BSA samples and one reference sample for each aquatic biotic tissue type and in three to six BSA samples and one reference sample for each terrestrial biotic tissue type. The biota samples collected are summarized below. Tables 3-4 through 3-12 summarize the available PCB, mercury, and non-mercury metals tissue data, respectively, for each BSA. PCDD/PCDF data are summarized in Appendix F. Full data for PCDD/PCDF are presented in Appendix E.

3.4.1 Aquatic Tissue Data

Aquatic tissue collection targeted dominant species within each habitat type that would be most representative of the known foraging habits and dietary composition of the identified upper trophic level (e.g., birds and mammals) receptors found within OU-4.

From the Off-Site RFI Phase II Floodplain Survey and ESR (BBL 2000a, Arcadis BBL 2007), five major aquatic habitat types in OU-4 were identified: riffles, runs, EAV, tributary confluences (backwaters), and depositional environments (islands, banks/bars). With the exception of aquatic plants that were only collected within the areas of EAV, tissue collection for each aquatic tissue type targeted dominant species within sample reaches containing riffles, runs, and EAV. Based on Phase 1 survey results, these three habitat types were expected to contain the highest density of species that would encompass the dietary components of the upper trophic level receptors within OU-4 as well as to represent the most likely locations of receptor foraging. Efforts were made to collect all biotic tissues in each of the aquatic habitat types that were targeted. However, specific biota were not always found in each habitat. Exceptions and specific tissue types collected are noted below. Aquatic plants, emergent insects, benthic invertebrates, molluscs, and fish were collected in all BSAs and reference areas. Crayfish and amphibians/reptiles were collected opportunistically as samples were not found in all areas and habitat types and reference areas. The species of aquatic tissue collected included:

- Aquatic plants consisted primarily of the stems and leaves of alligator weed.
- Benthic macroinvertebrate and emergent and flying insect target species included Ephemeroptera, Plecoptera, and Trichoptera. Based on the limited abundance and presence of larval and adult forms of these orders, alternate species were collected. Odonate larvae were collected for benthic macroinvertebrates. Emergent insects associated with the riparian corridor consisted of adult dragonflies and damselflies (*Odonata* sp.), flies (*Diptera* sp.) -- primarily craneflies (*Tipulidae* sp.), and other insects (*Hymenoptera* sp.) -- primarily sweat bees (*Halictidae* sp.)[8].
- Aquatic molluscs and crustacean target species included Asiatic clam (*Corbicula fluminea*), rock snails, and crayfish species based on the Phase 1 community surveys. Based on abundance in the three targeted habitats (riffle, run, EAV), Asiatic clam and crayfish were collected opportunistically as samples were not found in all areas and habitat types and reference areas.

[8] While Hymenoptera and Halictidae are not aquatic species, they were collected in the general area proximal to the creek where other emergent insects were collected in order to obtain adequate sample volumns for anlaysis.

- Reptiles and amphibians targeted for collection included green frogs (*Rana clamitans*), spring peepers (*Pseudacris crucifer*), northern slimy salamanders, queen snakes (*Regina septemvittata*), cooters, and turtle species. Based on the aquatic habitats present and other floodplain waterbodies and wetland habitats, abundance and catchability of target organisms were limited in some cases. A total of five frog and toad species and four aquatic snake species were collected. Species of frogs collected include southern leopard frogs, bullfrogs (*Rana catesbeiana*), bronze or green frogs, and northern cricket frogs (*Acris crepitans*). Snake species collected include midland water snake (*Nerodia sipedon*), queen snake, cottonmouth (*Agkistrodon piscivorus*), and yellow-bellied water snake (*Nerodia erythrogaster*).
- The fish collection effort focused on the collection of three trophic levels: predator, bottom feeder, and forage:
    - Target predator species included spotted bass (*Micropterus punctulatus*) greater than 12 inches in length. Where the abundance of adult spotted bass was not sufficient, both redeye bass (*Micropterus coosae*) and largemouth bass (*Micropterus salmoides*) were collected
    - Target bottom feeder species included catfish species greater than 6 inches in length. Based on the limited abundance of catfish species observed in the aquatic sample reaches and target habitats, bottom fish collected included adult black redhorse and blacktail redhorse.
    - Forage species targeted included largescale stoneroller and shiner species less than or equal to 6 inches in length. Based on the diversity of forage species found within the habitats, composites consisting of the most dominant and abundant were collected. This included 14 species, representing the family of suckers (Catostomidae), family of shiners and minnows (Cyprinidae), and family of topminnows (Fundulidae).
    - Forage – shiner species (*Notropis* sp.): juvenile and adult – less than or equal to 6 inches

3.4.2 Terrestrial Tissue Data

Terrestrial tissue collection targeted dominant species within each habitat type that would be most representative of the known foraging habits and dietary composition of the identified upper trophic level (e.g., birds and mammals) receptors found within OU-4.

From the Off-Site RFI Phase II Floodplain Survey and the ESR (BBL 2000a, Arcadis BBL 2007), three major non-aquatic habitat types were identified within OU-4: forested floodplain, maintained fields, and successional fields. In support of the diversity of terrestrial floodplain receptor groups and their associated habitats, the tissue collection design targeted each of these three habitat types within each of the ecological exposure areas within OU-4 and applicable reference areas. All terrestrial tissues were collected in September 2009. The species of terrestrial tissue collected included:

- Terrestrial plants included grass species (e.g., yellow foxtail), herbaceous plant species (e.g., pokeberry [*Phytolacca* sp.]), shrub species (e.g., elderberry), and cultivated species (e.g., soy beans [*Glycine* sp.] and cotton [*Gossypium* sp.]). All plant tissue composite samples were collected within the individual BSAs of OU-4 from each habitat type across each of the three AAs (UAA, MAA, LAA) and the reference areas.

- Terrestrial invertebrates included earthworm, soil grub (*Coleoptera* sp.), and grasshopper (*Caelifera* sp.)/cricket (*Gryllidae* sp.) tissue composite samples collected across OU-4 BSAs and reference areas. Initially targeted non-worm species were spiders, springtails, and ground beetles. Based on Phase 1 community surveys, pitfall and hand collection efforts indicated limited abundance of these target organisms in relation to achieving tissue sample mass requirements. While efforts were made to collect target species during the Phase 2 collection efforts, these efforts were not successful, and grasshoppers and crickets were collected opportunistically within the successional field and maintained field BSAs of OU-4.
- Small mammal target species included deer mouse (*Peromyscus maniculatus*), cotton mouse (*Peromyscus gossypinus*), harvest mouse (*Neotoma floridana*), and hispid cotton rat (*Sigmodon hispidus*). In addition to these species, based on abundance in certain BSAs, northern short-tailed shrew (*Blarina brevicauda*) and woodland/pine vole (*Microtus pinetorum*) were observed and collected. The targeted sample size of 54 individual small mammal samples within the 27 BSAs of OU-4 was not fully completed, as only 44 individual small mammal samples could be collected. Abundance of small mammal species and habitat quality among the different BSAs were both factors that limited the success of the tissue collection efforts. Within the seven reference location BSAs, a total of 10 individual small mammal samples were collected. Abundance of small mammal species and habitat quality limited the success of the tissue collection efforts. Small mammal species collected within the reference location BSAs included: cotton mouse, eastern harvest mouse (*Reithrodontomys humulis*), and hispid cotton rat.

3.5 Sediment Toxicity Testing Data

A total of 26 sediment samples from six different locations in OU-4, and six reference sediment samples from Choccolocco Creek approximately 3 kilometers (km) upstream of OU-4, were collected for toxicity testing. Toxicity tests were conducted on all 26. Three of the six OU-4 locations sampled were from surface sediments and the remaining three were from sediments at depths ranging from 1 to 4 feet bgs. The toxicity tests were conducted by the United States Geological Survey's Columbia Environmental Research Center in Columbia, Missouri, and the United States Army Corps of Engineers' Engineer Research and Development Center in Vicksburg, Mississippi (Ingersoll et al. 2014). A range of growth, reproduction, and survival endpoints were tested using a freshwater amphipod (*Hyalella azteca*; 42-day tests) and midge (*Chironomus dilutus*; up to 54-day tests).

The bioaccumulation of PCBs was tested for 14 sediment samples (12 test sediments and two reference sediments) using the *Lumbriculus variegatus* 28-day bioaccumulation test in basic accordance with the USEPA and ASTM International (2012) standard methods. Specific details regarding sediment toxicity and bioaccumulation testing can be found in Ingersoll et al. 2014. Sediment PCB concentrations were measured as Aroclors, homologs, and congeners and tissue PCB concentrations were measured as homologs and congeners.

The bioavailability of PCBs in 14 sediment samples were additionally investigated using SPME passive samplers. Tissue residues predicted using SPME-derived porewater data provide information regarding the bioavailability of PCBs in these sediments. For metals, a small dialysis chamber called a "peeper" was used to measure dissolved metal concentrations in porewater. While the laboratory bioaccumulation data are useful in demonstrating that metals are bioavailable at low concentrations and that PCBs do

accumulate in the tissues of aquatic worms, these data do not necessarily reflect uptake under actual field conditions. Thus, the *Lumbriculus variegatus* bioaccumulation data are used in this OU-4 BERA to model uptake into aquatic worms.

Sub-samples of the sediments collected for toxicity testing were analyzed for grain-size, moisture content, loss on ignition, OC, 23 major and trace elements (including the 16 metals and metalloids on the USEPA Target Analyte List), acid volatile sulfide, five simultaneously extracted metals, nine PCB Aroclors, 13 PCB congeners, 10 PCB homolog groups, one biphenyl, 46 parent and alkylated PAHs, 21 organochlorine pesticides, and 17 PCDD/PCDF congeners. Additionally, during the toxicity tests, porewaters (collected by centrifugation or by peepers) were analyzed for pH, conductivity, alkalinity, hardness, and concentrations of ammonia, hydrogen sulfide, dissolved OC, four inorganic anions, and 61 major and trace elements. The sediment chemistry data as well as the toxicity testing and bioaccumulation data are provided in Appendix E.

3.6 Ecological Community Data

The ecological community data collected for OU-4 are described in detail in Section 2.1. The five investigations conducted between 1996 and 2008 include:

1. *Intensive Water Quality and Biological Study of Choccolocco and Snow Creeks, Coosa River Basin* (Bayne 1997)
2. Off-Site RFI Habitat and Biological Assessment (BBL 2000b)
3. Off-Site RFI Phase II Floodplain Surveys (BBL 2005a)
4. Remedial Investigation/Feasibility Study (RI/FS) Phase 1 Ecological Surveys (ESR; Arcadis BBL 2007)
5. RI/FS Phase 1 Supplemental Ecological Surveys – in spring 2008 (ENVIRON 2014)

The results of the Phase 1 Ecological surveys (items 4 and 5, above) are used in this OU-4 BERA to quantitatively evaluate ecological communities of soil invertebrates, benthic invertebrates, fish, birds and mammals. Terrestrial plants are evaluated using similar metrics and based on data collected during the Off-Site RFI Phase II Floodplain Surveys. The majority of the data collected prior to the Phase 1 Ecological Surveys are used in this OU-4 BERA for the development of the ecological CSM and selection of AEs, MEs and representative receptors described in Section 2 and/or as supporting information for the community analysis conducted in Section 5.4. The data employed in the quantitative analysis by receptor type include: vegetation species counts and percent cover, benthic and terrestrial macroinvertebrate counts, fish species counts, and wildlife species counts conducted within OU-4 transects and reference transects.

4 EXPOSURE ASSESSMENT

Section 4 Summary

The assumptions used to estimate exposure to each of the representative receptors are presented in this section. Lower trophic levels (plants, invertebrates, fish, and aquatic life) were evaluated based on direct contact with environmental media, whereas upper trophic levels (birds and mammals) were evaluated using standard dietary food web models (USEPA 1997) with measured tissue EPCs or modeled tissue EPCs calculated from abiotic media EPCs and BAFs. In addition, invertebrates, fish, small mammals, and birds were evaluated based on whole body (or egg for birds) tissue residues. The following assumptions were used to estimate exposures:

- EUs and assessment areas: OU-4 was divided into aquatic areas and terrestrial areas in the floodplain. These habitat areas evaluated on two spatial scales: EUs and assessment areas. For the EUs, the habitat areas were broken up into ten reaches (C1 through C10) based on logical break points using a combination of natural and man-made features within OU-4. The floodplain reaches were further sub-divided into EUs (such as north, south, etc; Figure 4-2a) to account for foraging ranges of receptors and creek geography. In general, the EUs parallel those evaluated in previous investigations. For the assessment areas, the habitat areas were broken up into three ecologically distinct areas (UAA, MAA, and LAA) along Choccolocco Creek and a fourth area comprised of Snow Creek (Reach C1), each of which include multiple EUs. Additionally, riparian areas (which include a 100-foot wide corridor of floodplain soil on both sides of the creek) were evaluated for each of the four assessment areas.
- EPCs: For PCBs and mercury, abiotic media EPCs were based on the 95% upper confidence limit on the mean (95%UCL) concentration for floodplain and riparian soil EUs and a spatially weighted 95th percentile concentration calculated using probabilistic methods for sediment in each EU. For non-mercury metals, EPCs were based on the 95%UCL in each EU, or the maximum detected concentration when sample size was insufficient to calculate a reliable 95%UCL. Surface water EPCs for PCBs and metal COPCs are based on the assessment area-wide and OU-4-wide 95%UCL concentrations. Measured tissue EPCs are based on assessment area-wide 95%UCL concentrations.
- Exposure Scenarios and Parameters: Dietary compositions for each of the wildlife representative receptors, and wildlife exposure parameters are presented in Tables 4-1a through 4-2c. These values were selected based on receptor natural history information and with input from the USEPA.
- BAFs: Site-specific BAFs (Tables 4-20 and 4-21) were developed using biotic tissue data collected from OU-4 and abiotic media data collected within the same BSA, as described in detail in Appendix B. For PCBs and mercury, regression relationships were used when significant; however, in most cases (and in all cases for other COPCs), median BAFs were used to estimate prey tissue concentrations in this OU-4 BERA.

The exposure assessment describes the assumptions and supporting rationale used to estimate exposure to each of the AEs or representative receptors. The exposure assessment also provides exposure parameters that identify the intensity and spatial and temporal extent of contact of receptors to COPCs for specific exposure pathways. Complete and significant exposure pathways consistent with the ecological CSM were evaluated. The intensity, spatial, and temporal extent of contact with COPCs are described by

the EUs, EPCs, exposure assumptions, and intakes (or dose estimates), as discussed in the following sections.

As discussed in the CSM (Section 2.3) and MEs (Section 2.5), exposure to COPCs for lower trophic level receptors consisting of benthic and terrestrial invertebrate communities, aquatic and terrestrial plant communities, and aquatic life (invertebrate, fish, and amphibian communities) were quantitatively evaluated based on direct contact with environmental media (sediment, soil, and surface water). Exposure to COPCs for upper trophic-level receptors consisting of birds and mammals were quantitatively evaluated based on dietary food web exposure estimated using measured tissue EPCs or modeled tissue EPCs calculated from abiotic media EPCs and BAFs. In addition, tissue burden-based exposures were evaluated for invertebrates, fish, birds, and small mammals. As discussed earlier (Section 2.6), due to lack of sufficient toxicity data for amphibians and reptiles, potential risk to these receptors were not quantitatively evaluated. The following sections describe the specific inputs for calculating direct, food web, and tissue-based COPC exposure estimates. These sections include selection of EUs, the methods for media-specific EPC calculation, exposure scenarios for birds and mammals, the dietary exposure model and associated receptor exposure parameters, and the tissue-based exposure estimates.

4.1 Exposure Units

The EUs selected for OU-4 and associated rationale are described below. As discussed in Section 2.6, in addition to terrestrial and aquatic plants, soil and sediment invertebrates, and fish, 17 avian and mammalian species were selected as representative receptors for the risk evaluation. The foraging ranges and other exposure parameters evaluated in this OU-4 BERA are provided in Tables 4-1a and 4-1b for birds and Tables 4-2a and 4-2b for mammals. The receptor foraging ranges can vary greatly depending on a number of factors including season, habitat quality, and food availability. For receptors that forage within the creek or on prey that are closely associated with the creek, the foraging ranges vary from 0.1 km (0.062 RMs) (the low end of the range for the tree swallow) to 31 km (19.3 RMs; the high end of the range for the river otter). For receptors that forage within the greater floodplain, the ranges vary from 0.25 acres (the low end of the range for the short-tailed shrew) to 12,217 acres (the high end of the range for the raccoon).

While it is important to consider individual foraging ranges, it is equally important to recognize that relevant guidance from the USEPA specifies that the goal for non-threatened or endangered species in a risk assessment is to protect local populations of organisms rather than individuals (USEPA 1999). As such, the evaluation of individual foraging ranges is not warranted. Similarly, the evaluation of the entirety of OU-4 (37 creek miles and 6,000 floodplain acres) as a single EU would be too broad. The EUs were selected to represent a reasonable and conservative estimate of an exposure area for the range of receptors being evaluated in this OU-4 BERA. Due to limitations in the tissue dataset available for BAF development, AAs, consisting of multiple EUs, were also evaluated. The specific EUs and AAs are described in Sections 4.1.1 and 4.1.2.

The location, size, and shape of the foraging area may be influenced by the available food base and habitat due to the potential uncertainty in assigning EUs/AAs for a given receptor species. In addition, the PCB concentrations tend to be higher in the floodplain area closest to the creek with concentrations decreasing with distance away from the creek. Because some receptors feed primarily on aquatic prey either within the creek itself or within the riparian corridor (the area of the floodplain closest to the creek)

and their receptors feed more generally within the larger floodplain, the floodplain areas of each reach were divided into multiple EUs. Specifically, to address specific habitat needs and foraging strategies for the range of receptors evaluated in this OU-4 BERA, the receptors were categorized according to three basic foraging area types:

- Aquatic-Feeding – These receptors consume fish and/or other aquatic prey found within the bounds of Choccolocco Creek and the small downstream portion of Snow Creek that is included in OU-4. These EUs are based on creek miles, and are referred to as reaches. Larger AAs were also evaluated.
- Semi-Aquatic – These receptors consume prey associated with the creek (e.g., aquatic emergent insects) with foraging primarily within the riparian area associated with the creek and are expected to be exposed to both aquatic and terrestrial media and/or prey. The riparian area is assumed to include floodplain soil within a 100-foot wide riparian corridor along both sides (200 feet in total) of the creek. The riparian EUs and AAs are defined operationally as a 100-foot wide riparian corridor along both sides (200 feet in total) of the creek and are associated with creek miles.
- Terrestrial – These receptors feed primarily in the floodplain. These EUs are based on acres within the floodplain. Larger AAs were also evaluated.

4.1.1 Reaches for Exposure Units and Assessment Areas

The OU-4 portion of the Site includes areas that exhibit a wide range of physical characteristics and ecological habitats. To segment the OU-4 habitats into smaller geographic segments or reaches, OU-4 was initially divided into three ecologically distinct reaches as part of the OU-4 Phase 1 FSP (Arcadis BBL 2006a). These reaches correspond to the three AAs (UAA, MAA, LAA) and were large in size. For this OU-4 BERA, Snow Creek was not included in three AAs defined along Choccolocco Creek; Snow Creek was evaluated separately as reach C1. The data collected since 2006 have provided a more complete characterization of environmental conditions in OU-4. Due to the large size of OU-4 (37 creek miles and 6,000 floodplain acres) and habitat variability, the division of OU-4 into smaller subunits was also evaluated for this OU-4 BERA. The division of the creek and floodplain into smaller reaches is further supported by the distribution of PCBs, which generally demonstrates decreasing concentration trends with increasing downstream distance of the backwater area portion of OU-4 and with increasing distance from the creek bank.

The first step in developing the EUs was segmenting the OU-4 portions of Snow and Choccolocco Creeks and their floodplains into smaller reaches. These reaches were selected recognizing that exposure, and hence the ensuing EUs for the creek and the associated riparian areas, are based on creek-miles. Exposure for the adjoining broader expanses of the floodplain is based on acres. Segmenting the creek and floodplain into EUs that are smaller than the initial three ecologically distinct reaches is also generally consistent with the size of the foraging ranges for the receptors identified in OU-4 (i.e., less than one acre for the Carolina wren and the short-tailed shrew to greater than 12,000 acres for the raccoon). The division into EUs also utilizes the macro scale trends exhibited in floodplain PCB data that show a decreasing trend in PCB concentration with distance downstream and distance from the creek bank. These divisions act to reduce variability in the dataset, especially in the downstream area where concentrations are generally lower than those found in the upstream section of the floodplain. This approach also recognizes that, for some species, the foraging ranges may be smaller or larger than the EUs. Having the foraging

ranges for some of the receptors smaller than the EUs is acceptable given the complexities of attempting to segment this large OU into smaller areas for the purposes of this OU-4 BERA.

The reaches evaluated for this OU-4 BERA as EUs are based on the approach used to develop the characterization areas described in the OU-4 Phase 1 FSP (Arcadis BBL 2006a) and are the same reaches evaluated in the PSCSR (ENVIRON 2014). The division points are based on logical break points using a combination of natural and man-made features within OU-4 that could affect the transport mechanisms of solids to and from the floodplain and the introduction of non-PCB containing suspended solids through tributary creek inputs. For example, major roads and bridges, confluence points associated with tributaries and creeks, the physical attributes of the backwater area, and significant changes in the width of the floodplain were taken into account in identifying the break points between reaches.

The reaches moving in a downstream direction and moving away from the creek bank reflect an approach to group similar PCB distributions for the purposes of developing the EPCs. This includes the use of a riparian corridor, where applicable, that includes the floodplain soil data adjacent to (within 100 feet) the creek. This approach also works well with the ecological receptors for OU-4, some of which derive a portion of their exposure from the riparian corridor. This approach is similar to the inner and outer EUs developed to support the human health risk assessment for OU-4. Using this process, the creek and floodplain were divided into ten EUs (C1 through C10). As noted above, OU-4 is also evaluated on an AA basis. Snow Creek includes only reach C1. The UAA includes reaches C2 through C4, the MAA includes reaches C5 and C6, and the LAA includes reaches C7 through C10. Reach C1 is evaluated independently and is not included in the AAs because it is located along Snow Creek and upstream of the I-20 corridor. It is considered to be distinct from a hydraulic and habitat perspective from the remaining Choccolocco Creek portion of OU-4. Figure 4-1 shows the EU and AA designations. These are described as follows:

C1 – This reach includes the lower portion of Snow Creek, including approximately 76 acres of land between Highway 78 and Interstate 20 and 0.4 miles of Snow Creek. The two EU subgroups in this reach include east (39 acres), and west (45 acres). This terrestrial acreage includes open lands and the Oxford Lake sports complex on the eastern side of Snow Creek and several commercial properties on the western side of Snow Creek. The land areas immediately east and west of Snow Creek are relatively undeveloped or commercial, while farther to the east of Snow Creek, the land is used for recreational activities. Given the commercial and urban development pressure on this reach of Snow Creek, riparian habitat is not present in most areas along this reach of the creek. This reach does not contain terrestrial or aquatic habitat associated with Choccolocco Creek.

UAA / C2 – This reach is referred to as the OU-4 backwater area, including approximately 228 acres of land from approximately 1 mile upstream of the Snow Creek/Choccolocco Creek confluence, downstream to the Friendship Road Bridge (0.9 creek mile along Choccolocco Creek). The four EU subgroups in this reach include north (71 acres), south (66 acres), central (101 acres), and riparian (71 acres). This area includes a section of divided channel on Choccolocco Creek and additional braids within the creek. The highest PCB and mercury concentrations are typically detected in the backwater area because much of the area is depositional in nature and is characterized as having low surface water velocities. The majority of the land in the central portion of the reach is currently under the control of a conservation land trust. Land on the north side of Choccolocco Creek is associated with the Anniston waste water treatment plant.

UAA / C3 – This reach includes approximately 567 acres of land and 2 miles of Choccolocco Creek from Friendship Road downstream to the Highway 21 Bridge. The three EU subgroups in this reach include north (269 acres), south (240 acres), and riparian (49 acres). The majority of land is used for agriculture.

UAA / C4 – This reach includes approximately 1,524 acres of land and 5 miles of Choccolocco Creek from the Highway 21 Bridge to Silver Run Road. The three EU subgroups in this reach include north (693 acres), south (666 acres), and riparian (141 acres). The land in this reach includes a mix of agriculture, forest, and open lands associated with the Anniston Airport.

MAA / C5 – This reach includes approximately 824 acres of land and 6 miles of Choccolocco Creek from Silver Run Road downstream to Creek Mile 23.1 (near to Mitchell Matson Road). The three EU subgroups in this reach include north (681 acres), south (512 acres), and riparian (149 acres). The land in this reach includes a mix of agricultural use and forest.

MAA / C6 – This reach includes approximately 205 acres of land and 4.1 miles of Choccolocco Creek from Creek Mile 23.1 (adjacent to Mitchell Matson Road) downstream to Creek Mile 18.9 (approximately 2,000 feet upstream of the Curry Station Road bridge). The three EU subgroups in this reach include north (131 acres), south (149 acres), and riparian (98 acres). The land in this reach is predominantly forested. This is the narrowest reach of floodplain along the creek with an average width of approximately 200 feet.

LAA / C7 – This reach includes approximately 1,482 acres of land and 5 miles of Choccolocco Creek from Creek Mile 18.9 (approximately 2,000 feet upstream of the Curry Station Road Bridge) downstream to the confluence with Eastaboga Creek. The three EU subgroups in this reach include north (741 acres), south (784 acres), and riparian (127 acres). The land in this reach is predominantly agricultural. This reach has the largest amount of floodplain area relative to creek miles.

LAA / C8 – This reach includes approximately 295 acres of land and 4.4 miles of Choccolocco Creek from the confluence with Eastaboga Creek downstream to Jackson Shoals. The three EU subgroups in this reach include north (407 acres), south (487 acres), and riparian (105 acres). The land in this reach includes a mixture of agricultural use and forest.

LAA / C9 – This reach includes approximately 218 acres of land and 3.1 miles of Choccolocco Creek from Jackson Shoals downstream to the Highway 77 Bridge. The three EU subgroups in this reach include north (197 acres), south (213 acres), and riparian (77 acres). The land in this reach includes a mixture of agricultural use and forest.

LAA / C10 – This reach includes creek sediment in Choccolocco Creek downstream of the Highway 77 Bridge to the original confluence with Lake Logan Martin. The former floodplain of Choccolocco Creek in this area is now part of the creek bed since Lake Logan Martin was created through the construction of upstream and downstream dams on the Coosa River. Surface water elevations in Lake Logan Martin and this portion of Choccolocco Creek are controlled through operation of the dams that prevent flooding along the edges of the lake and along this lower portion of the creek. During the winter months when there is potential for flooding, the water levels in the lake and this portion of Choccolocco Creek are lowered by 4 to 5 feet to prevent flooding. Because the former floodplain and riparian zones are now a part of the sediment exposure and operation of the dams prevent overbank flooding along this reach of Choccolocco Creek, only sediment exposure is evaluated in this OU-4 BERA for this reach (C10).

4.1.2 Exposure Units Within Each Reach

The EUs for this OU-4 BERA were selected to estimate ecological exposures (i.e., creek, riparian EUs, and floodplain EUs). For the terrestrial floodplain areas, each of the 10 reaches was further divided into EUs, depending on creek geography, the exposure scenario, and the foraging habits of the receptor species. The floodplain EUs for this OU-4 BERA differ slightly from the characterization areas and EUs presented in OU-4 PSCSR (ENVIRON 2014) because those areas were based on the specific concerns related to human health exposures (i.e., specific agricultural or residential areas). The AAs, reaches, and EUs within each reach are shown on Figure 4-2a and in Table 4-3 on the following page. PCB and mercury soil and sediment results are presented for these EUs on Figure 4-2b through 4-2k and Figures 4-3a through 4-3k, respectively.

Table 4-3. Tissue Sampling Areas

Assessment Area	Reach
NA	C1
Upper (UAA)	C2
	C3
	C4
Middle (MAA)	C5
	C6
Lower (LAA) [1]	C7
	C8
	C9
	C10

Notes:
[1]Biota sampling stopped at end of reach C7.
EU: exposure unit
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
UAA: upper assessment area
EUA, EMA, ELA – Biological sampling area designations for aquatic tissue sampling in the upper, middle, lower, and reference assessment areas respectively. EUT, EMT, ELT, are same for terrestrial tissue sampling areas. See Figures 3-3a through 3-3j

With the exceptions discussed below, most of the reaches are generally divided into four EUs:

- In-stream sediment
- Riparian corridor adjacent to both sides of the creek
- Soils located within the 100-year floodplain along the northern side of Choccolocco Creek, for reaches C3 through C9
- Soils located within the 100-year floodplain along the southern side of Choccolocco Creek, for reaches C3 through C9

Note that reach C1 is divided into only three EUs (sediment and the eastern and western floodplain soils). Given the commercial and urban development pressure on this reach of Snow Creek, a riparian corridor has not been included as a separate EU. Reach C2 (the backwater area) includes a fifth EU (central area) as shown on Figure 4-2a. Reach C10 was evaluated for exposure to sediment only because, as described above, the water levels in the lake and this portion of Choccolocco Creek are lowered during the winter months and also because the former floodplain and riparian zones are now a part of the sediment exposure and operation of the dams prevents overbank flooding along this reach of Choccolocco Creek.

4.2 Exposure Point Concentrations

To estimate COPC exposure, the concentration term for the various media in the exposure estimate were calculated as the arithmetic average of the concentration that is contacted at the exposure point or points over the exposure period (USEPA 1989). To assure that the estimate of the average is conservative and is not underestimated, a 95%UCL on the mean concentration is used as an estimate of the EPC (USEPA 1989) using the USEPA's software (ProUCL version 5.1.00) and accompanying guidance (USEPA 2016a, 2016b, 2016c) for most media. For sediment, EPCs were estimated for PCBs and mercury using a spatially-weighted probabilistic approach (Section 4.2.1).

The USEPA recommends caution in the use of UCLs for small datasets (e.g., < 4 to 6 detects or 8 to 10 total samples) as well as larger datasets with low frequency of detection (e.g., less than 30%) because the performance of the various methods may not be reliable in these cases. Typically, at least five detected concentrations and eight total samples are necessary to calculate UCLs on the mean concentration (i.e., 95%UCLs). When these dataset criteria were not met, maximum concentrations were selected as the EPC. EPCs estimated for use in the quantitative exposure assessments are discussed below.

For PCBs, data are presented as total PCBs based on the sum of detected Aroclors or detected homologs within each sample (i.e., if one or more Aroclor or homologs was detected in a sample, the nondetect [ND] values for other Aroclor or homologs were not added to the total reported concentrations). If no Aroclors or homologs were detected, the highest reporting limit (RL) for either a single Aroclor or homologs was used for reporting purposes.

For PCDD/PCDFs and DL-PCB congeners, avian, fish, and mammalian 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD, or dioxin) TEQs, concentrations were calculated from the individual congener concentrations using toxic equivalency factors (TEFs) from WHO (Van den Berg et al. 1998, 2006 as cited in USEPA 2008). PCDD/PCDF TEQ concentrations were calculated from the 17 2,3,7,8-substituted PCDD/PCDF congeners. DL-PCB TEQ concentrations were calculated from the 12 DL-PCB congeners identified by WHO (Van den Berg et al. 2006). Total TEQ, including PCDD/PCDF TEQ and DL-PCB TEQ,

were also calculated and are presented in Appendix E. Details of the TEQ calculations are presented in Appendix F.

EPCs for each EU and AA were calculated based on the approaches described below for total PCBs and all metal COPCs. The EPCs were developed for COPCs in creek sediment as well as floodplain soils in the riparian zones adjacent to the creek and in the broader portions of the floodplain. Data for dioxin TEQs (PCDD/PCDF TEQs and total TEQs) were not sufficient to calculate EPCs for the individual exposure areas based on EUs. Methods for evaluating the available OU-4 TEQ data are presented in Appendix F.

4.2.1 Sediment EPCs

This section summarizes historical data acquisition approaches, data selected to develop EPCs, and discusses the purpose of using a spatially-weighted probabilistic approach to estimate the EPC. For creek sediments, EPCs were calculated using surficial sediment data and a spatially-weighted probabilistic approach. For a standard mean or 95% UCL calculation, ProUCL assigns an equal weight (probability) to each sample when calculating the overall mean and UCL, regardless of its spatial representativeness. The spatially-weighted probabilistic approach accounts for spatial bias that is common in sampling programs (e.g., higher sampling intensity in areas of known contamination).

Surficial sediment data generally included samples with a start depth of 0 inches, and depending on the sampling program, ranged in depth from 0- to 2-inch and 0- to 6-inch intervals. The 0- to 2-inch data were collected primarily during the Off-Site RFI data collection program, and the 0- to 6-inch data were collected under the OU-4 Phase 2 FSP data collection program. Surficial data were selected to represent exposures within the biologically active sediment zone (Charbonneau and Hare 1998; Clarke et al. 2001; Ford 1962; Matisoff et al. 1985; USEPA 2005c, 2013b, 2015b). Uncertainties associated with the sampling depth for the OU-4 sediment dataset are discussed in Section 6.2.1.1.

The Choccolocco Creek sediment characterization program is anchored in the stratified sampling approach outlined as part of the Off-Site RFI investigation program (BBL 1999a). The stratified sampling approach is based on established principles regarding sediment and hydrophobic constituent transport and deposition in rivers, which predict a general relationship between flow velocity and the deposition of PCBs associated with fine-grained sediment. This relationship is such that the highest PCB concentrations are expected to be found in low energy zones of the creek where fine-grained sediments accumulate. The sediment characterization program was completed in two phases of investigation. Phase I included characterization of the types and distribution of sediment through intensive in-stream sediment probing/coring and channel characterization survey along a series of regularly-spaced transects. Phase II used the results of Phase I to direct the selection of sample locations for PCB analysis to characterize the distribution of PCBs within the identified geographic and textural strata. Using textural data to bias sample selection is an efficient way to allocate samples toward maximizing statistical confidence for a given number of samples.

Phase I characterization of sediments and river flow dynamics was conducted through probing of 187 transects along Choccolocco Creek. The probing observations were combined with the Unified Soil Classification System classifications into four main textural strata including:

- Fine sediment – consisting of organic material, clays, silts, and fine sands
- Coarse sediment – consisting of well and poorly graded sands

- Gravel – consisting of well and poorly graded gravels
- No recovery – consisting of boulders, bedrock, and areas where material was not recovered

Phase II of the stratified sampling approach involved the selection of sediment cores for PCB analysis. For the creek as a whole, the transect surveys and probing information were combined to examine stream gradient, sediment thickness, water depth, water velocity, and other parameters. Based on a review of these characteristics and overlaying the upland site topography and location of tributaries, the creek was divided into reaches (or geographic strata) to represent changes of conditions in the downstream direction. The actual selection of core locations within each textural strata was random to avoid any potential spatial bias within the textural strata of the geographic reach.

Preliminary review of the data indicated that sediment variability is not symmetrical (i.e., variability in sediment types and PCB concentrations is higher laterally [across the channel] than longitudinally [upstream and downstream] for a given area). This asymmetry is a result of physical sediment transport processes that create small-scale differences in the deposition/erosion characteristics across the Choccolocco Creek channel in the areas near banks, in the side slopes of the channel, and at the center of the channel throughout the creek. In the longitudinal direction, variability occurs on a larger scale as a result of slope changes, the occurrence of alternating pools and riffles, and impounded and backwater areas.

For many of the reaches, PCB concentrations reflected the asymmetry in sediment texture. Typically, the highest mean PCB concentrations were observed in fine sediment, though it was also noted that fine sediment represented a comparatively small area of the reach compared to coarse sediment. Conversely, the smaller areas of fine sediment also tended to be sampled more densely than areas of coarse sediment (note this was intended for site characterization as described above). A consequence of the higher sampling intensity in small areas of high concentration can result in a biased estimate of the mean and UCL that more reflects small areas of a site (or reach) than the overall exposure area that is to be represented by an EPC. As a result, spatial bias must be accounted for in order to calculate a representative and unbiased estimate of the mean, as well as a UCL on the mean.

To counter the intentional bias in the sampling design, a spatially-weighted probabilistic approach was used that relied on the known bias in sampling program related to sediment texture. A probabilistic approach was used to calculate a spatially-weighted mean and spatially-weighted 95 percentile on the mean within each reach and AA. The spatially-weighted EPC calculation methodology for Choccolocco Creek sediments accounts for different sampling intensities, spatial extent, and PCB concentrations observed across fine, coarse, and gravel areas sampled in the RFI and FSP collection programs.

The sediment EPC approach uses the average PCB concentration for a given sediment textural class and the area associated with that class to create an EPC that is representative of the reach as a whole. For the purposes of the evaluation, the sediment textural classes included:

- Fine (f) sediment
- Coarse (c) sediment
- Gravel (g)

The spatial areas of each of these classes were based on over 750 sediment core locations collected from 187 sampling transects in Choccolocco Creek as part of the Off-Site RFI and RI/FS programs (BBL1999a,

2000a). Sediment PCB data for samples that were collected for this OU-4 BERA under the OU-4 Phase 2 FSP (Arcadis 2010a) were also included in the pool of data that was used to develop the sediment PCB EPC. For each reach, the average PCB concentration for fine- and coarse-grained sediment and gravel was calculated. Sediment data also included a subset of gravel samples. Areas where material was not recovered were presumed to provide no viable habitat and were not included in the calculation.

For locations with duplicate sample results, the arithmetic average of the two results was used in the calculations. For ND values, the sample-specific RL (e.g., approximately 0.05 milligrams per kilogram [mg/kg]) was used in the calculations. For reaches where gravel was present, but no gravel samples were available, the mean value for coarse sediment was used as a proxy value. This was considered a reasonable proxy value based on the observation that the mean PCB value for coarse areas was typically higher than gravel data in reaches where both coarse and gravel data were available.

The spatially-weighted EPC was calculated using the most recent release of @Risk (version 7.5). The software was used to sample from the original dataset (i.e., bootstrap resampling) based on a spatial-weighting factor assigned to each sample within a reach. The approach used in the reach-based assessment is described below, but is also the same process used for the AA:

1. Calculate the surface areas for coarse, fine, and gravel sediment textures in each reach. Calculate a texture-weighting factor by dividing each texture surface area by the total coarse, fine, and gravel sediment area in the reach.

2. Identify all sample results that are contained within each texture class that are within the boundaries of the reach. Calculate a sample-weighting factor as the number of samples in the texture class by the texture class-weighting factor in Step 1. Pool all samples from coarse, fine, and gravel areas into a single dataset with weighting factors (note: the sum of individual sample-weighting factors is equal to 1).

3. Use bootstrap resampling (i.e., resample with replacement) to generate a dataset of equal sample size to the original dataset in Step 2. Further details regarding bootstrap resampling techniques are provided in the USEPA guidance (USEPA 2001, 2016a, 2016b, 2016c). Use the spatial-weighting factor to determine the probability that any given sample is selected for the bootstrap sample. Calculate the arithmetic mean of the bootstrap sample.

4. Repeat Step 3 up to 10,000 times to generate an array of bootstrapped datasets, all with sample sizes equal to the original dataset (Step 2). Confirm sufficient bootstrap samples were generated to generate a stable mean concentration.

5. Calculate the overall mean of all bootstrap sample means (e.g., n = 10,000), and the 95th percentile of all bootstrap sample means. Use the 95th percentile of the means as the EPC for the reach.

The spatially-weighted probabilistic EPCs for PCBs in sediment are presented in Table 4-4. For reach C1, spatial and textural information is not available to calculate a spatially-weighted EPC. Instead, the standard 95UCL was selected, as calculated using ProUCL 5.1. For reach C6, the PCB dataset is too small for reliable calculation of a spatially-weighted EPC or standard 95UCL. A texturally-weighted maximum concentration was selected as the EPC for reach C6. The PCB EPCs ranged from 0.17 mg/kg

in reach C6 to 16 mg/kg in reach C1. For the AAs, the PCB EPCs ranged from 0.76 mg/kg in the MAA to 4.09 mg/kg in the UAA.

Using a similar approach, the EPCs for mercury in sediment were calculated for the reaches and AAs. However due to limitations with the dataset in a few of the reaches, in some cases reaches were grouped as shown below and reach EPCs (Table 4-5a and b) for mercury were calculated for:

- C1 - Oxford Lake Park
- C2 - Backwater Area
- C3 and C4 – Friendship Road to Silver Run Road
- C5 through C8 – Silver Run Road to Jackson Shoals Dam
- C9 and C10 – Jackson Shoals Dam to Lake Logan Martin

The spatially-weighted probabilistic EPCs for mercury in sediment are presented in Tables 4-5a and 4-5b for each sediment texture within these combined reaches. Similar to PCBs, a spatially-weighted EPC could not be calculated for reach C1 due to the lack of spatial and textural data for C1 sediments. The maximum detected concentration in C1 was selected as the EPC due to small sample size. The sediment mercury EPCs range from 0.58 mg/kg (the maximum detected concentration) for reach C1 to 27 mg/kg for C2. For the AAs, the sediment mercury EPCs ranged from 0.85 mg/kg in the MAA to 4.45 mg/kg in the UAA.

For non-mercury metal COPCs in sediment, sufficient data are not available to estimate spatially-weighted EPCs. As a result, EPCs were based on the maximum detected concentrations for most of the EUs (C1 through C9). For C10, data were sufficient to calculate the 95%UCL for all metals. Additionally, non-mercury metals were not analyzed in sediments from C6 and C8. Assuming a concentration gradient, EPCs for these metals from the upstream EUs were used as surrogates (i.e., EPCs from C5 were used as surrogates for C6 and EPCs from C7 were used as surrogates for C8). Uncertainties associated with this assumption are discussed in Section 6.2. The summary statistics for non-mercury metal COPCs in sediment are presented in Table 4-6. For dioxin TEQ in sediment (i.e., summation of PCDD/PCDF and DL-PCB TEQ results]), sufficient data are not available to estimate spatially-weighted EPCs. The methods used to evaluate dioxin TEQ are presented in Appendix F. There is some uncertainty calculating sediment dioxin TEQs using fish and bird TCDD TEFs as these are tissue-based, not ingestion-based like mammalian TEFs. This uncertainty is discussed in more detail in Section 6.2.

4.2.2 Soil EPCs

The floodplain soil EPCs were developed using soil data from the 0- to 6-inch-interval within each EU in reaches C1 through C9[9] for PCBs and metals. The EPCs for soils in the floodplain were calculated as the north or south side of the floodplain (inclusive of the riparian corridor on that side) with the exception of C1, which was based more on land type and available data. In the case of reach C1, the floodplain EUs were segmented into eastern and western EUs.

[9] C10 is not evaluated for floodplain or riparian soil exposure. See Section 4.1.1.

EPCs for the riparian corridor, where applicable, were calculated using data from within 100 feet of both sides of the creek. The 0- to 6-inch interval was selected as the biologically relevant depth interval where the majority of the soil-associated flora and fauna will derive most of their exposure (Suter 2007, DTSC 1998, Anderson et al. 2010). Duplicate sample results were averaged to create one concentration per location and ND values were noted with a binary flag. These data were entered into ProUCL (version 5.1.00, USEPA 2016c), and a 95%UCL of the mean was generated from the data. ND values were treated in accordance with the specific recommendation of ProUCL. The recommended UCL from ProUCL was taken as the EPC for these areas. In the event that the maximum reported result was less than the UCL calculated by ProUCL, the maximum reported value was used for the EPC.

The floodplain and riparian soil summary statistics for PCBs are presented in Table 4-7. The PCB EPCs in the riparian corridor range from 1.8 mg/kg in the LAA, based on the 95%UCL, to 32 mg/kg in reach C2, based on the maximum concentration. The PCB EPCs for the rest of floodplain ranged from 0.33 mg/kg (based on the 95%UCL) in the south portion of C9 to 207 mg/kg (based on the maximum detected concentration) on the western portion of C1. For the soil AAs, PCB 95%UCL EPCs in floodplain soil ranged from 0.8 mg/kg in the LAA to 9.5 mg/kg in the UAA.

The floodplain and riparian soil summary statistics for mercury are presented in Table 4-8. The mercury EPCs for the riparian corridor range from 0.5 mg/kg in C2 to 5.9 mg/kg in C3, both based on the 95%UCL. In other portions of the floodplain, the mercury EPC values range from 0.07 mg/kg (based on the 95%UCL) in the south side of C2 to 4.7 mg/kg (based on the maximum detected concentration) on the northern side of C8. For the soil AAs, mercury 95%UCL EPCs in floodplain soil ranged from 0.8 mg/kg in the MAA to 2.2 mg/kg in the UAA.

The floodplain and riparian soil summary statistics for chromium are presented in Table 4-9. The EPCs for chromium in the riparian corridor range from 13.4 mg/kg (based on the maximum) at C2 to 46 mg/kg at C4 (based on the maximum detected concentration). In other portions of the floodplain, the chromium EPC values range from 10 mg/kg (based on the maximum detected concentration) in the south side of C6 to 55.2 mg/kg (based on the maximum detected concentration) on the south side of C3. For the soil AAs, chromium 95%UCL EPCs in floodplain soil ranged from 19 mg/kg in the MAA to 27.5 mg/kg in the UAA.

The floodplain and riparian soil summary statistics for lead are presented in Table 4-10. The EPCs for lead in the riparian corridor range from 15.5 mg/kg at C9 (based on the 95%UCL) to 89.1 mg/kg at C4 (based on the 95%UCL). In other portions of the floodplain, the lead EPC values range from 14.3 mg/kg (based on the maximum detected concentration) in the south side of C6 to 106 mg/kg (based on the maximum detected concentration) on the south side of C3. For the soil AAs, lead 95%UCL EPCs in floodplain soil range from 23.5 mg/kg in the LAA to 45.3 mg/kg in the UAA.

The floodplain and riparian soil summary statistics for vanadium are presented in Table 4-11. The EPCs for vanadium in the riparian corridor range from 9.7 mg/kg (based on the maximum detected concentration) at C9 to 28.3 mg/kg at C8 (based on the maximum). In other portions of the floodplain, the vanadium EPC values range from 12.2 mg/kg (based on the maximum detected concentration) in the north side of C9 to 32.1 mg/kg (based on the 95%UCL) on the south side of C5. For the soil AAs, vanadium 95%UCL EPCs in floodplain soil range from 20.2 mg/kg in the UAA to 25.2 mg/kg in the MAA.

Floodplain and riparian soil summary statistics are also provided for barium (Table 4-12) and cobalt (Table 4-13). Although these metals are not COPCs in soil, EPCs were necessarily to calculate dietary exposures for semi-aquatic (mixed-diet) receptors.

For dioxin TEQ in soil, sufficient data are not available to calculate EPCs for the individual exposure areas. The methods used to evaluate dioxin TEQ are presented in Appendix F.

4.2.3 Surface Water EPCs

Surface water EPCs were developed using available whole water surface water data for PCBs and metal COPCs collected from Choccolocco Creek. These data are described in detail in Section 3.3. Surface water data were not categorized into EUs; instead data from all the locations within Choccolocco Creek were grouped into one site-wide dataset representative of OU-4. Surface water data were also evaluated grouped by the three AAs and reach C1. Duplicate sample results were averaged to create one concentration per location, and ND values were noted with a binary flag. These data were entered into ProUCL (version 5.1.00, USEPA 2016c), and a 95%UCL of the mean was generated from the data. ND values were treated in accordance with the specific recommendation of ProUCL. The recommended UCL from ProUCL was taken as the EPC for surface water. The EPCs for some of the COPCs were based on the maximum detected concentrations due to small sample sizes and/or small numbers of detected concentrations. The summary statistics for surface water data are presented in Table 4-14.

4.2.4 Measured Tissue (Biota) EPCs

Tissue EPCs were developed using available measured tissue data for PCBs and metal COPCs collected from the nine aquatic and 27 terrestrial BSAs. These data are described in detail in Section 3.4. The tissue data were not categorized into EUs due to small sample sizes for most tissues. Instead, data were grouped into AAs for calculation of PCB and mercury EPCs. For non-mercury metals, site-wide EPCs were used due to the small sample size. Duplicate sample results were averaged to create one concentration per location, and ND values were noted with a binary flag. These data were entered into ProUCL (version 5.1.00, USEPA 2016c), and a 95%UCL of the mean was generated from the data. ND values were treated in accordance with the specific recommendation of ProUCL. The recommended 95%UCL from ProUCL was taken as the EPC for tissue. The tissue EPCs for some of the COPCs were based on the maximum detected concentrations due to small sample sizes and/or small numbers of detected concentrations. The summary statistics for tissue data are presented in Table 4-15 for aquatic tissues and Table 4-16 for terrestrial tissues.

4.3 Exposure Scenarios

For this OU-4 BERA, in addition to the lower trophic level receptors (plants, invertebrates, and aquatic life), 17 wildlife receptors were evaluated, representing the various feeding guilds and AEs. Table 4-17 presents all of the exposure scenarios evaluated for each of the reaches (C1 through C10), including the EUs and the receptors in the three identified EU types (floodplain soil, riparian, and in-stream sediment). Table 4-17 also presents the COPCs evaluated for each medium, the EPCs used in the dietary exposure model, the composition of diet for each of the receptors, and the BAFs that were used to estimate modeled tissue concentrations. The elements of the exposure scenarios were discussed previously (EUs in Section 4.1, and EPCs in Section 4.2), and the remaining elements are discussed in following sections. For reaches C1 and C10, riparian habitat is not present. Risk to wildlife receptors exposed to riparian media in the food web models was evaluated using the UAA-wide riparian soil EPCs for C1 and the LAA-wide riparian soil EPC for reach C10. Additionally, metals were not analyzed in floodplain soil in reach C1

and thus risks associated with terrestrial exposure are estimated only for PCBs in this reach. Uncertainties related to these assumptions are discussed in Section 6.2.1.1.

4.4 Dietary Exposure Model

Exposure to COPCs for birds and mammals is evaluated in this OU-4 BERA using a dietary exposure estimate. Dietary exposure in the form of a daily dose is estimated using methods that are consistent with USEPA guidance (1997). A daily intake represents an estimate of a constituent dose that a receptor might receive per day and was calculated by summing all intakes for complete and significant exposure pathways (i.e., dietary, incidental soil/sediment ingestion, ingestion of surface water) for each wildlife receptor. The dietary dose model used for this OU-4 BERA was calculated following Equation 1:

$$ADD_{pot} = \sum_{k-1}^{n}[(C_k \times FR_k \times NIR_f) + (NIR_f \times COPC_s \times DF_s) + (NIR_w \times COPC_w) \times SUF$$

Where:

ADD_{pot}	Potential average daily dose (milligrams COPC /kilogram body weight per day [mg/kg BW-d])
n	Number of food types
C_k	COPC concentration in the kth food type (mg/kg dry weight [dw]).
FR_k	Dietary fraction of intake of the kth food type
NIR_f	Normalized ingestion rate of food (kilograms of dry weight of food ingested per kilogram of body weight per day [kg dw/kg BW-d])
$COPC_{s\ or\ w}$	EPC in soil/sediment (s) (mg/kg dw) or water (w) (milligrams per liter [mg/L])
DF_s	Dietary fraction of soil/sediment ingested (range 0 to 1.0)
SUF	Site use factor (assumed to be 100%); see Section 4.5.4 for definition

4.4.1 Prey Tissue Concentration Estimates

Two prey tissue scenarios were evaluated in the dietary food web models, using measured prey tissue and modeled prey tissue. As noted above in Section 4.2.4, measured prey tissue concentrations were based on the AA-wide 95%UCL concentration in individual tissue types. Modeled prey tissue concentrations were estimated from abiotic media concentrations and BAFs. Both approaches are described in more detail below.

4.4.1.1 Measured Tissue Concentration Estimates

The biotic data collected within OU-4 were used to calculate AA-wide 95%UCL tissue concentrations for use in the food web models (Tables 4-15 and 4-16 for aquatic and terrestrial tissues, respectively). Because some prey tissue types included in the dietary composition of wildlife receptors were not collected in OU-4, surrogate tissues were selected. These cases include aquatic oligochaetes (*Lumbriculus variegatus*) and spiders. For aquatic oligochaetes, benthic invertebrate (Odonata) tissue EPCs were used in the food web models to represent oligochaete tissue. For spiders, earthworm EPCs

were selected based on information in the literature that suggests that PCB uptake in spiders can be similar to earthworms (Walters et al. 2010; Shang et al. 2013; and Sample et al. 1999).

4.4.1.2 Modeled Tissue Concentration Estimates

The biotic data collected within OU-4 were used to develop uptake models or BAFs. Additional discussion of the specific data available for BAFs and the BAF derivation methodology is provided in Appendix B.

The bioaccumulation model represents the relationship between the soil or sediment and the measured prey tissue concentration. It is expressed either as a function based on regression analysis of exposed soil or sediment concentrations and biotic tissue concentrations (e.g., for a linear model, tissue concentration [y] = slope [m] of the line x soil concentration [x] + the y intercept [b]), or as a simple ratio.

For example:

$$BAF = \frac{C_{benthic\ invertebrate}(mg/kg\text{-}dw)}{C_{sediment}(mg/kg\text{-}dw)} \qquad \text{Equation 2}$$

Where:

C COPC concentration in the biotic or abiotic media (mg/kg, dw).

Thus,

$$C_{benthic\ invertebrate} = BAF_{benthic\ invertebrate} \times C_{sediment}$$

For this OU-4 BERA, the ingestion rates (IRs) for the identified receptors are based on dry weight estimates. As such, it was necessary to estimate prey tissue concentrations in dry weight. For biotic tissues, the COPC concentrations are reported from the laboratory as wet weight. The fraction of solids in each sample was also measured. Thus, the fraction of solids was used to calculate a dry weight concentration from each reported wet weight tissue concentration (concentration as mg/kg wet weight [ww]/fraction solids – see Appendix B).

4.4.1.3 Datasets for BAF Development

Available soil/sediment and biotic tissue data from nine aquatic BSAs and 27 terrestrial BSAs were sampled as part of the 2009 Phase II sampling in support of BAF development. Tissue samples were collected throughout each of the terrestrial and aquatic BSAs. As the data are not co-located, soil/sediment samples from the Phase I (2007) and Phase 2 (2009) investigations located within or nearby each BSA were grouped and evaluated with the tissue data from the same BSA. These data groupings, used for BAF development as described in Appendix B, are summarized in Table 4-18 for sediment and Table 4-19 for soil. Older abiotic media data collected prior to 2007 were not included in the BAF datasets.

For PCBs and mercury, regression analysis was performed on each tissue type to determine whether COPC concentrations in abiotic media are predictive of tissue residues in OU-4 biota. Detected concentrations in biota and abiotic media in OU-4 and reference areas were used in the regression analysis. When the regressions were statistically significant ($p<0.1$), predictive ($r^2>0.3$), and had a positive slope, the regressions were used to estimate COPC uptake into OU-4 prey tissues. Otherwise, median BAFs were developed for each of the three AAs based on the BSA data groupings. The median AA BAFs

were calculated from OU-4 data using individual tissue samples and the mean abiotic media concentration in the BSA. Kaplan-Meier statistics were used to account for any ND results in soil or sediment. In cases where a median AA BAF could not be calculated, alternate approaches, including site-wide median BAFs and literature-based BAFs, were used to estimate COPC concentrations in prey tissue. These methods (regression analysis, median BAF calculation, and literature BAFs) are described in detail in Appendix B.

For non-mercury metals, the BAF datasets were small, and site-wide median BAFs were selected instead of AA median BAFs. In some cases, site-wide median BAFs could not be developed for the other metals. For these COPCs and tissues, alternate BAF methods were employed, as described in Appendix B.

For calculation of dioxin TEQ concentrations in prey tissues, site-wide median BAFs were calculated for individual PCDD/PCDF and DL-PCB congeners, using methods similar to the non-mercury metals, as presented in Appendix F. In some cases, site-wide median BAFs could not be developed for individual congeners. For these COPCs and tissues, alternate BAF methods were employed, as described in Appendix F.

The selected uptake regressions, BAFs, and literature uptake factors used in this OU-4 BERA are summarized below. Note that for reach C1, biota data were not available. BAFs for the UAA were used to estimate COPC uptake in reach C1.

4.4.1.4 Sediment to Biota Uptake for PCBs and Mercury

For PCBs, possible correlations were evaluated based on sediment measured as Aroclors and homologs on a dry weight, OC-normalized, and fines-normalized basis. The sediment PCB concentrations were compared to biotic tissues measured as Aroclors or homologs on a dry weight, wet weight, and lipid-normalized basis. For mercury, possible correlations were evaluated based on sediment dry weight and fines-normalized concentrations and tissue on a wet weight and dry weight basis.

For PCBs, a significant (i.e., $r^2 > 0.3$ and $p < 0.1$) positive relationship was found between PCBs in sediment and aquatic oligochate (*Lumbriculus variegatus*) tissue in the laboratory bioaccumulation tests conducted with OU-4 and reference sediments. Specific details of the analyses and methods employed during laboratory bioaccumulation testing as well as the data are presented in Ingersoll et al. (2014). The regressions were highly significant for all combinations of sediment and tissue data, regardless of whether the data were log-transformed, lipid/OC-normalized, or whether sediment PCBs were evaluated as Aroclors or homologs. The regression based on log-transformed sediment Aroclors and log-transformed wet weight tissue was selected for use in this OU-4 BERA for simplicity. Additionally, a significant, positive relationship was found between PCBs measured as Aroclor in sediment normalized to percent fines and benthic invertebrate tissue on a wet weight basis. No positive and significant relationships were identified for other tissue types using field-collected tissue data. Because no other significant relationships between fines-normalized sediment and biotic tissue were identified and fines were not correlated with PCB concentrations, this regression was not selected for use in this OU-4 BERA. This uncertainty is discussed in Section 6.2.2.1.

For mercury, significant positive relationships were found between sediment and four aquatic prey tissues: benthic invertebrates (Odonata), crayfish, frogs, and snakes. For benthic invertebrates, the significant, positive relationship with the highest r^2 value was found between log-transformed mercury in sediment (dry weight) and benthic invertebrate tissue on a log-transformed wet weight basis. For crayfish, the

significant, positive relationship with the highest r^2 value was found between log-transformed mercury in sediment (dry weight) and crayfish tissue on a log-transformed dry weight basis. For snakes, the significant, positive relationship with the highest r^2 value was found between log-transformed mercury in sediment (dry weight) and snake tissue on a log-transformed wet weight basis. These uptake equations were selected for use in this OU-4 BERA. For frogs, the significant, positive relationship with the highest r^2 value was found between log-transformed mercury in sediment (dry weight) normalized to fines and log-transformed dry weight tissue concentrations for frogs. Because fines were not correlated with mercury concentrations, this regression was not selected for use in this OU-4 BERA. The regression based on log-transformed mercury in sediment (dry weight) and benthic invertebrate tissue on a log-transformed wet weight basis was also highly predictive and significant, and was selected for use in this OU-4 BERA. Appendix B provides a detailed description of the correlation analyses conducted for these and other tissue types.

For the remaining tissue types collected in OU-4, tissue concentrations were estimated in this OU-4 BERA based on median BAFs (Appendix B). For mercury in aquatic oligochaete tissue (which was not collected in OU-4), a BAF of 1.0 was selected from data presented by Gilmour et al. (2013).

The regressions selected for use in this OU-4 BERA are summarized in Table 4-20 for PCBs and mercury, and are presented on Figure 4-4 for PCBs and Figure 4-5 for mercury. The median BAFs are summarized in Table 4-21.

For emergent insect samples, which consist of data from craneflies and mixed emergent insects (damselflies, dragonflies, sweat bees, and craneflies), the PCB BAFs are considerably higher in the UAA than in other areas. This is due to two cranefly tissue samples collected from two areas. These cranefly tissue samples contain significantly elevated PCB concentrations relative to mixed insect samples collected in the remaining areas of OU-4.

For fish, three tissue types were available: forage fish, bottom fish, and predator fish. Sediment-to-all fish BAFs for PCBs and mercury were calculated by taking the median of the individual sample BAFs for forage fish, bottom fish, and predator fish combined.

4.4.1.5 Soil to Biota Uptake for PCBs and Mercury

Soil-to-biota uptake factors were derived similar to those for sediment. For PCBs, possible correlations were evaluated based on soil measured as Aroclors and homologs on a dry weight, OC-normalized, and fines-normalized basis, and compared to biotic tissues measured as Aroclors or homologs on a dry weight, wet weight, and lipid-normalized basis. For mercury, possible correlations were evaluated based on soil dry weight and fines-normalized concentrations and tissue on a wet weight and dry weight basis.

For PCBs, a significant (i.e., $r^2 > 0.3$ and $p < 0.1$) positive relationship was found for two tissue types: small mammals and soil invertebrates (earthworms). For small mammals, three subsets of tissue were evaluated, including all small mammals, non-shrew small mammals (mice, rats, voles), and mice only. When the data are log-transformed, a significant relationship exists between soil PCBs and all three types of small mammal tissue regardless of whether the data are on a dry weight basis or normalized to OC or lipid content. The uptake relationships were all highly significant, and therefore, the small mammals regression equation on a dry weight basis was selected for this OU-4 BERA, as predators are assumed to consume a mixed diet consisting of various types of small mammals. OC and lipid-normalization gave

similar results, so the dry weight uptake regression was selected for simplicity. Similarly for earthworms, significant positive relationships exist between soil PCBs and earthworm tissue regardless of log-transformation and/or data normalization. Untransformed data gave relationships with the highest r^2 values as compared to log-transformed data, and the regression based on dry weight soil and dry weight tissue was selected for simplicity and to avoid the need for static assumptions regarding organic carbon content in soil across an EU.

PCB uptake in the remaining terrestrial prey tissue types was estimated as follows: for terrestrial plants, the data were insufficient for regression analysis and median BAF calculation. An uptake relationship based on data presented by Ficko et al. (2013) for PCBs in willow trees was selected for this OU-4 BERA. For terrestrial insects (grasshoppers), PCBs were never detected in grasshopper tissue; a BAF of 0.17 was selected based on data presented by Blankenship et al. (2005). Uncertainty related to the use of the literature-based terrestrial insect BAF instead of a tissue concentration representative of the laboratory RL is discussed in Section 6.2. For spiders, which were not collected in OU-4 biota sampling, data from Walters et al. (2010), Shang et al. (2013), and Sample et al. (1999) demonstrate that spiders can have PCB body burdens similar to earthworms. As recommended by USEPA (2016d), the site-specific earthworm bioaccumulation model was selected to estimate PCB uptake into spiders.

For mercury, a significant (i.e., $r^2 > 0.3$ and $p < 0.1$) positive relationship was found for earthworms regardless of log-transformation or data normalization. The relationship between soil PCBs on a dry weight basis and earthworm tissue on a dry weight basis was selected to model uptake for soil invertebrates in this OU-4 BERA, as this regression equation had the highest r^2 value and was highly significant ($p < 0.0001$). No significant relationships were identified for all small mammal tissue, non-shrew small mammal tissue, or mice tissue. Therefore, median AA BAFs were selected for this OU-4 BERA based on all small mammals, consistent with the approach for PCBs. For terrestrial plants and insects, data were insufficient for regression analysis. A BAF of 0.05 was selected for terrestrial plants from data presented by Pant et al. (2011). For terrestrial insects, the site-wide median BAF was selected. Similar to the approach for PCBs, the earthworm regression was also used to estimate mercury concentrations in spider tissue.

The regressions selected for use in this OU-4 BERA are summarized in Table 4-20 for PCBs and mercury, and are presented on Figure 4-6 for PCBs and Figure 4-7 for mercury. The median BAFs are summarized in Table 4-21.

4.4.1.6 Uptake Factors for Non-Mercury Metals and PCDD/PCDFs

For metals (barium, chromium, cobalt, lead, and vanadium) and PCDD/PCDFs, data were insufficient to conduct regression analysis or calculate median AA BAFs. Thus, BAFs for these non-mercury metal and PCDD/PCDF COPCs were calculated using the site-wide median BAF, as described in Appendix B and summarized in Table 4-21 for non-mercury metals. PCDD/PCDF and DL-PCB congener BAFs are calculated as described in Appendix F.

Certain metals were never detected in some prey tissue types. In these cases, no median BAF could be calculated.

When metals were never detected in a prey tissue, a tissue concentration equal to half the maximum RL was selected. This is the case for the following COPC-tissue pairs, with ½ maximum RL shown in parentheses:

- Chromium – snakes (9.01 milligrams per kilogram dry weight [mg/kg dw]), and terrestrial insects (7.38 mg/kg dw)
- Cobalt – aquatic plants (34.7 mg/kg), crayfish (20 mg/kg), snake (22.53 mg/kg), forage fish (19.31 mg/kg), terrestrial insects (18.45 mg/kg), and small mammals (15.63 mg/kg dw)
- Vanadium – snake (9.01 mg/kg dw), small mammals (6.25 mg/kg dw)

Additionally in certain cases, metals were detected in tissue samples, but abiotic data from the same BSA were lacking; therefore, a BAF could not be calculated. In these cases, a site-wide average ratio BAF was calculated by dividing the site-wide average detected tissue concentration by the site-wide average concentration in soil or sediment. The site-wide average ratio BAF values are presented in Table 4-21, and were selected to model uptake in the OU-4 BERA for the following COPC-tissue pairs:

- Barium – frogs, snakes, terrestrial plants, and small mammals
- Chromium – frogs, terrestrial plants, and small mammals
- Cobalt – frogs, and terrestrial plants
- Lead – frogs, snakes, terrestrial plants, and small mammals
- Vanadium – frogs, terrestrial plants

Tissue metals data were not collected for spiders or oligochaetes. Similar to the approach for PCBs and mercury, earthworm metals BAFs were selected to model uptake into spiders and benthic invertebrate (odonatan) BAFs were selected to model uptake into oligochaetes.

4.4.1.7 Bioaccumulation Factors for Uptake into Bird Eggs

Because egg tissue was not collected within OU-4, uptake factors were needed to estimate potential concentrations of PCBs and mercury in bird eggs. Following available guidance (California's Office of Environmental Health Hazard Assessment [OEHHA 2012]), uptake of PCBs and mercury were estimated using uptake transfer coefficients (TCos) recommended by OEHHA (2012, 2015), as described in Appendix B. The TCos, expressed in days/kilogram (kg), represent the ratio of contaminant concentration in fresh weight animal product (in mg/kg, for example) to the daily intake of contaminant by the animal (in milligrams per day [mg/day]). These TCos were multiplied by the daily intake (i.e., daily dose in mg/kg BW-d multiplied by the body weight in kilograms to get daily intake in mg/day) predicted from the dietary intake pathways (including sediment and/or soil ingestion) for each bird receptor in the OU-4 to predict wet weight egg concentrations. The wet weight egg concentrations were converted to a dry weight basis, assuming 75% moisture content in egg tissue (Ahn et al. 1997).

4.5 Exposure Parameters

For wildlife receptors, exposure parameters such as dietary composition, body weight, and IRs are defined and summarized in Tables 4-1a, 4-1b, 4-2a, and 4-2b. In this section, exposure and intake assumptions

are defined on the basis of available information, best professional judgment, and direction from the USEPA using the following hierarchy, with the exception of receptor IRs as discussed below:

1. USEPA's *Wildlife Exposure Factors Handbook* (Wildlife Handbook; USEPA 1993)
2. USEPA's *Guidance for Developing Ecological Soil Screening Levels* (EcoSSL; USEPA 2007)
3. Sample and Suter (1994)
4. Other sources as necessary and appropriate (e.g., primary literature)

4.5.1 Body Weight

Body weights for the short-tailed shrew, raccoon, mink, river otter, red fox, osprey, red-tailed hawk, great blue heron, and spotted sandpiper were taken as the average of values presented in the Wildlife Handbook (USEPA 1993). For the long-tailed weasel and mourning dove, values were available from the USEPA's EcoSSLs document (USEPA 2007). Body weights for the little brown bat, white-tailed deer, and belted kingfisher were taken from Sample and Suter (1994). For the tree swallow, Carolina wren, and blue jay, values were not available from these three sources, and body weights were identified in the primary literature. Body weights and sources of the values are presented in Tables 4-1a and 4-1b for birds and Tables 4-2a and 4-2b for mammals.

4.5.2 Dietary Composition

The composition of the diet (FR_k in Equation 1) for birds and mammals, expressed as a fraction of the total diet, is based on information on the feeding guilds for each of the species. Because the Nagy (2001) equation recommended for estimating the IRs for each receptor is based on the metabolic need, the prey tissue components of each diet is a total of 100%. The percent of incidental soil, sediment, or water ingested is in addition to the diet estimates, making the total diet composition greater than 100%.

The percent soil/sediment ingested was based on data from Beyer et al. (1994), Sample and Suter (1994), and the USEPA (1993). Drinking water IRs were obtained from the USEPA (1993). For receptors where data were not available, assumptions were made based on the foraging habits of receptors and values from surrogate species were assigned. For the tree swallow, American osprey, little brown bat, American mink, and river otter, incidental ingestion of soil or sediment was assumed to be negligible and therefore, assigned a value of 0% (Tables 4-1a and 4-2a).

Where available, information from the Wildlife Handbook (USEPA 1993) was used to develop the dietary composition for each species. Dietary composition for selected receptors is summarized in Tables 4-1a, 4-1b, 4-2a, and 4-2b for birds and mammals, respectively. For a number of receptors, based on input from the USEPA, two dietary exposure scenarios were evaluated to address possible variability and uncertainty associated with dietary composition assumptions. Specifically, birds evaluated using two different diet composition assumptions were the Carolina wren, spotted sandpiper, and belted kingfisher (Table 4-1b). Mammals include the short-tailed shrew, raccoon, American mink, and red fox (Table 4-2b). A brief description of the dietary composition assumptions for each receptor is provided below.

4.5.2.1 Birds

The spotted sandpiper was selected as a representative aquatic ground-feeding/sediment-probing insectivore residing and foraging along and within the creek banks and within riparian corridor soils. Based on information from Oring et al. (1997), the spotted sandpiper can be considered an aquatic-dependent insectivore with 100% of the diet consisting of aquatic insects, mainly midges and mayflies. However, based on information provided in Appendix A about the variety of habitats that can be used by spotted sandpipers for foraging, two dietary scenarios were evaluated: 1) 50% of its diet based on aquatic emergent and 50% based on earthworms (i.e., mixed aquatic and terrestrial exposures; referred to as sandpiper-1), and 2) 50% aquatic emergent/flying insects and 50% aquatic oligochaetes (i.e., only aquatic exposures; referred to as sandpiper-2) (Table 4-1b). The BAFs selected to estimate dose for sandpiper-1 and sandpiper-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The belted kingfisher was selected as a representative piscivorous bird residing and foraging along the creek bank. The belted kingfisher eats primarily fish (Kelly et al. 2009), with the average length of fish eaten by a belted kingfisher ranging from 3 to 18 centimeters (cm) (Prose 1985). One dietary scenario was evaluated for the belted kingfisher using this assumption (i.e., only aquatic exposures; referred to as kingfisher -1). However, other studies reveal that kingfishers can eat roughly 19% of their diet in crayfish and a small proportion of amphibians (Alexander 1977; Salyer and Lagler 1946; and Davis 1982; all as cited in USEPA 1993) and snakes (USEPA 1993). Thus, for the kingfisher, a second scenario (i.e., only aquatic exposures; referred to as kingfisher-2) was evaluated that includes crayfish and amphibians in the diet. The average values from these studies were used to determine the specific percentages of crayfish and amphibians (Table 4-1b). The BAFs selected to estimate dose for kingfisher-1 and kingfisher-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The American osprey was selected as a representative piscivorous bird residing and foraging along the creek bank. The American osprey diet consists completely of fish (Greene et al. 1983; Hughes 1983; Collopy 1984; and Van Daele and Van Daele 1982; all as cited in USEPA 1993). Approximately 3% of their diet consists of fish smaller than 10 cm, 42% of their diet consists of fish 11 to 20 cm, 47% of their diet consists of fish 21 to 30 cm, and 7% of their diet consists of fish 31 to 40 cm in length (Van Daele and Van Daele 1982 as cited in USEPA 1993). Thus, the osprey diet was evaluated considering fish that range in size from 11 to 40 cm (i.e., only aquatic exposures; Table 4-1a). The BAFs selected to estimate dose for the osprey in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The great blue heron was selected as a representative wading carnivorous bird residing and foraging along the creek bank. Great blue herons consume primarily fish in their diet, typically consuming fish ranging from 5 to 30 cm (DeGraaf and Yamasaki 2001), but are also known to eat small percentages of amphibians and snakes and occasionally include crustaceans and mammals in their diet. A study by Alexander (1977 as cited in USEPA 1993) was used to develop a dietary scenario appropriate for a riverine habitat, which includes primarily fish (94%) and a small portion of crayfish (1%), amphibians (4%), and small mammals (1%) (Table 4-1a) and therefore, evaluated as an aquatic receptor. The BAFs selected to estimate dose for the great blue heron in in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The tree swallow was selected as a representative aerial-feeding insectivorous bird residing and foraging along the creek bank and the riparian corridor. Tree swallows and Carolina wrens are not included in the USEPA Wildlife Handbook (USEPA 1993). Information from Blancher et al. (1987 as cited in Robertson et

al. 1992) states that tree swallows consume primarily emergent and flying insects. Thus, the tree swallow was evaluated based on a dietary composition of 100% emergent insects (i.e., only aquatic exposures). The BAFs selected to estimate dose for the tree swallow in in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The Carolina wren diet was based on information from Cristol et al. (2008) and Walters et al. (2010), which states that the Carolina wren consumes 91% terrestrial insects and 9% plant matter (i.e., only terrestrial exposures; Table 4-1b). One dietary scenario was evaluated for the Carolina wren using this assumption (i.e., only terrestrial exposures; referred to as Carolina wren-1). Cristol et al. (2008) and Walters et al. (2010) report that wrens may also consume aquatic-feeding spiders from terrestrial areas near water. Therefore, for the Carolina wren, a second scenario (i.e., mixed terrestrial and aquatic exposures; referred to as Carolina wren-2) was evaluated that includes aquatic plants and aquatic-feeding spiders (estimated using sediment EPCs and earthworm BAFs) in the diet. The specific percentages of terrestrial insects, earthworms, spiders, and plants are presented in Table 4-1b. The BAFs selected to estimate dose for Carolina wren-1 and Carolina wren-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The blue jay was selected as a representative omnivorous bird residing and foraging in the floodplains. The blue jay is not included in the USEPA Wildlife Handbook (USEPA 1993). The blue jay diet was evaluated as 11% terrestrial insects, 11% spiders, and 78% vegetation (fruits and grains) based on information from Beal (1922 as cited in Tarvin and Woolfenden 1999) and Smith et al. (2013) (i.e., only terrestrial exposures; Table 4-1a). The BAFs selected to estimate dose for the blue jay in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The mourning dove was selected as a representative herbivorous bird residing and foraging in the floodplains. The mourning dove is also not included in the USEPA Wildlife Handbook (USEPA 1993). Lewis (1993) states that 99% of the diet of the mourning dove consist of seeds; therefore, the dietary composition of the mourning dove was categorized as 100% terrestrial plants. Moisture assumptions for plants were adjusted in the dose model to account for differences in moisture in seeds compared to leafy vegetation. The BAFs selected to estimate dose for the mourning dove in the modeled tissue scenario are presented in Table 4-21.

The red-tailed hawk was selected as a representative raptor residing and foraging in the floodplains. Red-tailed hawks tend to be opportunistic and will feed on the most abundant species (Brown and Amadon 1968). Small mammals including mice, shrews, voles, squirrels, and rabbits make up the majority of the red-tailed hawks' diet; however, lizards and snakes can consist of up to 13% of their diet depending on availability (Janes 1984 as cited in USEPA 1993). Although the hawk diet consists of mixed aquatic and terrestrial prey, their diet was assumed to consist primarily of small mammals (87%) with a lower percent of reptiles (13%) (Table 4-1a); therefore, the hawk was evaluated as a terrestrial bird. The BAFs selected to estimate dose for the hawk in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

For the reaches of the creek where riparian or floodplain soil habitats were not identified (C1 and C10), the diet of the wildlife receptors was not modified. In these two reaches, the modeled tissue concentrations were estimated using AA-wide EPCs for floodplain and/or riparian soil. Specifically, in reach C1 a riparian area is not present. For the C1 modeled tissue scenario, EU-wide EPCs (C1 East and C1 West) were used for floodplain soil and AA-wide EPCs were used for riparian soil. In reach C10, floodplain and riparian soil are not present. For the C10 modeled tissue scenario, terrestrial receptors/floodplain soil was

not evaluated and AA-wide EPCs were used for riparian soil. For the AA modeled tissue scenarios and the measured tissue scenarios, AA-wide EPCs were used in all cases. These assumptions are also presented in Table 4-17.

4.5.2.2 Mammals

The mink was selected as a representative piscivorous mammal residing and foraging along the creek bank and the riparian corridor. The mink diet includes fish, amphibians, aquatic invertebrates, as well as mammals and birds. Mink commonly consume forage fish ranging from 7 to 20 cm (USEPA 2003). Two dietary scenarios are provided in Table 4-2b; Scenario 1 (referred to as mink-1) included a mink diet with a higher relative proportion of mammals and birds (Korschgen 1958 as cited in USEPA 1993), and Scenario 2 (referred to as mink-2) was based on a more riverine habitat and included a higher percentage of fish in the diet (Alexander 1977 as cited in USEPA 1993). Mink-1 was evaluated as a mammal with mixed diet of aquatic and terrestrial prey and mink-2 was evaluated as an aquatic mammal. The BAFs selected to estimate dose for mink-1 and mink-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The short-tailed shrew was selected as a representative ground-feeding invertivorous mammal residing and foraging in the floodplains. The short-tailed shrew has a varied diet that can include invertebrates (e.g., earthworms, slugs, millipedes, and spiders), small mammals, amphibians, and plants. The short-tailed shrew has been known to eat voles, frogs, and other shrews as well. Two dietary scenarios were developed for the short-tailed shrew (Table 4-2b). Scenario 1 (referred to as shrew-1) consisting of terrestrial invertebrates (worms, insects, and spiders) and plants based on the average diet composition of Whitaker and Ferraro (1963) and Hamilton (1940), both as cited in USEPA 1993 (i.e., only terrestrial exposures). Scenario 2 (referred to as short-tailed shrew-2) consists of a more varied but primarily terrestrial prey diet including invertebrates, plants, small mammals, reptiles, and amphibians, based on Hamilton (1930) and Hamilton (1940), both as cited in USEPA 1993. Therefore, shrew-1 and shrew-2 were evaluated as terrestrial mammals. The BAFs selected to estimate doses for shrew-1 and shrew-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The river otter was selected as a second representative piscivorous mammal residing and foraging along the creek bank. As discussed in Section 6.1, mammal communities and habitat suitability was assessed qualitatively based on the 2006 and 2007 surveys and suitable river otter habitat may be present within OU-4. The river otter diet consists mostly of fish; however, they are also an opportunistic forager, and their diet can include amphibians and aquatic invertebrates, particularly crayfish, where regionally available. River otters consume different fish species according to their availability but commonly prey on fish between 5 and 50 cm (Loranger 1981, USEPA 2003). Because the mink is a similar receptor and is being evaluated using multiple diet composition scenarios, it was agreed in discussion with the USEPA that the otter would be evaluated based on a diet of 100% fish only (i.e., only aquatic exposures; Table 4-2a). The BAFs selected to estimate dose for the otter in the modeled tissue scenarios are presented in Tables 4-20 and 4-21.

The raccoon was selected as a representative omnivorous mammal residing and foraging along the creek bank, the riparian corridor, and the floodplains. The raccoon diet is diverse and includes fruit, berries, grain, eggs, poultry, vegetation, nuts, molluscs, fish, insects, and rodents. Raccoons can consume a wide variety of fish including sculpins, suckers, and minnows ranging from 10 to 33 cm (Alexander 1977). Two

dietary scenarios are presented in Table 4-2b. Scenario 1 (referred to as raccoon-1) is a more varied diet based on Llewellyn and Uhler (1952 as cited in USEPA 1993), and Scenario 2 (referred to as raccoon-2) is based on a more riverine habitat and contains a higher proportion of fish, crayfish, and mollusc based on the information in Alexander (1977 as cited in USEPA 1993). Both the raccoon-1 and raccoon-2 scenarios include mixed dietary exposures from both aquatic and terrestrial sources. The BAFs selected to estimate doses for raccoon-1 and raccoon-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The red fox was selected as a representative terrestrial-dependent carnivorous mammal residing and foraging in the floodplains. The red fox feeds mostly on mammals, birds, insects, and fruit. Two dietary scenarios are presented in Table 4-2b, both with a high proportion of birds and mammals. Scenario 1 (referred to as red fox-1) has a relatively higher proportion of plants in the diet and also includes a small proportion of terrestrial invertebrates based on Knable (1974 as cited in USEPA 1993), which was focused more on farm and wood habitats. Scenario 2 (referred to as red fox-2) diet consists primarily of mammals and birds with a small proportion of plants, based on the information in Korschgen (1959 as cited in USEPA 1993). Both scenarios include terrestrial exposures, which may be more appropriate for a riverine habitat. The BAFs selected to estimate doses for red fox-1 and red fox-2 in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The long-tailed weasel was selected as a representative terrestrial-dependent carnivorous mammal residing and foraging in the floodplains. The long-tailed weasel diet consists mostly of small mammals like mice, voles, rabbits, gophers, and chipmunks (i.e., only terrestrial exposures); therefore, its dietary composition was based on Sheffield and Thomas (1997) (Table 4-2a). The BAFs selected to estimate the dose for the weasel in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The little brown bat was selected as a representative aerial-feeding insectivorous mammal residing and foraging along the creek bank and the riparian corridor. The little brown bat diet consists solely of flying emergent insects based on Belwood and Fenton (1976 as cited in Sample and Suter 1994) (i.e., only aquatic exposures; Table 4-2a). The BAFs selected to estimate the dose for the brown bat in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

The white-tailed deer was selected as a representative herbivorous mammal residing and foraging in the floodplains. The diet of the white-tailed deer consists completely of terrestrial vegetation including buds and twigs from trees and shrubs, grasses and forbs, and masts and fruit (Smith 1991 as cited in Sample and Suter 1994) (i.e., only terrestrial exposures; Table 4-2a). The BAFs selected to estimate the dose for the white-tailed deer in the modeled tissue scenario are presented in Tables 4-20 and 4-21.

For the reaches of the creek where riparian or floodplain soil habitat were not identified (C1 and C10), the diet of the wildlife receptors was not modified. In these two reaches, the modeled tissue concentrations were estimated using AA-wide EPCs for floodplain and/or riparian soil. Specifically, in reach C1 a riparian area is not present. For the C1 modeled tissue scenario, EU-wide EPCs (C1 East and C1 West) were used for floodplain soil and UAA-wide EPCs were used for riparian soil. In reach C10, floodplain and riparian soil are not present. For the C10 modeled tissue scenario, terrestrial receptors/floodplain soil was not evaluated and LAA-wide EPCs were used for riparian soil. For the AA modeled tissue scenarios and the measured tissue scenarios, AA-wide EPCs were used in all cases. These assumptions are also presented in Table 4-17.

4.5.3 Ingestion Rates

Literature-based values for food IRs for birds and mammals can vary substantially, likely as a result of differing geographic regions, habitats, and seasons evaluated. In addition, IRs for animals in captivity can vary relative to animals in the wild. Because of this variability and at the request of the USEPA, total food IRs for birds and mammals expressed in kg dw/kg BW-d were calculated as a function of body mass using allometric equations (Nagy 2001). The Nagy equation estimates food ingestion based on metabolic need of the receptor and is expressed on a dry weight basis. This provides a consistent method of estimating food ingestion as well as incidental soil or sediment ingestion for all receptors.

Drinking water IRs for wildlife species were calculated as a function of body weight using allometric equations (Calder and Braun 1983 as cited in USEPA 1993).

4.5.4 Home/Foraging Ranges

Home range is defined as the geographic area encompassed by an animal's activities (except migration) over a specified time (USEPA 1993). Because the objective of considering a receptor's home range is to estimate the area over which it might be exposed through its diet, foraging ranges were selected to estimate home range as a first preference. Breeding territory and home range were considered if information on foraging range was not available. Because there is a great deal of variability associated with estimating foraging or home ranges for receptors, when available, an upper, central, and lower value is provided in Tables 4-1a and 4-2a for each receptor. For aquatic-dependent receptors, such as the kingfisher, osprey, and mink, home ranges were provided in linear measurement, usually in terms of linear kilometers along the river or riparian area instead of acres. Home ranges can be used to estimate site use factors (SUFs). The SUF is the ratio of the exposure area to the home range for receptors. In some cases, the size of a given exposure area or EU is greater than an individual home range for a specific receptor and in some cases it is smaller. Because of the uncertainty associated with where a specific receptor or group of receptors forages, SUFs were set at 1 for all receptors. This assumption is conservative for some receptors, and uncertainty related to the use of a SUF of 1 is discussed in Section 6.2.

A brief description of the foraging/home range information identified and considered for each receptor is provided in Appendix A and presented in Tables 4-1a and 4-2a.

5 EFFECTS ASSESSMENT

Section 5 Summary

The effects assessment presented in this section includes the development of toxicity values as well as the evaluation of potential effects through a number of community metrics. The selected toxicity values, described in detail in Appendix D (and Appendix F for TEQ), were based on endpoints that could result in population-level impacts such as survival, reproduction, development, and growth.

- Media-based toxicity benchmarks from federal, state, and literature-based sources were used to assess lower trophic levels.
- Site-specific toxicity tests were used to develop benthic community toxicity thresholds for PCBs. Twenty-six toxicity tests were conducted using sediments from within OU-4, and six reference sediments from upstream locations were tested using two standard bioassay tests. A range of effects thresholds based on reproduction, survival, and growth in the tests were derived.
- Dietary TRVs for wildlife from published sources or developed from the literature were used to assess risk to birds and mammals. For PCBs, high-sensitivity and mid-senstivity TRVs were developed to reflect differences in PCB sensitivity based on aryl hydrocarbon receptor (AHR)-receptor types in birds. In addition to a mammal TRV based on small mammals, two mink-specific TRVs were also evaluated based on this species elevated sensitivity to PCBs relative to other mammals.
- Tissue-based TRVs, referred to as CTCs, were developed for PCBs, mercury, and some metals for invertebrates, fish, birds, and mammals.

Ecological/biological community data collected in OU-4 were quantitatively evaluated using a variety of standardized metrics, typically including taxa richness, Shannon-Weiner diversity, Simpsons dominance, EPT Index (for benthic invertebrates), and others. Results of the ecological community assessments are presented in this section, and indicate that, in general, OU-4 conditions are similar to reference, and therefore, there appear to be no adverse effects of PCBs or other COPCs within OU-4.

The effects assessment includes 1) the identification, selection and/or development of toxicity values for ecological receptors and 2) the calculation of site-specific biological metrics to evaluate effects to ecological communities between the OU-4 and reference habitats or within reaches. Each of these serve as important LOEs in the WOE risk characterization (Section 6).

Toxicity values can be media-based, diet-based, or tissue-based. For this assessment, media-based values are used to evaluate lower trophic level receptors (e.g., benthic invertebrates and plants). These values are referred to as toxicity benchmarks when derived from published or literature-based sources. The media-based benthic invertebrate toxicity values derived from OU-4 bioassay data are referred to as site-specific toxicity thresholds. Although more than one exposure route/pathway is considered potentially complete for lower trophic level receptors, route-specific doses are generally not quantified for these groups of receptors. Exposures of lower trophic level receptors to environmental media are expressed as concentrations rather than doses, and generally encompass all potential exposure routes. For upper

trophic level receptors (e.g., birds and mammals), the effects assessment describes the selection and development of the dietary and tissue-based TRVs. A dietary TRV is defined as a daily dose of a chemical expressed in mg/kg BW-d. Tissue-based TRVs, referred to as CTCs, were selected to evaluate a subset of receptors (e.g., invertebrates, fish, bird eggs, and small mammals) and are expressed as mg/kg of body weight on a wet weight basis. The toxicity benchmarks, TRVs, and CTCs are used to calculate HQs and the sediment toxicity thresholds are compared to individual OU-4 sediment samples as described in Section 6.

Toxicity values were evaluated and selected for both no observed adverse effect level (NOAEL) and lowest observed adverse effects level (LOAEL) or equivalent values. The NOAEL represents the concentration or dose at or below which no adverse effects on the test organism have been observed. The LOAEL represents the lowest value at which adverse effects have been observed. In the scientific literature, there is usually a range of both NOAELs and LOAELs reported for specific types of organisms (i.e., fish, birds, mammals). The USEPA often selects the lowest reported NOAEL- and LOAEL-based values for the most sensitive species in the range of those tested; this approach was applied in this OU-4 BERA as described below.

Sufficient toxicity data for reptiles and amphibians were not available for selection of benchmarks, TRVs, or CTCs. Risks to these receptors were evaluated only qualitatively in Section 6.1. Uncertainties of this assumption are discussed in the uncertainty analysis (Section 6.2).

Toxicity benchmarks, TRVs, and CTCs were initially developed/selected for OU-4 in 2009 (Appendix A from Arcadis 2009) and updated in 2012 following discussions with the USEPA. Generally, conservative values for the most sensitive species of a given receptor group (i.e., fish, birds, mammals, etc.) were selected from the range of NOAELs and LOAELs reported in the scientific literature. For the OU-1/OU-2 SERA, toxicity benchmarks for benthic invertebrates and TRVs for birds and mammals for the relevant COPCs, as they applied to the OU-1/OU-2 SERA, were updated to address the USEPA's comments/direction on that document. These values are employed in this OU-4 BERA in most cases, with modifications as requested by USEPA (2016d). Toxicity benchmarks for plants, invertebrates, and aquatic life and TRVs/CTCs for the remaining OU-4 COPCs were updated for this OU-4 BERA with modifications and additions (primarily to CTCs) based on comments from USEPA (2016d) on the 2015 BERA (Arcadis 2015). The site-specific toxicity thresholds, toxicity benchmarks, and TRVs/CTCs selected or developed for this OU-4 BERA are described in detail in Appendix C (Analysis of Operable Unit-4 Sediment Toxicity Test Results and Development of Site-Specific Risk-Based Concentrations for Polychlorinated Biphenyls in Sediment) and in Appendix D (Development of Benchmarks and Toxicity Reference Values) and summarized in this section.

The receptors and COPCs for which media-based toxicity benchmarks, dietary TRVs, or tissue-based CTCs were developed/selected for this OU-4 BERA are listed in Table 5-1. This table also clarifies which receptors and COPCs benchmarks, TRVs, or CTCs could not be identified due to insufficient toxicity data. A summary of the benthic invertebrate site-specific toxicity thresholds for PCBs and mercury is presented in Table 5-2a. Toxicity benchmarks, TRVs, and CTCs used in this OU-4 BERA are presented in Table 5-2b. The development of site-specific toxicity thresholds for PCBs and mercury is presented in Appendix C, and development of the toxicity benchmarks, TRVs, and CTCs is presented in Appendix D. The development of the toxicity benchmarks, TRVs, and CTCs for dioxin TEQs (PCDD/PCDF and DL-PCBs) is described in Appendix F.

5.1 Benthic Community Toxicity Thresholds

For assessment of risk to the benthic community, the site-specific sediment bioassay program conducted for OU-4 was used as a primary LOE. From the results of the bioassays, a range of sediment-based toxicity thresholds were developed for PCBs and mercury.

A total of 32 sediment samples (26 samples from six different locations in OU-4, and six reference samples from Choccolocco Creek approximately 3 km upstream of OU-4) were collected for toxicity testing. The goal of the program was to test sediments that spanned a wide range/combination of total PCBs and OC concentrations. Mercury was also measured in the test sediments, as well as a variety of other inorganic and organic constituents. While the sediment bioassay program was designed around PCB and TOC concentration ranges, an evaluation of the risk potential for non-PCB constituents was also assessed from data collected under this program.

Toxicity tests were conducted on 26 different sediments (20 sediment samples from OU-4, and six reference sediment samples) in each of the two testing cycles. Additionally, as part of a between-laboratory comparison, replicate tests were conducted on five of the 20 sediment samples from OU-4, resulting in a total of 31 toxicity tests conducted with non-control sediments. The toxicity tests were conducted by the United States Geological Survey's Columbia Environmental Research Center (CERC) in Columbia, Missouri, and the United States Army Corps of Engineers' Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi (Ingersoll et al. 2014).

A range of growth, reproduction, and survival endpoints were tested using a freshwater amphipod (*Hyalella azteca*; 42-day tests) and midge (*Chironomus dilutus*; up to 54-day tests). For each endpoint, using a reference envelope approach, sediment-based toxicity thresholds were developed, which are the effective concentrations relative to the lowest reference effect (EC*s). The site-specific toxicity thresholds for PCBs and mercury are described in more detail in the section below and discussed in detail in Appendix C.

For metals, toxicity benchmarks were selected from the consensus-based sediment quality guidelines (SQGs) developed by MacDonald et al. (2000a). These threshold effect concentrations (TECs) and probable effects concentrations (PECs) are used as toxicity benchmarks to identify the potential for toxic effects. Results of acid volatile sulfide and simultaneously extractable metals (AVS-SEM) analyses, and direct measures of metals in porewater were also used to assess the potential risk of metals. In the case of mercury, the literature thresholds and AVS-SEM results provide additional perspective relative to the site-specific mercury thresholds developed from the OU-4 sediment toxicity tests.

Literature-based sediment benchmarks for PCBs from MacDonald et al. (2000b) were also employed as a LOE. These provide additional perspective relative to the site-specific PCB thresholds developed from the OU-4 sediment toxicity tests.

As mentioned earlier, sediment benchmarks for aquatic plants, fish, reptiles, and amphibians are not provided at this time due to the lack of an appropriate toxicity dataset. However, the benchmarks that were developed for screening purposes for sediment invertebrates are considered conservative and are assumed to be protective of all benthic communities. Uncertainty associated with this assumption is discussed in Section 6.2.3.

5.1.1 Site-Specific Sediment Toxicity Thresholds for PCBs and Mercury

As noted above, a series of toxicity tests were conducted with sediments collected from OU-4 as part of this OU-4 BERA. Because PCBs were the dominant toxicant in the OU-4 sediments (see below and Appendix C) and because PCB concentrations in sediments across OU-4 had previously been characterized in terms of Aroclor (instead of homolog or congener) concentrations, concentration-response relationships were determined for total PCB Aroclors as predictors of a variety of survival, growth, and reproduction endpoints based on the results of the OU-4 sediment-toxicity tests. Mercury was also measured in sediments and data were sufficient to derive site-specific toxicity thresholds for this metal.

The 32 sediments samples (a total of 26 sediment samples from six different locations in OU-4, and six reference sediment samples from Choccolocco Creek approximately 3 km upstream of OU-4) collected for toxicity testing collectively spanned a wide range of combinations of total PCBs and OC concentrations, instead of randomly sampling the OU-4 sediments. The six targeted bins of OC-normalized PCB concentrations (expressed as milligrams PCB/kg OC) were: less than 100; 100 to 500; 501 to 1,000; 1,001 to 5,000; 5,001 to 10,000; and greater than 10,000. The study objective of the OU-4 sediment toxicity testing was to develop concentration-response relationships for the freshwater amphipod (*Hyalella azteca*) and midge (*Chironomus dilutus)* endpoints, not to determine which specific sediments across OU-4 were toxic.

The sediments selected for the toxicity testing program were not randomly chosen. Instead, bulk sediment was collected from a few select locations (three site locations and one reference area) and a variety of depths (up to 4 feet) to ensure that a wide range of combinations of PCB and OC concentrations were tested. None of the test sediments in OU-4 were collected specifically from the biologically active zone (i.e., surface to about 0.5 feet) and there was no spatial consideration as to sample location to evaluate variations in actual effects in different locations/habitat types. For these reasons, it is not appropriate to compare any of the OU-4 test sediments to the reference condition to determine the percentage of toxic sediments across all of OU-4. As intended by the study objectives, the spatial evaluation of potential toxicity across the site is accomplished by comparing the available surface sediment chemistry data to the range of site-specific concentration-based toxicity thresholds.

The experimental design, implementation details, chronology and data from the OU-4 sediment toxicity test program are provided in Ingersoll et al. (2014), and summarized as appropriate herein. Tests and related chemical analyses were conducted at the CERC and ERDC laboratories. Because of the large number of tests and associated logistical requirements, the tests were conducted in two separate testing cycles that were started during the week of November 1, 2010 and during the week of January 17, 2011. Chronic toxicity tests were conducted on 26 different sediments (20 separate sediment samples from OU-4 and six reference sediment samples not counting laboratory control sediments that were included with each batch of toxicity tests) (Ingersoll et al. 2014).

Test organisms were the freshwater amphipod *Hyalella azteca* (42-day tests) and the midge *Chironomus dilutus* (up to 54-day tests). The tests were conducted according to standard procedures specified by the USEPA (2000) and ASTM International (2012). Twelve survival, growth, and reproduction endpoints were measured in the *Chironomus dilutus* tests; and 11 survival, growth, and reproduction endpoints were measured in the *Hyalella azteca* tests (Appendix C, Table C-1). The sediments were analyzed for six grain-size categories, moisture content, loss on ignition, concentrations of OC, 23 major and trace

elements (including the 16 metals and metalloids on the USEPA Target Analyte List), acid volatile sulfide, five simultaneously extracted metals, nine PCB Aroclors, 13 PCB congeners, 10 PCB homologs, one biphenyl, 46 parent and alkylated PAHs, 21 organochlorine pesticides, and 17 PCDD/PCDF congeners. Additionally, during the toxicity tests, porewater samples were analyzed for pH; conductivity; alkalinity; hardness; and concentrations of ammonia, hydrogen sulfide, dissolved OC, four inorganic anions, and 61 major and trace elements. SPME samplers were also used to estimate PCB concentrations in porewater of the test sediments. Specific details of the analyses and methods employed during the testing program and the sediment toxicity data are presented in Ingersoll et al. (2014), Summary tables and the raw data from the porewater sampling program are provided in Appendix C.

Concentrations of inorganic constituents (primarily metals) were generally low in both the sediment samples and porewater samples. Concentrations in sediments, with few exceptions, were lower than "consensus-based" PECs for inorganic chemicals published by MacDonald et al. (2000a), and most constituents in porewater were either ND, or below available ecological water quality standards (Ingersoll et al. 2014). Additionally, the results of AVS-SEM analyses revealed that there is little potential for bioavailability of divalent metals (cadmium, copper, nickel, lead and zinc) in OU-4 sediments (see Table C-2). Calculation of values of SEM minus AVS (SEM-AVS, molar basis), and SEM-AVS normalized to the fraction of sediment OC (SEM-AVS/f_{OC}) indicate low bioavailability and low probability of risk from divalent metals (USEPA 2005d). Instead, these metals are likely bound up by sulfur compounds in the sediment and not available for biological uptake/exposure. The sediments with the highest positive SEM-AVS values also had the highest lead concentrations. However, mean values of SEM AVS/f_{OC} for those ranged from only 56 to 73, and according to USEPA guidance, a sediment having a value of SEM-AVS/f_{OC} of less than 130 should pose low risk of adverse biological effects from these five metals (USEPA 2005d).

An exception to this was mercury, which was not analyzed for in the porewater samples, and exceeds its PEC in a number of the sediment samples analyzed. While it is likely that the available AVS is sufficient to bind some or all of the mercury in sediments and render it non-bioavailable, it was examined with respect to concentration-response for the sediment toxicity endpoints because of the PEC exceedances and its known co-occurrence with PCBs in OU-4 sediments.

Concentrations of PAHs and organochlorine pesticides were also consistently lower than "consensus-based" PECs published by MacDonald et al. (2000a). Therefore, those COPCs are not likely to have contributed significantly (relative to PCBs) to toxicity in OU-4 sediments, leaving PCBs as the likely dominant contaminant (Ingersoll et al. 2014).

Ingersoll et al. (2014) conducted concentration-response evaluations for PCBs in both sediment and porewater. The authors concluded from their analyses that there is a similar relationship, with almost identical statistical significance, between PCB concentrations and effects for both sediment and porewater data for the same samples, but that the reliability of the porewater data as a predictive tool for PCBs was lower than that of sediment. The results of the SPME estimations of PCBs in porewater are presented for total homolog PCBs in table C-5, and the raw data are provided in Appendix C. After examination of these data and the statistical analyses comparing sediment and porewater concentration relationships conducted by Ingersoll et al. (2014), it was verified (as anticipated) that sediment data are the appropriate media by which to evaluate the concentration-response for the sediment toxicity tests. This was an important issue to verify, as any risk management decisions that relate to sediment-dwelling biota will be made on sediment data results from OU-4, not those from porewater.

Because the chronic toxicity tests for each species were conducted in three separate batches (at different times and/or in different labs) and the control responses sometimes differed considerably among those batches (Appendix C, Table C-3), the response measured for each endpoint for each species was normalized to the average response measured for that endpoint in the control sediment tested concurrently with that batch of sediments. Therefore, the response for each endpoint in each sediment sample was expressed as a percentage of the average control response; and thus, control-normalized responses greater than 100% sometimes occurred in reference and/or OU-4 sediments. The substantive uncertainties associated with high control variability and the implications for interpretations of the chronic endpoint results are discussed in Section 6.2, and Appendix C.

After control normalization, each endpoint response was regressed against PCB concentration using a non-linear logistic equation to produce a sigmoid concentration-response relationship. Regression equations were determined separately for dry weight-normalized PCB concentrations measured as the sum of Aroclors and for OC-normalized PCB concentration to develop two concentration-response relationships for each endpoint. The dry weight-normalized and OC-normalized PCB concentrations measured as Aroclors were chosen as the predictors for the concentration-response relationships because sediments within OU-4 were previously characterized in terms of their PCB Aroclors instead of their total PCB homolog concentrations. Thus for comparability, the toxicity-predictor equations are based on PCBs measures as the sum of Aroclors concentrations.

To determine background toxicity, a reference envelope was calculated for each endpoint using the control-normalized responses of the six reference sites. The “bottom” of that response envelope was defined as the lowest control-normalized response percentage observed in the six reference sediments, and 0%, 10%, 20%, and 50% effect concentrations (EC0*, EC10*, EC20*, and EC50* values, relative to the “bottom” of the reference envelope) were calculated from the PCB-response regressions for each survival, growth, and reproduction endpoint. In other words, the EC0*, EC10*, EC20*, and EC50* are the regression-predicted PCB concentrations that would cause an additional 0%, 10%, 20%, or 50% effect beyond the lowest response measured in the reference sediments (i.e., 1×, 0.9×, 0.8×, and 0.5× the response at the “bottom” of the reference envelope). By this definition, the EC0* value is the regression-predicted concentration at the “bottom” of the reference envelope. The “bottom” of the response envelope is often defined as the 5th percentile of the reference-sediment response. Because only six reference sediments were tested, a parametrically-derived 5th percentile is in most cases less than the minimum reference response. Therefore, the bottom of the reference envelope was capped at the minimum response due to the uncertainty about the true numerical value of the 5th percentile. Mercury concentrations in the tested sediments were modeled similarly to PCBs. EC* values for all benthic toxicity testing endpoints are presented in Appendix C.

The EC0*, EC10*, and EC20* values are selected as the range of toxicity thresholds for evaluation of potential PCB site-related effects on the benthic community. These values are presented in Table 5-2a for endpoints with a valid concentration-response curve (i.e., a concentration-response curve in which survival, growth, or reproduction decreased monotonically as PCB concentration increased). It is important to note that these values were derived as a single number by endpoint category using the average control-adjusted response, and that the confidence limits surrounding the actual concentration-response curves were typically large for many of the chronic endpoints, and particularly for the *Hyalella azteca* reproductive endpoint, where control variability was roughly 130%.

The *Chironomus dilutus* adult biomass endpoint reported by Ingersoll et al. (2014) was excluded because the dry weights were estimated values and resulted in inconsistent and unreliable EC* values. This endpoint was estimated by the testing laboratories by calculating adult emergence × 13-day ash-free dry weight, with an explicit assumption that the ratio of adult ash-free dry weight (not measured during the toxicity tests) to the 13-day ash-free dry weight (which was measured) was constant for all the control, reference, and OU-4 sediments. That assumption cannot be verified, thus leaving that reported adult biomass values speculative. Compensatory growth in the high-mortality sediments might have at least partially offset the decreased survival, thus leading to higher adult biomass in those high-mortality sediments (relative to the adult biomass in lower-mortality sediments) than the 13-day ash-free dry weights would lead one to conclude. Because adults were not weighed, there is no way to know what the actual adult biomass values (and more importantly, the relative differences in biomass among the OU-4 sediments) were. It is expected that potential effects on growth and survival for *Chironomus dilutus* are adequately encompassed using the range of other endpoints evaluated in the overall testing program.

As shown in Table 5-2a, eight endpoints for *Chironomus dilutus* and seven endpoints for *Hyalella azteca* were selected to develop toxicity thresholds at the EC0*, EC10*, and EC20* levels resulting in 45 different EC* values with which to characterize risk to benthic invertebrates (Section 6). The EC0* values range from 1 to 209 mg PCB/kg dw for all endpoints, with a median value of 12 mg PCB/kg dw. Similarly, the median EC10* value for all endpoints is 31 mg PCB/kg dw (range 2.6 to 260mg PCB/kg dw) and for the EC20*, the median value is 58 mg PCB/kg (range 4 to 324 mg PCB/kg dw). The most sensitive endpoint for *Hyalella azteca* was related to reproduction and the associated EC* values were 1.4 (the EC0*), 2.6 (the EC10*), and 4.4 (the EC20*) mg PCB/kg dw of sediment for 42-day young/female normalized to 42-day survival (Appendix C, Table C-1). The most sensitive endpoints for *Chironomus dilutus* were related to emergence (the lowest EC0*, EC10*, and EC20* values were 2.0 [the EC0*], 6.8 [the EC10*], and 14 [the EC20*] mg PCB/kg dw of sediment, for percent emergence of the pupae from their cocoons; Appendix C, Table C-1). The most sensitive endpoint was similar for mercury resulting in EC0*, EC10*, and EC20* values of 0.41, 0.66, and 1.0 mg/kg mercury based on *Hyalella azteca* reproduction (Table 5-2a and Appendix C, Table C-6). The comparable EC values are also reported on an OC basis. The OC-normalized values introduce more uncertainty into the evaluation, as OC is generally low in most OU-4 sediments (and often not detected) with an average content of 1.1% in the 268 surface sediment samples and a standard deviation of 1.0. Given the low bias of the OC data, it is unlikely that OC is significantly influencing the bioavailability of PCBs in the aquatic system. While the OC-normalized results provide a datum, they are not useful for evaluating exposure-based risk due to the low OC concentrations and the high level of uncertainty in the results.

In addition to the EC* values, efforts were made to estimate the EC0 relative to the average reference response. The EC0 is estimated as the PCB concentration at which the average reference-sediment response would be predicted to occur, when projected onto the concentration-response curve generated for that endpoint with OU-4 sediments. This EC0 differs from the EC0* described above, which is the concentration at which no effects were observed beyond those observed in reference sediments. The EC0* represents a concentration to which no site-related effects can be attributed; and because only six reference sediments were tested, the threshold for site-related effects would be expected to occur at some concentration higher than the EC0*. As shown in Table 5-2a, the EC0 values could not be estimated for most endpoints because the average reference-sediment response was greater than the regression-predicted maximum control-normalized response, resulting in predicted EC0 values below zero. Therefore,

for most endpoints, the mean reference sediment concentration was selected as the EC0 value; therefore, this statistic cannot be considered truly predictive of the average reference response. EC0 values could only be calculated for the two least sensitive endpoints (both for *Chironomus dilutus*: number of young per egg case and adult survival time). The site-specific toxicity thresholds for PCBs and mercury (EC*) are summarized in Table 5-2a. The methodology used to develop the benthic invertebrate sediment toxicity thresholds for PCBs and mercury is presented in more detail in Appendix C.

As a follow-up to the OU-4 sediment toxicity study reported in Ingersoll et al. (2014) that was used to derive the site-specific toxicity thresholds for invertebrates for this OU-4 BERA, additional toxicity testing was conducted on behalf of the USFWS on the same sediment samples using the juvenile fatmucket mussel (*Lampsilis siliquoidea*). The report on this testing (USFWS 2015) was released after the development of the toxicity thresholds for this OU-4 BERA. An evaluation of the mussel testing data was conducted to determine if the results of the tests would change any of the toxicity thresholds in this OU-4 BERA, based on a comparison of the relative sensitivities of the test organisms. As discussed in USFWS (2015), the mussel was less sensitive to the test sediments than either the midge or amphipod used in the original test program. As such, the response-based toxicity thresholds developed for the midge and amphipod are more conservative than those that would be developed from the mussel and, therefore, are appropriate for assessing risk. It is important context, however, that this mussel test suggests that bivalves (i.e., clams and mussels), which are important resident organisms in much of OU-4, are less sensitive than infaunal species tested. This means that the effects concentrations used in this OU-4 BERA likely overestimate potential risk to bivalves. It should be noted, that CERC and ERDC were under contract to Arcadis to conduct the sediment toxicity testing program and provide a dataset for use in this OU-4 BERA. Arcadis conducted the statistical analyses of the data to develop the site-specific sediment toxicity thresholds for assessing risk herein. Ingersoll et al. (2014) also conducted an evaluation of the data for purposes other than risk assessment. The results of their evaluation differ somewhat than those in this OU-4 BERA, but not substantially. A comparison of the differences, which are primarily related to the concentration-response modeling and related assumptions, are presented and discussed in Appendix C, as well as the basis for why the Arcadis analyses are more appropriate for this OU-4 BERA.

5.1.2 Literature-Based Sediment Benchmarks

While the site-specific bioassays have been conducted as summarized above, and were used as important lines of evidence to evaluate potential risks to benthic invertebrates in this OU-4 BERA, empirically-derived sediment screening benchmarks from published sources were also considered to: 1) provide perspective relative to the site-specific toxicity thresholds for PCBs and mercury, and 2) for evaluating the sediment data with respect to other organic and inorganic constituents to assess their potential to cause toxicity/risk to invertebrate communities. While such benchmarks are available from a number of sources, values selected for this OU-4 BERA are the TECs and the PECs developed by MacDonald et al. (2000a, 2000b). As presented in Table 5-2b, TECs and PECs are available for PCBs (0.060 micrograms per kilogram, dry weight [µg/kg dw and 0.68 µg/kg dw, respectively) and mercury (0.18 µg/kg dw and 1.1 µg/kg dw, respectively). TECs and PECs were also available for chromium and lead, and are presented in Table 5-2b. TECs and PECs were unavailable for barium, cobalt, and vanadium.

5.2 Soil Benchmarks

Soil-based benchmarks are available for soil invertebrates and terrestrial plants. While the specific applicability of these benchmarks to OU-4 invertebrate or plant communities is somewhat uncertain, uncertainties are biased conservatively, and these values are appropriate and conservative for screening soil for potential adverse effects. Soil benchmarks used in this OU-4 BERA are considered to be conservative and are presented in Table 5-2b and summarized below.

Soil-based benchmarks for the protection of plants were identified in Oak Ridge National Laboratory (ORNL): *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants* (Efroymson et al. 1997a). Although the ORNL values are either the lowest reported low observed effect concentration (LOEC) or the 10th percentile of observed LOEC values, these values are assumed to be protective, as studies were carried out under high bioavailability conditions. The soil screening benchmarks are thus considered to be NOAEL-equivalent values.

For soil invertebrates, the USEPA Region 4 Ecological Screening Value benchmark for PCBs is based on equilibrium partitioning theory and a water quality benchmark predicted from the ECOSAR model (EPISuite software; USEPA 2012c) for a saltwater mysid. Because the log soil organic carbon-water partitioning coefficient (Koc) for most PCBs is greater than the prediction interval for the ECOSAR model, alternate water quality benchmarks for aquatic invertebrates were selected from Fuchsman et al. (2006). Fuchsman et al. (2006) calculated a Final Chronic Value (FCV) of 0.54 micrograms per liter (µg/L), based on aquatic invertebrate toxicity data for 21 species from the USEPA AQUIRE database and the USEPA (Stephen et al. 1985) methodology. A LOAEL-equivalent soil ESV of 36 mg/kg was calculated using the aquatic invertebrate FCV (0.54 µg/L), Koc (66870 liters per kilogram) predicted from the Aroclor 1254 Kow (EPISuite; USEPA 2012c), and Henry's Law constant for Aroclor 1254 (326.4) from the USEPA (2016b) and the USEPA Region 4 ESV equation (see Appendix D for details). An uncertainty factor of ten was applied to estimate a NOAEL-equivalent soil ESV of 3.6 mg/kg. For the remaining COPCs, soil values protective of terrestrial invertebrates are taken from USEPA EcoSSLs (USEPA 2007) when available, or ORNL: *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes* (Efroymson et al. 1997b). As noted above for the plant benchmarks from ORNL, the soil invertebrate benchmarks are considered to be NOAEL-equivalent values.

Additionally, a LOAEL-equivalent soil benchmark for mercury of 0.23 mg/kg was selected. The benchmark is based on a study by Son et al. (2007), in which springtail (*Paronychiurus kimi*) exposed to spiked sediments containing mercuric chloride had reduced offspring production. The EC50 for reduced offspring production per adult is 0.23 mg/kg, which is slightly lower than the LOAEL for this endpoint in the Son et al. (2007) study.

5.3 Surface Water Benchmarks

For aquatic life, acute and chronic surface water quality standards (WQS) protective of aquatic life were selected from ADEM (2015) and the USEPA (2016e) National Ambient Water Quality Criteria (NAWQC) for protection of aquatic life. The datasets used to develop state criteria include toxicity data for a range of taxonomically diverse species that may include plants, fish, amphibians, and invertebrate species. As such, these values are considered protective of a range of receptors, including aquatic plants, aquatic

invertebrates, fish, and amphibians. In addition to the ADEM and NAWQC values, Suter and Tsao (1996) developed values specific to fish, aquatic invertebrates (daphnids), and aquatic plants using the available WQS datasets specific to receptor groups. For each aquatic receptor group exposed to water, the risk assessment considered both the aquatic life benchmark and the receptor group-specific benchmarks from Suter and Tsao (1996), when available.

For PCBs, an acute WQS for aquatic life was not available from ADEM or the NAWQC; thus, the acute value selected (0.6 µg/L) was obtained from secondary acute value for Aroclor 1254 (the lowest of the range of Aroclor values) from Suter and Tsao (1996). The chronic value of 0.014 µg/L was obtained from ADEM (2015). For mercury, chromium, and lead, acute and chronic WQS were obtained from ADEM. For barium, cobalt, and vanadium, the surface water benchmarks were obtained from Suter and Tsao (1996). The receptor group-specific benchmarks were obtained from Suter and Tsao (1996), when available. These values are presented in Table 5-2b.

5.4 Dietary TRVs for Birds and Mammals

Consistent with USEPA guidance (1997), dietary TRVs were developed for birds and mammals based on endpoints that could result in population-level impacts such as survival, reproduction, development, and growth. Both NOAEL and LOAEL TRVs were selected. For PCBs and mercury, available peer-reviewed toxicity data were reviewed to develop dietary avian and mammalian TRVs.

Dietary TRVs for the remaining five metals (barium, chromium, cobalt, lead, and vanadium) were selected primarily from the datasets compiled for development of USEPA EcoSSLs (USEPA 2005b and 2007) and from ORNL (Sample et al. 1996). Because the USEPA EcoSSL guidance (USEPA 2005b and 2007) provides only NOAEL TRVs, in cases where the EcoSSL was the basis for a TRV, it was necessary to develop a LOAEL from the underlying data. The toxicity datasets for each metal were reviewed and a relevant LOAEL was selected as follows:

- When a bounded NOAEL-based TRV was recommended (i.e., the same study included a LOAEL for that endpoint), the LOAEL from that study was selected.
- When the recommended NOAEL-based TRV was unbounded, the lowest reproduction, growth, and survival LOAEL greater than the NOAEL-based TRV was selected.
- When the recommended NOAEL-based TRV was a geometric mean of the reproduction and growth NOAELs, the lowest reproduction, growth, and survival LOAEL greater than the NOAEL-based TRV was selected.

The selection of LOAELs is described in more detail in Appendix D.

For PCBs, available toxicity data for all mammalian species were considered initially. Because the data for mink indicate that mink are likely more sensitive than most other mammalian species to PCBs (e.g., Aulerich et al. 1985), mink PCB TRVs were developed separately from non-mink small mammal TRVs. While mink also appear to be more sensitive to mercury than other small mammals (California Environmental Protection Agency [CalEPA] 2000), toxicity dataset limitations precluded development of different TRVs and therefore the mercury TRV for mink was conservatively selected for other mammals. While this value is for total mercury and not methylmercury, it is similar to methylmercury values for non-mink small mammals and is considered appropriate for both mink and non-mink species. For the other five

metal COPCs (barium, chromium, cobalt, lead, and vanadium), this differential sensitivity was not evident and one set of TRVs was selected for all mammals.

The development of dietary TRVs for PCBs and mercury is summarized below and discussed in detail in Appendix D. The TRVs for PCBs, mercury, and non-mercury metals used in this OU-4 BERA are summarized in Table 5-2b. The development of the TRVs for total TEQs (PCDD/PCDF and DL-PCBs) is described in Appendix F.

5.4.1 Avian Dietary TRVs for PCBs

Available toxicity data for all species were considered initially. However, specifically for PCBs, based on all of the avian toxicity data reviewed, studies conducted with domestic chickens (*Gallus domesticus*) appear to represent the high end of the sensitivity range for PCB toxicity. A significant body of research has been conducted which identifies the sensitivity of many individual avian species to arylhydrocarbon receptor (AHR)-mediated effects of DL-compounds. AHR-mediated effects are the primary mechanism of toxicity for PCBs in vertebrate species (Okey 2007). While non-AHR-mediated effects can occur, they are thought to occur at much higher concentrations than AHR-mediated effects (Giesy and Kannan 1998). Based on this research, two sets of TRVs were developed for PCBs. One represents species at the high end of the range of sensitivity and is based on toxicity data from chickens. The second, based on non-chicken data, represents species in the mid-range of sensitivity for avian species and is likely more relevant for most avian species present in OU-4.

For the high end of the sensitivity range, from the eight studies considered, the LOAEL TRV is based on Lillie et al. (1974) in which a decline in chick growth was observed at 0.13 mg/kg BW-d of Aroclors 1254 and 1248. The chronic NOAEL of 0.043 mg/kg BW-d was estimated by dividing the chronic LOAEL by an uncertainty factor of three. A factor of 10 is considered excessive (would result in 0.013 mg/kg BW-d) based on the range of the NOAEL data reviewed in which the lowest tested NOAEL was 0.065 mg/kg BW-d (Table D-3 of Appendix D).

For the mid-range sensitivity, a total of 14 studies were compiled for consideration. The LOAEL from Koval et al. (1987) of 1.4 mg/kg BW-d was based on a study where mated mourning dove pairs were isolated for 28 days and fed pellets containing 10 mg/kg Aroclor 1254 or control feed ad libitum, which resulted in a lower percentage of treated females that laid eggs and an increased time interval between nest occupation and egg laying. The dietary concentration was converted to a dietary dose of 1.4 mg/kg BW-d using an IR of 15 grams per day (Taber 1928) and a body weight of 0.108 kg (MacMillen 1962). While the authors provided no statistical information regarding this result, this exposure concentration was selected as a LOAEL for this OU-4 BERA due to the significance of the effect on reproduction. The LOAEL of 1.4 mg/kg BW-d from Koval et al. (1987) was selected as the dietary avian LOAEL TRV for PCBs for mid-range sensitivity. To derive the NOAEL, the chronic LOAEL was divided by an uncertainty factor of three, resulting in the chronic NOAEL of 0.47 mg/kg BW-d. A factor of 10 is considered excessive (would result in 0.18 mg/kg BW-d) based on the range of the NOAEL data reviewed in which the lowest measured NOAEL was 0.41 mg/kg BW-d (Table D-4 of Appendix D).

The NOAEL-based and LOAEL-based avian PCB dietary TRVs for the high sensitivity are 0.043 mg/kg BW-d and 0.13 mg/kg BW-d, respectively (Table 5-2b). The NOAEL-based and LOAEL-based avian PCB dietary TRVs for the mid-range sensitivity are 0.47 mg/kg BW-d and 1.4 mg/kg BW-d, respectively (Table

5-2b). Additional detail on AHR-related research and the development of the two sets of TRVs is provided in Appendix D.

5.4.2 Avian Dietary TRVs for Mercury

As a part of the *Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife* (USEPA 1995), dietary NOAEL and LOAEL TRVs for mercury were selected based on evaluation of the range of underlying studies available in the peer-reviewed literature. As a part of this process and outlined in the criteria document (USEPA 1995), a comprehensive literature search was conducted, and the evaluation focused on studies that included dose-response data. Studies with both methylmercury and inorganic forms of mercury were considered, with birds demonstrating much greater sensitivity to methylmercury than inorganic forms. The USEPA (1995) criteria document provides the basis for the selection of dietary TRVs that are described in this section.

Unlike PCBs, chickens do not appear to be more sensitive to mercury than other wild avian species (Heinz et al. 2009). As such, one set of TRVs are developed herein and will be considered applicable to all avian species evaluated for OU-4. The studies considered in the USEPA (1995) criteria document focus on endpoints that could result in population-level impacts such as survival, reproduction, development, and growth. Because the benchmarks provided in the criteria document (USEPA 1995) are based on a literature search conducted in or prior to 1995, other more recent toxicity studies for mercury, which may have evaluated more sensitive endpoints (e.g., nest productivity, fledging) or species (e.g., white ibis [*Eudocimus albus*], American kestrel [*Falco sparverius*], egret) were reviewed.

Three studies were identified that provided dose-response data for dietary mercury. These included Albers et al. (2007), Spalding et al. (2000), and Frederick and Jayasena (2011). Albers et al. (2007) studied the effects of methylmercury on reproduction of American kestrels and determined the dose which resulted in a reduced number of fledglings and decreased percent of nestlings fledged. Frederick and Jayasena (2011) exposed white ibises to dietary methylmercury concentrations of 0.05, 0.1, or 0.3 milligrams per kilogram wet weight (mg/kg ww) for 3.5 years which resulted in significantly more unproductive nests than control birds of 13.2%, 14.6%, and 13.5% for low, medium, and high doses, respectively. The study also found increased homosexual pairing behavior at a dose of 0.1 and 0.3 mg/kg in diet. There were no significant differences or dose-response in the number of fledglings per female across all dose groups with low-dose females fledging 33.5% fewer young per female, medium-dose females fledging 4% more young per female, and high-dose females fledging 34.8% fewer young per female than control. Converting the food concentrations to a daily dose, the range of doses was 0.01 to 0.1 mg/kg BW-d[10] for the range of endpoints evaluated in the study. While the ecological relevance of all of the measured endpoints (e.g., altered pairing behavior) and observed effects to local populations of birds is not clear, the selected LOAEL TRV for this OU-4 BERA for mercury is within this range. The selected LOAEL TRV is based on a study conducted by Spalding et al. (2000). The study determined that dietary methylmercury resulted in adverse effects on growth of great egret nestlings at the low dose of 0.068 mg/kg BW-d[11]. The selected LOAEL of 0.068 mg/kg BW-d from the Spalding et al. (2000) study was divided by an uncertainty factor of three, resulting in the chronic NOAEL of 0.023 mg/kg BW-d (Table 5-2b). A factor of 10 is considered

[10] Dose calculated from the dietary concentrations using a food IR and body weight for ibises taken from Kushlan (1977a, 1977b).
[11] Dose calculated from the LOAEL of 0.5 mg/kg ww in diet using an estimated food IR from the low dose group of 17% body weight (range in study was 6 to 27%).

excessive (would result in 0.0068 mg/kg BW-d) based on the range of the data considered and the selection of a LOAEL TRV that is based on the lowest value in this range.

To summarize, for mercury, the NOAEL avian dietary TRV of 0.023 mg/kg BW-d and a LOAEL avian dietary TRV of 0.068 mg/kg BW-d was selected for use in this OU-4 BERA to evaluate potential risk to birds (Table 5-2b).

5.4.3 Avian Dietary TRVs for Other Metals

The TRVs for other metals were selected based on the dataset used to develop the USEPA EcoSSLs (USEPA 2005b and 2007) as described above and in Appendix D.

5.4.4 Avian Dietary TRVs for Dioxin-Like Compounds

The literature on the effects of TCDD on birds from field studies is inconsistent; some studies show no effects at even relatively high concentrations of TCDD in diet, while others show effects at lower levels of exposure. Laboratory studies where PCDDs/PCDFs have been fed to avian species are limited. As discussed in detail in Appendix F, in the Tittabawassee River study by Fredricks et al. (2011), no adverse effects on tree swallow hatching success or productivity were observed at dietary doses as high as 800 ng TEQ/kg BW-d, whereas in the Woonasquatucket River study by Custer et al. (2005) no adverse effects on hatching success or nestling period were observed at an estimated dietary dose of 145 ng TEQ/kg BW-d.

As described in Appendix F, the study by Custer et al. (2005) was selected as the NOAEL-based avian TRV (145 ng TEQ/kg BW-d) because:

- The evaluation looked at sensitive and population-relevant reproductive endpoints: hatching success and fledging.
- The study was conducted on tree swallows, a species that was selected as a representative receptor for OU-4.
- Custer et al. (2005) reported that nearly 90% of the TEQ in tree swallow eggs and nestling carcass samples was from a single congener—2,3,7,8-TCDD. Thus, this study is specific to the single congener used as the standard for the TEQ method (USEPA 2008). The NOAEL TRV derived from the Custer et al. (2005) study (145 nanograms per kilogram body weight per day [ng/kg BW-d]) is lower than the NOAEL TRV derived from the study by Fredricks et al. (2011) (800 ng/kg BW-d), and is therefore considered more conservative.

5.4.5 Non-Mink Mammalian Dietary TRVs for PCBs

A total of 11 studies were considered in the development of dietary TRVs for PCBs for small mammal species (Table D-7 of Appendix D). The mouse and rat comprise most of the available species data, with the exception of two studies reporting toxicity results for the ferret and rabbit. A study conducted by McCoy et al. (1995) reported the lowest effect level of the available data and was selected as the basis for the LOAEL TRV. McCoy et al. (1995) was a multigenerational study with mice and a single dietary exposure of 5 mg/kg Aroclor 1254 for 12 months. This dietary concentration was converted to a daily dose of 0.68 mg/kg BW-d by using a mouse food IR of 0.135 kg/kg BW-d reported by Linzey (1987), which was not reported by McCoy et al. (1995). The dietary dose of 0.68 mg/kg BW-d was selected as the LOAEL TRV

(Table 5-2b). This dosage elicited significantly fewer offspring born per month and reduced body weights of newborn mice. Only two sets of bounded NOAEL and LOAEL values were available; however, these NOAELs were higher than the TRV selected for the LOAEL. Thus, a NOAEL TRV of 0.23 mg/kg BW-d (Table 5-2b) was derived by applying an extrapolation factor of three to the LOAEL. A factor of 10 would have been excessive (would result in 0.068 mg/kg BW-d) based on the fact that the other NOAELs available for non-mink small mammals were higher than the TRV selected for the LOAEL.

5.4.6 Mink Dietary TRVs for PCBs

The available toxicological studies were compiled and reviewed to select a TRV for mink and other potentially sensitive mustelid species that may be exposed to PCBs, of which 14 toxicity studies were considered for TRV development (Table D-8 in Appendix D). The studies where co-contamination from Saginaw Bay fish that were used for dosing may have influenced toxicity are Restum et al. (1998), Heaton et al. (1995), and Hornshaw et al. (1983).

Two multi-generational studies have been conducted with mink and PCBs (Brunstrom et al. 2001; Restum et al. 1998). The Restum et al. (1998) study was conducted with field-contaminated fish collected from Saginaw Bay, and the Brunstrom et al. (2001) study was a controlled dosing study conducted with Clophen A50. The Brunstrom et al. (2001) study was not considered further because the test compound used was a technical grade Clophen A50 (see Appendix D for rationale).

Restum et al. (1998) observed a significant reduction in kit body weights after parental exposure to 0.25 mg/kg ww PCBs in fish (0.05 mg/kg BW-d as reported by the authors) and significant reduction of kit survival at a parental exposure concentration of 0.5 mg/kg (0.1 mg/kg BW-d). Although the Restum et al. (1998) study was conducted with co-contaminated fish collected from Saginaw Bay and the Brunstrom et al. (2001) study was conducted with Clophen A50, a similar trend of increased effects with longer exposure was observed in both studies. Due to the lack of multigenerational studies with mink, TRVs derived from a single breeding season study may be limiting for understanding chronic effects (multiple generations). The observed difference between effects of exposures for one versus multi-generation breeding seasons can be significant and therefore, results from the multi-generation studies were included in the TRV derivation.

Two sets of TRVs based on the Restum et al. (1998) study were evaluated at the request of the USEPA, based on growth endpoints or reproductive endpoints. The lowest LOAEL is based on a 15 to 25% reduction in kit growth at 3 or 6 weeks of age. For the growth endpoint, a LOAEL of 0.05 mg/kg BW-d was selected. A paired NOAEL is not available. However, the endpoint affected was decreased kit weight, and the biological relevance of this effect is uncertain. While progeny growth has been identified as an ecologically relevant endpoint in the EcoSSL documents (USEPA 2007), body weight can be affected by various aspects of a study in addition to chemical toxicity, and without additional toxicity endpoints, kit weight may not be an appropriate measure of population-level effects. Therefore, a second scenario based on reproductive endpoints was also evaluated. For the reproductive endpoint, the NOAEL and LOAEL values are 0.05 mg/kg BW-d and 0.10 mg/kg BW-d, respectively, with exposure at the LOAEL concentration resulting in reduced in kit survival.

To summarize, two sets of mink TRVs were selected, based on the growth and reproduction endpoints from the Restum et al. (1998) study. A reproductive endpoint NOAEL of 0.05 mg/kg BW-d and a LOAEL of 0.10 mg/kg BW-d from the Restum et al. (1998) study were used as the mink dietary TRVs (Table 5-2b).

However, due to the elevated mortality at the LOAEL concentration and potential for co-contamination with other constituents from the Saginaw Bay fish used for dosing, a second scenario was considered for mink dietary TRVs based on the growth endpoint from the Restum et al. (1998) study. The growth LOAEL value of 0.05 mg/kg BW-d from the Restum et al. (1998) study was evaluated. A NOAEL is not available for the growth endpoint, and was not estimated. Use of these TRV values is discussed further in the Uncertainty Analysis of this OU-4 BERA.

5.4.7 Mammalian Dietary TRVs for Mercury

Similar to avian species, the *Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife* (USEPA 1995) provides the basis for the selection of mammalian dietary TRVs. Values developed for use in the USEPA (1995) criteria document were reviewed along with peer-reviewed studies that have been conducted and published since the development of the criteria document values. The study by Dansereau et al. (1999) is a two-generation study in which mink were fed a range of doses of total mercury in their contaminated fish-based diet, and of the studies considered, included the lowest LOAEL. Mortalities occurred in 11 month old G1 and G2 females fed the 1.0 mg/kg mercury diet after 90 days and 330 days of exposure, respectively. No mortality was observed in the 0.5 mg/kg exposure group. Converting this dietary concentration using an IR of 0.15 kg/day and a body weight of 1 kg (USEPA 1995), the LOAEL dose is 0.15 mg/kg BW-d. This study also provided a corresponding NOAEL of 0.075 mg/kg BW-d. For mammalian species, the mink appears to be more sensitive to mercury (CalEPA 2000); therefore, results from the study by Dansereau et al. (1999) are selected as the mammalian dietary TRVs for this OU-4 BERA (Table 5-2b). An additional study based on methylmercury exposure in rats (Verschuuren et al. 1976) was considered, but was ultimately not selected based on the higher sensitivity of mink to mercury and the low expected proportion of methyl mercury as total mercury in OU-4. The conservative nature of TRVs derived from studies based on exposure to methylmercury and that actual exposure within OU-4 would not likely be comprised of 100% methylmercury are discussed in the uncertainty analysis (Section 6.2).

5.4.8 Mammalian Dietary TRVs for Other Metals

The TRVs for other metals were selected based on the dataset used to develop the USEPA EcoSSLs (USEPA 2005b and 2007) as described above and in Appendix D.

5.4.9 Mammalian Dietary TRVs for Dioxin-Like Compounds

As with avian species, the literature was reviewed for studies that evaluated the effects of dioxin (on a TCDD or TEQ basis) on mammals for the derivation of the mammalian TRV. Laboratory studies particularly on mice and rats have shown effects from dioxin exposure including immune system suppression, increased hepatic porphyria, development of tumors, reduced sex hormones, and decreased fertility. Previous studies of individual PCDD/PCDF congeners or their mixtures have demonstrated that mink are among the more sensitive mammalian species tested and expected to occur along Choccolocco Creek due to habitat availability, and this species provides a surrogate for the less sensitive mammals that are being evaluated in OU-4. In choosing the study for development of the TCDD-based TRV, one of the primary criteria was that the animals were not co-exposed to PCBs, particularly PCB-126. A recent study by Moore et al. (2012) satisfies this criterion and was selected as the basis for the mammalian TRV.

As described in Appendix F, the study by Moore et al. (2012) was selected as the basis for the derivation of the mammalian TRV (25 ng TEQ/kg BW-d), for the following reasons:

- Mink are likely more sensitive to the effects of PCDDs/PCDFs than are most of the other representative mammalian receptors for OU-4.
- Mink in this study were exposed only to constituents that are the focus of this assessment: TCDD, PCDDs/PCDFs.
- The study evaluated sensitive and population-relevant endpoints: litter size and viability of offspring.

The NOAEL-based TRV is supported by the results of other studies where dietary doses up to 30 ng TEQ/kg BW-d did not affect mink reproduction and kit viability (Zwiernik et al. 2009).

5.5 Tissue-based CTCs

For PCBs and mercury, available peer-reviewed toxicity data were reviewed to develop tissue-based CTCs for invertebrates, fish, birds, and mammals. Due to limitations in the datasets, tissue CTCs were not developed for non-mercury metals, except for lead in fish tissue.

The available tissue-based CTC values are summarized below and presented in detail in Appendix D.

5.5.1 Avian Tissue-based CTCs

Bird CTCs are based on COPC concentrations in eggs. The egg-based CTCs are summarized below.

5.5.1.1 Avian Egg-Based CTCs for PCBs

Five studies were available that reported PCB egg-based concentrations for chickens and six were available for non-chicken avian species. The majority of the available studies applied dietary exposure routes and reported the resulting PCB egg concentrations from maternal transfer. Based on this research, two sets of CTCs were developed for PCBs based on sensitivity to AHR-mediated toxicity. One represents the high end of the range of sensitivity and the second represents the mid-range of sensitivity for avian species. A summary of the literature that was considered relevant is provided in Appendix D and summarized below.

For the high end of the sensitivity range, five reproductive NOAELs and five corresponding reproductive LOAELs were considered in CTC derivation. The lowest LOAEL and highest NOAEL that was below the lowest LOAEL were both from a study conducted by Britton and Huston (1973) in which white leghorn chickens were exposed to five doses of Aroclor 1242 in their diet for up to 42 days. A slight but significant reduction in egg hatchability was observed after six weeks of exposure at a dietary concentration of 10 mg/kg, though egg hatchability at this dose improved during a subsequent recovery period and was not significantly different from control. This dietary concentration corresponded to a PCB concentration in the egg yolk of 3.7 mg/kg. This egg yolk concentration was converted to a whole egg basis using whole egg and yolk weights reported in the literature, as shown in Table D-6 of Appendix D. Thus, the derived NOAEL and LOAEL from this study are 0.52 and 1.1 microgram PCB per gram egg wet weight (µg PCB/g egg ww), respectively. This is the lowest available LOAEL for chicken species and is also below two bounded reproductive NOAELs. These values were converted to dry weight assuming a 75% moisture

content in bird egg tissue (Ahn et al. 1997) resulting in NOAEL and LOAEL egg-based CTC values of 2.1 and 4.5 µg PCB/g egg dw, respectively.

For the mid-range sensitivity, five studies were available that reported exposures as PCB egg concentrations for four non-chicken avian species including the mallard (type 3 species), ring dove (*Streptopelia risoria*) (type 2 species), American kestrel (type 3 species), and screech owl (*Megascops asio.*) (type 2 species). However, only a single dietary dose was tested in each of these studies resulting in no bounded effect levels. The lowest LOAEL available was from a study conducted by Peakall et al. (1972) in which ring doves were exposed to a single dietary dose of 10 mg/kg/day of Aroclor 1254 over two generations. This dietary dose corresponded to a measured egg concentration of 16.5 µg PCB/g egg ww (66 µg PCB/g egg dw assuming 75% moisture content in eggs [Ahn et al. 1997]). There was low hatching and fledging success (83% reduction in hatching and 92% reduction in fledging compared to controls) in the second generation due to heavy embryonic mortality attributed to reduced parental attentiveness. Although the exposure produced a high level of embryonic mortality, a lower LOAEL is not available for mid-sensitivity birds and several studies report NOAELs at similar concentrations (see Appendix D). Uncertainty related to the use of this LOAEL is discussed in the risk characterization section.

The highest reproductive NOAEL below this LOAEL was reported by McLane and Hughes (1980) in a dietary study in which screech owls were fed a dosage of 3 mg/kg Aroclor 1248 for 8 weeks prior to egg-laying and continued through two breeding seasons. This dietary dosage resulted in an average PCB egg concentration of 7.1 micrograms kilogram egg wet weight (µg/kg egg ww) (28 µg PCB/ g egg dw assuming 75% moisture content in bird egg tissue [Ahn et al. 1997]). At this treatment level, no adverse effects were observed on clutch size, hatchling success, fledging success, or eggshell thickness. This no-effect level is similar to that reported in two independent field studies (Bishop et al. 1999, Jayaraman et al. 2009) with tree swallows (type 2 species), in which no effect on clutch size, hatching success, or nesting attempts were found at egg concentrations of 11 µg/kg egg ww (45 µg PCB/ g egg dw assuming 75% moisture content in bird egg tissue [Ahn et al. 1997]).

To summarize, the NOAEL-based and LOAEL-based avian PCB egg-based CTCs for the high sensitivity are 2.1 mg/kg dw and 4.5 mg/kg dw, respectively (Table 5-2b). The NOAEL-based and LOAEL-based avian PCB egg-based CTCs for the mid-range sensitivity are 28 mg/kg dw and 66 mg/kg dw, respectively (Table 5-2b). Additional detail on the development of the two sets of CTCs is provided in Appendix D.

5.5.1.2 Avian Egg-Based CTCs for Mercury

Sources discussed in *Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations* (Thompson 1996) as well as Burger and Gochfeld (1997) were considered to identify avian egg-based CTCs. Twenty-five studies summarizing effects of mercury on avian eggs were identified for consideration in Appendix D.

The LOAEL value of 0.2 µg/g ww in egg from the Jackson et al. (2011) study which monitored reproductive success of Carolina wrens breeding along forest-floodplains of two mercury-contaminated rivers in Virginia compared to reference sites with levels of mercury exposure consistent with background atmospheric deposition. Nest survival was modeled based on individual female blood mercury concentrations. Based on the model results, egg mercury concentrations of 0.11 µg/g ww would result in a 10% reduction in nest success, and a concentration of 0.2 mg/kg ww would result in a 20% reduction in nest success. Uncertainties associated with this study are primarily related to the low sample size for

measured egg concentrations (n = 7) that was used to derive the equation for modeling the effect levels. In addition, the primary endpoint evaluated in the study is nest success rather than fledglings produced. Specifically, some of the nests that were considered failed may have produced fledglings; thereby, not affecting overall reproductive output. Because this study was conducted with one of the specific test species being evaluated in this OU-4 BERA and measured effects may have biological relevance, the modeled 10% and 20% effect levels of 0.11 and 0.20 mg/kg ww, respectively, are selected as the NOAEL and LOAEL egg-based CTCs for mercury. These values were converted to dry weight assuming a 75% moisture content in bird egg tissue (Ahn et al. 1997) resulting in a NOAEL and LOAEL egg-based CTCs for mercury of 0.44 and 0.80 mg/kg dw (Table 5-2b).

5.5.2 Mammalian Tissue-based CTCs

For non-mink small mammals, tissue-based CTCs (Section 5.6.6) were developed for PCBs. Sufficient data were not available to develop small mammal tissue-based CTCs for other COPCs. Likewise, for mink, the toxicity data for whole body mink tissue was insufficient to develop mink specific tissue-based CTCs.

5.5.2.1 Small Mammal PCB Tissue-Based CTCs

Standard literature sources such as the USEPA ECOTOX database (USEPA 2013a), California Cal/Ecotox (OEHHA 2013), and PCBRes (USEPA 2009) were queried to identify PCB CTCs for small mammal whole body tissue. A total of nine studies were identified in the PCBRes database (USEPA 2009) and evaluated in the derivation of PCB tissue-based CTCs for mammals (Table D-10 of Appendix D). These studies were selected because whole organism residue data were paired to NOAEL and in some cases LOAEL responses. Studies that only measured residues in specific tissues or organs and studies that evaluated single PCB congeners were not used. Further, only studies that evaluated the link between toxicity endpoints and tissue residue concentrations in the same organism were evaluated.

Of the nine studies considered, LOAEL tissue burdens were reported by McCoy et al. (1995) for mouse and Clark and Prouty (1977) for big brown bat. The McCoy study resulted in the lower of the two LOAELs and also provides a NOAEL. In this study, reductions in offspring were observed in the F1 generation dosed with 5 mg/kg in food. This dose resulted in a mean tissue burden for the F1 generation of 7.5 mg/kg, with a range of 3.1 to 12.5 mg/kg. The NOAEL is from the P1 generation and is 3.3 mg/kg, with a range of 0.44 to 7.2 mg/kg. Because this is a multigenerational study in which each successive generation was dosed and because the effects were relevant reproductive effects, a NOAEL tissue-based CTC of 3.3 and a LOAEL tissue-based CTC of 7.2 mg/kg were selected for this OU-4 BERA. The concentrations were assumed to be in wet weight, and were converted to dry weight concentrations of 10 and 23 mg/kg BW-d respectively, assuming 32% solids (USEPA 1993).

5.5.3 Fish Tissue-Based CTCs

Established tissue-based CTCs protective of fish are not currently available; however, tissue residue-based effects data exist and were used to support the development of tissue-based CTCs protective of fish for PCBs, mercury, lead, and vanadium. Data were insufficient to develop robust CTCs for barium, chromium, and cobalt. Possible effects on fish from these COPCs are discussed in the uncertainty analysis (Section 6.2). Details of the approach used and literature reviewed for selecting benchmarks is

provided in Appendix D and selected values are summarized in Table 5-2b. These values were converted to dry weight assuming a 73% moisture content in tissue (based on average moisture content of fish from OU-4) resulting in a NOAEL and LOAEL fish-based benchmarks are presented in mg/kg dw in Table 5-2b.

5.5.3.1 Fish Tissue-Based CTCs for PCBs

Scientific literature was used to identify the range of PCB concentrations associated with adverse effects on survival, growth, and reproductive success in non-salmonid fish (salmonid species are cold-water species and do not occur naturally within OU-4). Of the literature reviewed for the effects of PCBs on fish species, eight met the screening criteria (Table D-10 of Appendix D). None of the studies retained referred to controlled toxicity studies performed directly on the species for which tissue concentrations have been measured in OU-4. Because early life stage developmental endpoints are shown to be the most sensitive to PCBs, the adult survival data were not used in the derivation of the tissue threshold concentration range. The results for the eight studies are summarized in Table D-10 of Appendix D.

The Hansen et al. (1974) study evaluated reproductive effects in sheepshead minnows (*Cyprinus variegatus)* treated with Aroclor 1254 at five dose concentrations (0.09, 0.14, 0.39, 1.1, and 5.6 µg/L). This study reported a NOAEL tissue concentration based on fry survival of 1.9 mg/kg ww. A second study reported a similar NOAEL value of 1.6 mg/kg ww (Bengtsson 1980). This study exposed the minnow (*Phoxinus phoxinus*) to Clophen A50. Clophen A50 is a technical mixture that contains approximately three times more dioxin TEQ per unit than Aroclor 1254. This would likely overestimate risk to fish exposed to PCBs from OU-4 because the Anniston PCB Site contamination is a weathered mixture of PCB congeners which has a lower TEQ concentration than Clophen A50 (Appendix D). Because of the high TEQ concentration relative to OU-4 and because the results from this study are only slightly lower than the results from the Hansen et al. (1974) study, the NOAEL from Hansen et al. of 1.9 mg/kg ww is selected as the NOAEL for fish tissue.

The study by Hansen et al. (1974) was also selected as the basis for the LOAEL CTC of 9.3 mg/kg ww. The tissue residue at the dose concentration of 0.14 µg/L was 9.3 mg/kg ww in female fish tissue and resulted in a decrease in fry survival. This value is selected as the LOAEL PCB fish tissue CTC. Only one study reported a lower LOAEL value (Orn et al. 1998) but this study was not selected as the basis for the LOAEL CTC because the study specifies that the analysis of PCBs does not represent a whole-body analysis as the livers and ovaries were dissected prior to the analysis.

To summarize, for PCBs, the NOAEL fish tissue CTC of 1.9 mg/kg ww and a LOAEL fish tissue CTC of 9.3 mg/kg ww were selected for use in this OU-4 BERA to evaluate potential risk to fish. These values were converted to dry weight assuming a 73% moisture content in tissue (based on average moisture content of fish from OU-4) resulting in a NOAEL and LOAEL fish-based CTCs of 7.0 and 34 mg/kg dw (Table 5-2b).

5.5.3.2 Fish Tissue-Based CTCs for Mercury

Six potentially relevant studies reflecting whole body tissue no-effect and effect data for fish species were identified for mercury. Appendix D describes the data review and reduction steps. One of these studies (Beckvar et al. 2005) is a review study, which provides a review of tissue residue studies for mercury and considers all of the other studies obtained from Environmental Residue Effects Database (USACE 2013), and was identified as potentially relevant for CTC derivation. Beckvar et al. (2005) apply and evaluate

different systematic methods for linking tissue concentrations of mercury with observed adverse biological effects, including identification of the highest no-effect tissue concentration (0.23 mg/kg ww) that is below the lowest effect tissue concentration (0.25 mg/kg ww). As Beckvar et al. (2005) focus on data for sublethal endpoints (including growth, reproduction, and development), these values are considered to be conservative, protective, and appropriate for application in a risk assessment context.

Considering the studies identified as potentially relevant (reflecting sublethal endpoints associated with whole body concentrations in freshwater fish), no-effect tissue concentrations range from below the selected NOAEL CTC of 0.23 mg/kg ww (Webber and Haines 2003) to greater than 10 mg/kg for sublethal endpoints (Olson et al. 1975), and low-effect concentrations range from the selected LOAEL CTC of 0.25 mg/kg ww (Friedmann et al. 1996) to 29 mg/kg ww (Dillon 1984). This variability suggests that uncertainty exists regarding the true tissue threshold for effects associated with mercury, and that many factors (including site-specific factors that influence bioavailability and exposure) influence mercury uptake and toxicity.

To summarize, for mercury, the NOAEL-equivalent fish tissue CTC of 0.23 mg/kg ww and a LOAEL-equivalent fish tissue CTC of 0.25 mg/kg ww was selected for use in this OU-4 BERA to evaluate potential risk to fish. These values were converted to dry weight assuming a 73% moisture content in tissue (based on average moisture content of fish from OU-4) resulting in a NOAEL and LOAEL fish-based CTCs of 0.85 and 0.93 mg/kg dw, respectively (Table 5-2b).

5.5.3.3 Fish Tissue-Based CTCs for Non-Mercury Metals

Fish-tissue CTCs for non-mercury metals were selected based on literature studies. Data were insufficient to develop robust CTCs for barium, chromium, and cobalt.

For lead, the study by Holcombe et al. (1976) was selected for developing fish CTCs. This study presents the results of a three-generation study of brook trout (*Salvelinus fontinalis*) exposed to lead in water. Holcombe et al. (1976) proposed, based on observing the development of scoliosis in second- and third-generation fish and reduced growth of 12 week old third-generation fish, that the maximum allowable threshold concentration (assuming a water exposure) lies between 58 µg/L and 119 µg/L (i.e., between the no effect and effect level). These water exposure levels are associated with whole body tissue thresholds of 2.5 mg/kg ww and 4.0 mg/kg ww, and were selected as the NOAEL- and LOAEL-fish tissue CTCs for lead, respectively. These values were converted to dry weight assuming a 73% moisture content in fish tissue (based on average moisture content of fish from OU-4) resulting in NOAEL and LOAEL fish tissue CTCs for lead of 9.3 mg/kg dw and 15 mg/kg dw (Table 5-2b).

For vanadium, a study by Hilton and Bettger (1988) was selected for developing fish CTCs. This study recorded growth in rainbow trout (*Oncorhynchus mykiss*) fed 12 weeks on diets supplemented with vanadium as sodium orthovanadate at concentrations of 1.2, 10.2, and 80 mg/kg. Body weight gain was reduced in trout fed the lowest concentration diet of 10.2 mg/kg, but not in trout fed the control diet of 1.2 mg/kg. The reported no observed effect concentration of 0.090 mg/kg dw was selected as the NOAEL fish CTC and the reported LOEC based on reduced growth of 2.1 mg/kg dw was selected as the LOAEL fish CTC (Table 5-2b).

5.5.3.4 Fish Tissue-based CTCs for Dioxin-Like Compounds

Studies on lake trout (*Salvelinus namaycush*), brook trout, rainbow trout, channel catfish (*Ictalurus punctatus*), lake herring (*Coregonus artedi*), fathead minnow (*Pimephales promelas*), Japanese medaka (*Oryzias latipes*), northern pike (*Esox lucius*), white sucker (*Catostomus commersonii*), and zebrafish (*Danio rerio*) were included in the species sensitivity distribution for TCDD, and tissue residue benchmarks were derived by Steevens et al. (2005) to be protective of fish. Mean, lower, and upper 95%UCL benchmarks were selected at different species protection levels (i.e., protective of 99, 97.5, 95, or 90% of fish species). The species sensitivity distribution developed by Steevens et al. (2005) incorporates residue effect data for lake trout and other salmonids that are substantially lower (i.e., more highly sensitive) than residues associated with effects in the other, less sensitive fish species. Inclusion of the salmonid species in the residue-effects curve results in tissue reside benchmarks that are likely over-protective for other fish species. This has been illustrated by Sappington et al. (2011) who compared lethal residues associated with 50% mortality (LR_{50}) among fish species using data from the Steevens et al. (2005) analysis (Figure F-1 in Appendix F). Trout are the most sensitive species to the effects of TCDD (Figure F-1 in Appendix F). The fish species sampled and analyzed for TCDD for this OU-4 BERA include a variety of fish, and while none of these species were represented in the distribution shown in Figure F-1 in Appendix F, it is expected that all of these species are less sensitive to the effects of TCDD than the highly sensitive salmonids. Therefore, the 90% species protection level from Steevens et al. (2005) is considered to be sufficiently protective for the Choccolocco Creek fish species. The benchmark value based on the 95%UCL effects residue (based on the geometric mean of no-observed effects residue and observed effects residue lowest observed effects residue values) from the Steevens et al. (2005) study, 2.2 nanogram TCDD per gram (ng TCDD/g) lipid, was therefore selected as the CTC for fish.

5.5.4 Invertebrate Tissue-Based CTCs

Established tissue-based CTCs protective of terrestrial and aquatic invertebrates are not currently available; however, limited tissue residue-based effects data exist and are used to develop tissue-based CTCs at the request of USEPA. An approach similar to the approach used for fish was used to derive CTCs for invertebrate tissues, as described in detail in Appendix D.

5.5.4.1 Oligochaetes (Aquatic Worms) CTCs

5.5.4.1.1 Oligochaete CTCs for PCBs

Five studies were identified that contain relevant data for development of tissue CTCs for aquatic worms, which were considered to include any infaunal worm species. Data were available for three polychaete species and the oligochaete *Lumbriculus variegatus* (Table D-11). The lowest LOAEL is from a 35-day chronic study by Fisher et al. (1999) in which *Lumbriculus variegatus* were fed algal solutions containing one of four PCB congeners spanning a range of chlorination (2-monochlorobiphenyl, 4,4'-dichlorobiphenyl, 2,2'4,4'tetrachlorobiphenyl, and 2,2,4,4,5,5'-hexacholorobiphenyl). Lethal and sub-lethal chronic residues were measured. After 35 days, mortality was observed only at the highest exposure concentrations, and data were not sufficient for calculation of LC50s because few organisms died. Sublethal effects were measured by changes in biomass and reproduction (number of organisms at 35 days). In tissue, molar concentrations ranging from 0.343 to 0.532 millimoles per kilogram wet weight (mmol/kg ww) were

associated with a 20 to 38% reduction in organism number relative to controls. This response was consistent across PCB congeners. NOAEL effect concentrations ranged from 0.169 to 0.283 mmol/kg ww. Significant differences in biomass were also observed at the same effect levels.

Although the Fisher et al. (1999) study used PCB congeners and not mixtures, it was selected for CTC development due to the limited dataset for worms, good experimental design, chronic endpoints, consistent response across congeners at varying levels of chlorination, and availability of LOAEL tissue residue data for polychaetes at higher concentrations (Fowler et al. 1978). In Fisher et al. (1999), the low end of the range of LOAELs (0.343 mmol/kg ww) was converted to a wet weight concentration of 112 mg/kg, assuming a molar equivalent Aroclor 1254 concentration (326 grams per mol). The highest NOAEL below the LOAEL (0.283 mmol/kg ww) was similarly converted to a wet weight concentration of 92 mg/kg ww. These NOAEL and LOAEL values were converted to dry weight concentrations of 541 and 659 mg/kg dw, respectively, assuming 17% solids (Landrum et al. 2004).

5.5.4.1.2 Oligochaete CTCs for Mercury

No relevant tissue effects data were located, and therefore no tissue CTC was developed for aquatic worms.

5.5.4.2 Aquatic Emergent Insect CTCs

5.5.4.2.1 Aquatic Emergent Insect CTCs for PCBs

Only two studies were identified with relevant emergent insect tissue data. Five species were tested, including mayfly (*Ephemeroptera sp.*), midge (*Chaoborus punctipennis*), giant black stonefly (*Pteronarcys dorsata)*, and mosquito (Culicidae) (Table D-12). Only unbounded NOAELs are available. The highest NOAEL is 6.5 mg/kg ww for the midge for which no effect on survival was found after 14 days exposure to sediment and water containing Aroclor 1254 (Sanders and Chandler 1972). This NOAEL CTC was converted to a dry weight concentration of 21 mg/kg ww, based on the average site-wide emergent insect solids content of 31% for OU-4.

5.5.4.2.2 Aquatic Emergent Insect CTCs for Mercury

Only two studies that contain relevant tissue residue data for emergent insects were identified. The studies contain unbounded no-effects data for two species: burrowing mayfly and midge. The highest NOAEL is from a study by Rossaro et al. (1986) in which midge larve (*Chironomus riparius*) were exposed to mercuric chloride in flow-through chambers for 30 days. Aqueous concentrations in the test chambers ranged from 2 to 9 µg/L. The authors note that there was no effect on mortality at tissue concentrations reaching 107 mg/kg ww at the end of the test. The only other available data (Saouter et al. 1993) were for burrowing mayfly exposed over nine days to organic and inorganic mercury via water or sediment exposures. The highest tissue residues were found for methylmercury uptake from the dissolved phase, with no effect on growth or survival at a residue concentration of 7.48 mg/kg ww. Although the short exposure duration in the Saouter et al. (1993) study is not considered to be as relevant as the chronic exposure conducted by Rossaro et al. (1986), midge can be relatively tolerant to pollution, and therefore the mayfly data were selected as the basis for the NOAEL CTC. The NOAEL value of 7.5 mg/kg ww from

the Saouter et al. (1993) was selected as the NOAEL-equivalent CTC for evaluation of emergent insect data collected in OU-4. No LOAEL-equivalent value was selected.

The NOAEL CTC was converted to a dry weight concentration of 24 mg/kg dw, assuming 31% solids based on the average site-wide emergent insect solids content for OU-4.

5.5.4.3 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs

No odonate-specific tissue toxicity data were located, therefore other epibenthic arthropod species were considered suitable as surrogate receptors.

5.5.4.3.1 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs for PCBs

Three studies representing three amphipod species were identified with relevant tissue toxicity data. The lowest LOAEL is 76 mg/kg ww, based on 40% reduction in young produced per surviving adult in 60-day flow-through aqueous exposure to Aroclor 1242 (Nebeker and Puglisi 1974), and was associated with a dissolved concentration of 2.8 µg/L. In that study, *Gammarus pseudolimnaeus* were less sensitive to Aroclor 1248, for which a statistically significant reduction in offspring production did not occur until 552 mg/kg ww. The LOAEL value of 76 mg/kg ww was selected to evaluate odonate tissue in this OU-4 BERA. A paired NOAEL from the same study and endpoint is not available.

The highest NOAEL below the selected LOAEL is from a study by Borgmann et al. (1990), in which there was no effect found on survival, growth, or reproduction (number of young produced) after a 10-week chronic exposure of the amphipod *Hyalella azteca* to 30 µg/L Aroclor 1242. The resulting tissue concentration at this exposure concentration was 28 mg/kg ww. A paired LOAEL is not available from this study. The NOAEL value of 28 mg/kg ww was selected to develop the tissue CTC.

The selected NOAEL and LOAEL CTCs were converted to dry weight concentrations of 158 and 422 mg/kg dw, respectively, based on the average site-wide odonata solids content of 18% for OU-4.

5.5.4.3.2 Aquatic Odonate Larvae / Epibenthic Invertebrates CTCs for Mercury

One study conducted with the amphipod *Hyalella azteca* was identified with relevant tissue toxicity data. Borgmann et al. (1993) exposed juvenile amphipods to mercury for 10 weeks. At the LOAEL tissue concentration of 90 mg/kg dw, survival was 28% relative to controls and reproduction, measured by number of young per initial number of adults, was 38% of control levels. At mercury concentrations of 56 mg/kg dw, no effect on survival or reproduction was observed. The paired NOAEL and LOAEL values of 56 and 90 mg/kg dw, respectively, were selected to evaluate mercury in odonate tissues in OU-4.

These NOAEL and LOAEL values equate to wet weight concentrations of 10 and 16 mg/kg ww, based on the average site-wide odonate solids content of 18%.

5.5.4.4 Aquatic Molluscs CTCs

5.5.4.4.1 Aquatic Molluscs CTCs for PCBs

Four studies were identified that contain relevant data for development of tissue CTCs for molluscs. These studies include data for two common mollusc species (Table D-14). The selected LOAEL CTC is based on

a study by Lowe et al. (1972) in which juvenile oysters exposed to 5 µg/L Aroclor 1254 in 12-week flow-through exposures had a 25% reduction in whole body weight after 12 weeks exposure. Aroclor 1254 concentrations in the soft tissue after 12 weeks were approximately 150 mg/kg ww. After 24 weeks exposure to a slightly lower concentration (1 µg/L) of Aroclor 1254, there was no effect on oyster weight. The associated tissue residue was 101 mg/kg ww. A NOAEL of 101 mg/kg ww and LOAEL of 150 mg/kg ww were selected from Lowe et al. (1972) to evaluate mollusc tissue concentrations in OU-4.

The selected NOAEL and LOAEL tissue concentrations were converted to dry weight concentrations of 1263 and 1875 mg/kg dw, based on the average site-wide mollusc solids content of 8% for OU-4.

5.5.4.4.2 Aquatic Molluscs CTCs for Mercury

Five studies that contain relevant tissue residue data for molluscs were identified. The studies contain data for seven species, including snails, clams, limpets, and oysters. The selected LOAEL CTC is based on a study by Thain et al. (1984) that reported a LOAEL of 12 mg/kg ww, based on 25% reduced fecundity in slipper limpet (*Crepidula fornicata*) after 8 weeks of exposure to mercury, and a 25 to 50% reduction in shell growth over 16 weeks at tissue concentrations of 28 mg/kg ww. The highest NOAEL (6 mg/kg ww) below the selected LOAEL was from Dillon et al. (1977) for reduced survival in clams following acute exposure to mercury. The NOAEL effects concentration was multiplied by an acute-to-chronic uncertainty factor of 0.1, resulting NOAEL and LOAEL tissue CTCs of 0.60 and 12 mg/kg ww, respectively.

These NOAEL and LOAEL CTCs were converted to 8 and 150 mg/kg dw, based on 8% average solids content in site-wide clams.

5.5.4.5 Aquatic Crayfish CTCs

Although crayfish tissue data were located, additional data were considered for water column-inhabiting crustaceans due to the small size of the toxicity dataset.

5.5.4.5.1 Aquatic Crayfish CTCs for PCBs

Five studies were identified with relevant data for development of tissue CTCs for crayfish. These studies include data for three species of shrimp, a crayfish, and a crab (Table D-15). The selected LOAEL CTC is based on a study by Duke et al. (1970). In the 20-day exposures, pink shrimp (*Penaeus duorarum*) were exposed in flow-through chambers containing Aroclor 1254 concentrations that ranged from 3.8 to 4.2 µg/L and resulted in 72% mortality at test conclusion. Lethal tissue residues averaged 16 mg/kg ww (57 mg/kg dw, based on average 28% solids content for site crayfish), whereas the average tissue concentration in the surviving shrimp was 33 mg/kg ww. The lethal tissue residue concentration of 16 mg/kg ww reported by Duke et al. (1970) was selected as the LOAEL-equivalent concentration.

The highest NOAEL (14.6 mg/kg ww, assuming 28% solids) below the selected LOAEL CTC of 16 mg/kg ww is based on 96-hour survival data for *Daphnia magna* (Sanders and Chandler 1972). This study also reports 21-day exposures for a variety of species, including glass shrimp (*Palaemonetes kadiakensis*) which had the next highest NOAEL value of 21.5 mg/kg dw (6.0 mg/kg ww, assuming 28% solids). The longer duration grass shrimp test with lower exposure concentrations (~1.5 µg/L Aroclor 1254) was considered more relevant than acute data for a cladoceran. Therefore, the NOAEL of 6.0 mg/kg ww based

on survival was selected to evaluate crayfish. Note that a crayfish specific NOAEL of 6.1 mg/kg dw (1.7 mg/kg ww, assuming 28% solids) was also reported by Sanders and Chandler (1972).

5.5.4.5.2 Aquatic Crayfish CTCs for Mercury

Four studies were identified that contain relevant data for development of mercury tissue CTCs for crayfish. These studies include data for one species of shrimp, fiddler crab (*Uca* sp.), and a cladoceran. Biesinger et al. (1982) is the only study reporting adverse effect endpoints. In that study juvenile *Daphnia magna* were exposed to a range of mercuric chloride or methylmercury concentrations in 3-week flow-through exposures. Although there was no effect on survival, a 33 to 35% decrease in production of young was observed at 16 mg/kg dw (1.6 mg/kg ww) for methylmercury and 23 mg/kg dw (2.3 mg/kg ww) for mercury as mercuric chloride. The NOAEL tissue residue concentrations associated with no effect on young production are 15 mg/kg dw (1.5 mg/kg ww) for mercuric chloride exposures and 0.92 mg/kg dw (0.092 mg/kg ww; the control mercury tissue residue concentration) for methylmercury exposures. Although *Daphnia magna* are not closely related to crayfish, these toxicity data were considered suitable due to the lack of alternate effects and no-effects levels from chronic studies. The NOAEL and LOAEL of 0.92 mg/kg dw and 16 mg/kg dw resulting from exposure to methylmercury were selected to evaluate OU-4 crayfish tissue data.

5.5.4.6 Terrestrial Earthworms CTCs

5.5.4.6.1 Terrestrial Earthworms CTCs for PCBs

Laboratory-based earthworm tissue residue data are limited. The lowest LOAEL is from a study by Rodriguez-Grau et al. (1989) in which earthworms (*Lumbriculus terrestris*) were exposed for 5 days to filter paper containing Aroclor 1254. There was a 25% reduction in survival at tissue concentrations of 834 mg/kg dw (183 mg/kg ww, assuming 22% solids as reported in the study), which was assumed to be a LOAEL-equivalent tissue residue. The paired NOAEL for this endpoint is 780 mg/kg dw (172 mg/kg ww).

The paired NOAEL and LOAEL values of 172 and 183 mg/kg ww, respectively, were selected as the basis for tissue CTCs to evaluate OU-4 earthworm data. The effect concentrations were multiplied by an acute-to-chronic uncertainty factor of 0.1 to calculate the NOAEL CTC of 17 and LOAEL CTC of 18 mg/kg ww. These concentrations equate to 78 mg/kg dw and 83 mg/kg dw, respectively.

5.5.4.6.2 Terrestrial Earthworms CTCs for Mercury

Only a single study by Burton et al. (2006) was identified containing relevant mercury tissue residue data for earthworms. Burton et al. (2006) exposed adult earthworms for 28 days in soil historically contaminated with mercury and methylmercury. Tissue burdens of 15 mg total mercury/kg dw and 0.78 mg methylmercury/kg dw had no effect on survival (>95% in all treatments) or growth, as measured by growth rate (ranged from 5.1 to 6.1 mg/week). The highest NOAEL of 15 mg/kg dw was selected as the mercury CTC to evaluate earthworms in OU-4. A LOAEL-equivalent value is not available.

The NOAEL CTC is equivalent to a wet weight concentration of 4.4 mg/kg ww, based on 29% site-wide average solids content in earthworms

5.5.4.7 Terrestrial Crickets / Grasshoppers CTCs

5.5.4.7.1 Terrestrial Crickets / Grasshoppers CTCs for PCBs

Tissue residue data relevant for evaluation of epigeous soil insects (grasshoppers and crickets) were identified in a single study by Paine et al. (1993). In that study, cricket nymphs were exposed for 14 days to spiked soils containing Aroclor 1254 concentrations up to 2,000 mg/kg. Tissue residues in the surviving crickets were measured. The study LOAEL of 144 mg/kg ww is associated with 39 to 49% survival relative to controls, whereas tissue concentrations of 92 mg/kg ww had no effect on survival. The paired NOAEL and LOAEL concentrations were selected as PCB CTC for evaluation of cricket and grasshopper tissues collected in OU-4.

The selected NOAEL and LOAEL tissue concentrations were converted to dry weight concentrations of 307 and 480 mg/kg dw, assuming a tissue solids content of 30% (Paine et al. 1993).

5.5.4.7.2 Terrestrial Crickets / Grasshoppers CTCs for Mercury

No relevant tissue effects data were located, and therefore no tissue CTCs were developed for grasshoppers and crickets.

5.6 Effects on Ecological Communities

As described in Section 2.1, a great deal of ecological/biological data have been collected for characterization of OU-4. Despite the fact that the habitat quality and the ecology within the OU-4 portions of Snow Creek and Choccolocco Creek have been impacted by human activity (e.g., urbanization, agriculture, and grazing in some areas), there is valuable aquatic and riparian habitat in OU-4. Data from the various biological community surveys conducted for OU-4 (described in Section 2 and summarized in Table 2-1) were used to evaluate potential effects of COPCs to ecological communities and to understand upstream to downstream spatial trends (going from upper to middle to lower reaches). Data from locations in OU-4 (Choccolocco Creek) were compared to each other and to data from reference locations (upper Choccolocco Creek, Cheaha Creek, and Talladega Creek).

Effects to ecological communities based on the site-specific data were quantitatively evaluated, where applicable, using a variety of standardized metrics which include (for each community):

- Plants – taxa richness (total number of individual species), diversity (Shannon-Wiener Diversity; Shannon 1948), dominance (Simpsons Dominance), percent vegetation cover, and proportion of habitat type (measured along transects)
- Benthic Invertebrates - abundance (total number of individual organisms), taxa richness (total number of individual species), EPT Index, diversity (Shannon-Wiener Diversity Shannon-Wiener Diversity; Shannon 1948), tolerance (Hilsenhoff Biotic Index, Hilsenhoff 1988)
- Soil Invertebrates, Fish, Birds, and Mammals - abundance (total number of individual organisms), taxa richness (total number of individual species), diversity (Shannon-Wiener Diversity; Shannon 1948), dominance (Simpsons Dominance; Gotelli and Chao 2013)

Shannon-Wiener Diversity characterizes species diversity in a community by accounting for the number of different species as well the relative distribution of individual organisms among those species. A greater number of species and a more even distribution of individuals among species result in an increase in the Shannon-Wiener Diversity value. Shannon-Wiener Diversity was estimated using the following equation:

Equation 3: $-\sum_{i=1}^{S} p_i \ln(p_i)$

Where:

S number of species in the sample

p_i proportion of individuals in the *i*th species

Simpsons Dominance measures the relative proportion of a particular species to the total number of species in the sample and was estimated using the following equation:

Equation 4: $\sum_{i=1}^{S} {p_i}^2$

Where:

S Number of species in the sample

p_i proportion of individuals in the *i*th species

High values of abundance, richness, EPT, and diversity are generally indicative of healthy ecological communities. Tolerance values provide a measure of the sensitivity of aquatic organisms to anthropogenic disturbance and are used to assess the biological condition of streams and rivers (Hilsenhoff 1988). Tolerance values range from 0 (least tolerant) to 10 (most tolerant) to poor/impaired environment. Simpsons Dominance values range from 0 (all species are equally present) to 1.0 (one species dominants the community completely).

Different trends were assessed with two- or three-way analysis of variance (ANOVA) or generalized linear models (GLM) with interaction terms that assess if changes between OU-4 and reference were different among years or habitats. The measure was transformed if necessary, to meet assumptions of the parametric ANOVA or GLM models.

Table 5-3 summarizes the data used in the ANOVA conducted for each receptor group. Sections 5.6.1 through 5.6.6 summarize the evaluation methods and results for plants, benthic and terrestrial invertebrate, fish, bird, and mammal communities. Comparison among AAs was conducted only when sample size was large enough to split the data into each AA (benthic invertebrates) or when no reference data were available (terrestrial plants, aquatic birds, and aquatic mammals). Post-hoc pairwise comparison tests were performed when differences among areas were significant and results higher (or lower for tolerance) in the reference area (or most downstream AA when there were no reference data). Uncertainties associated with these community analyses are discussed in Section 6.2.4.

Table 5-3. Community Metrics Summary

Receptor Group	Data Used	Comparison to Reference	Comparison Among AAs	Abundance of Cover	Taxa Richness	Diversity	Dominance	Tolerance	Anova post-hoc test	ANCOVA (PCBs as covariate)
Terrestrial Plants	2001 and 2002 RFI		X	X	X	X	X			
Benthic Invertebrates	2006/2007 Phase I	X	X	X	X	X		X	X	X
Fish	2006/2007 Phase I	X		X	X	X	X			
Aquatic Birds	2006/2007 Phase I		X	X	X	X	X			
Terrestrial Birds	2006/2007 Phase I	X		X	X	X	X			
Aquatic Mammals	2006/2007 Phase I		X	X	X	X	X			
Terrestrial Mammals	2006/2007 Phase I	X		X	X	X	X			
Small Mammals	2006/2007 Phase I	X		X	X	X	X	X		

5.6.1 Plant Communities

As discussed in Section 2.1, some limited plant surveys were conducted in fall 2001 and spring 2002 (BBL 2005a). Vegetation data collected in 2006 were semi-quantitative (presence/absence only), and were not suitable for quantitative analysis. However, using the limited fall 2001 and spring 2002 survey results (BBL 2005a), vegetation communities on the floodplain were compared between reaches (upper, middle, and lower) and sampling periods. Surveys were not completed for reference locations during the 2001 and 2002 surveys and therefore, comparisons between OU-4 and reference locations could not be quantified. Community measures evaluated included taxa richness, Shannon-Wiener Diversity, Simpsons Dominance, and plant cover.

The relative proportion of habitat type surveyed within each reach (upper, middle, and lower) was estimated based on visual examination habitat cover maps overlaid with the location of each transect (BBL 2005a). The relative proportion of cover type sampled by each transect was used as covariate in the community analysis to account for differences in the number of individuals and species typically found in each of the referenced habitat types. Ten transects on which vegetation was observed varied in length from about 600 feet to 2400 feet in length.

The results of these measures are presented in Tables 5-4a through 5-4e. The three-way ANOVA results are presented in Table 5-5. The interaction involving reaches that are considered significant have bolded

P-values in Table 5-5. Significant interaction measures are plotted in Figure 5-1. Table 5-5 and Figure 5-1 indicate significantly lower species richness in the middle reaches (MAA) when compared to the upper reaches (UAA). Similar results were found when examining overall plant cover. Plant cover was significantly less in the middle reaches when compared to the lower reaches (LAA) and upper reaches. These results suggest that the differences in species richness and plant cover are not due to PCBs or other COPC concentrations as an upstream to downstream trend is not apparent. Due to limited data, quantitative comparisons of floodplain OU-4 to reference conditions could not be made for vegetation communities. Overall, the results suggest no adverse effect of PCBs or other COPCs on vegetation communities within OU-4.

Aquatic vegetation within OU-4 and reference areas was observed during both the Phase 1 and 2 ecological surveys and tissue sampling. Qualitative information is used to assess the aquatic plant community ME in Section 6.1.1.

5.6.2 Benthic Invertebrate Communities

As discussed in Section 2.1, benthic invertebrate surveys were conducted for OU-4 in October and November 2006 and May 2007. In general during each survey, two replicate samples were collected from each of two locations in each AA (UAA, MAA, and LAA) or from each of three reference locations and from each of the five habitats (backwater, depositional, EAV, riffle, and run) for a total of 158 samples (Table 2-2). At some reference locations not all habitat types were present. In general, the ranges of abiotic conditions were similar at OU-4 and reference locations for each habitat type. Table 5-6 summarizes water quality parameters during the 2006 and 2007 sampling events. Table 5-7 summarizes the composition of substrate at OU-4 and reference locations.

Benthic invertebrate communities were evaluated by comparing OU-4 locations (UAA, MAA, and LAA) with reference locations. The community measures compared included abundance, taxa richness, EPT Index, Percent EPT, Shannon-Wiener Diversity, and tolerance (i.e., Hilsenhoff Biotic Index). Different sampling methods were selected as appropriate to each habitat type, therefore measures are not standardized on a per unit area basis. Thus, absolute values across habitats were not compared or interpreted. Instead, relative differences were identified, and whether OU-4 locations had different trends within five habitats (backwater, depositional, EAV, riffle, and run) than reference. Generalized linear modeling was used to evaluate trends in benthic measures among the three categorical variables (area, habitat, and season). This type of modeling is usually referred to as ANOVA. Initial modeling revealed that there was significant seasonal variation that differed among habitats and areas and was not consistent across the other variables. In addition, one of the habitats (depositional) was not sampled in the reference area in the fall of 2006. Therefore, spring and fall datasets were evaluated separately.

Power calculations conducted for the spring 2007 dataset (n=82) indicate that the two-way ANOVA model has 70% power to detect a 20% decline in benthic measures at alpha = 0.05 assuming an average coefficient of variation of 0.25 among measures. This demonstrates the usefulness of this dataset in evaluating and detecting any significant differences in the benthic community that may occur across the range of conditions and habitats in OU-4, relative to reference. Because the range of PCB concentrations in surface sediments is well characterized and relatively low (i.e., there is no substantive gradient of concentrations), there was little utility in collecting co-occurring PCB data at the benthic invertebrate

sampling locations. Instead, the sampling focused on capturing the different habitat and substrate types, as well as geographic units and conditions within OU-4.

The benthic measure was transformed, if necessary, to meet the assumptions of linear models (i.e., normally distributed residuals). When an area was found to be a significant variable in the model (i.e., P-value < 0.05), post hoc testing was conducted to compare the means of the measures within each AA to reference. Dunnett's test, a one-sided test, was conducted to compare the overall mean of each AA to reference. A P-value less than 0.05 indicates that the reference mean is statistically significantly greater (or lower for tolerance) than the AA mean. If Dunnett's test was significant, and the habitat/location interaction term was also significant, a pairwise comparison was conducted (i.e., Tukey-Kramer multiple comparison test) to determine if the differences were significant across all habitats. In the case of tolerance, higher values in OU-4 locations would indicate poor/impaired conditions and a possible adverse effect from COPCs or other stressors.

Summary statistics for these measures are presented in Table 5-8 and illustrated in Figures 5-2a and 5-2b. The ANOVA results are presented in Table 5-9. Where area is significant and suggests site means are less than reference, the P-values are bolded in Table 5-9. Non-significant interaction terms were removed from the model before post hoc tests were conducted. The results indicate there were some significant differences in measures, but they were not consistent across seasons or habitats (Table 5-8 and Table 5-9). Overall, mean invertebrate abundance was similar or lower in reference compared to OU-4 locations (Table 5-8, Table 5-9). Mean taxa richness and diversity were lower in the UAA compared to reference in the fall of 2006 but not in the spring of 2007. Mean taxa richness and diversity were similar or greater in all AAs compared to reference in spring 2007 (Table 5-8, Figure 5-2b). The EPT Index and the percent EPT measures were extremely low in all backwater and depositional habitats regardless of location. The EPT Index was lower in the UAA than reference during both events, but in the spring of 2007 the difference was only significant for the riffle habitat. In contrast, the percent EPT in OU-4 locations was generally greater than that in reference, particularly in the riffle and run habitats preferred by these species. Tolerance was greater in the UAA than reference for some habitats, EAV in fall 2006, and run in spring 2007.

Benthic sampling locations were designed to compare benthic communities in OU-4 AA and habitats to reference areas. As previously discussed, the locations were not co-located with chemistry data because it was determined that the range of PCB concentrations in the surface sediments was not variable enough to be able to make assumptions regarding association. The surface sediments in the vicinity of these benthic locations (and throughout OU-4) have been extensively characterized during various sediment sampling programs. To evaluate the potential effect of PCB concentrations, a second analysis was conducted in which the benthic samples were paired up with the mean of all surface PCB concentrations measured in the comparable habitat within a half mile range of the benthic location (see Table 2-2). A GLM with both categorical variables (habitat, season) and a continuous variable (PCB concentration) was used to evaluate any potential association between the value of benthic measures and total PCBs. This type of model is usually referred to as analysis of covariance (ANCOVA). Model results are presented in Tables 5-8 and 5-9. There was no significant relationship between PCBs and any of benthic measures. The P-value for abundance is close to significance (P = 0.052) but the slope is positive indicating that abundance increases with PCB concentration.

Based on the results, although there is variability in the benthic community for the two years evaluated, overall results suggest no adverse effect of PCBs or other COPCs on the benthic invertebrate community and overall condition within the OU-4 AAs can be considered comparable to reference areas.

5.6.3 Soil Invertebrate Community

As discussed in Section 2.1, soil invertebrate surveys were conducted. Using data from these surveys, soil invertebrate communities were compared between floodplain OU-4 and reference locations. Community measures compared included abundance, Shannon-Wiener Diversity, and Simpsons Dominance. Trends were assessed with two-way ANOVA with an interaction term that tests if changes between OU-4 and reference were different among habitats. The measures were transformed if necessary, to meet assumptions of the parametric ANOVA model.

The results of these measures are presented in Tables 5-10a through 5-10d. The two-way ANOVA results are presented in Table 5-11. The interaction involving locations that are considered significant have bolded P-values in Table 5-11. The results indicate mean abundance, taxa diversity, and taxa dominance do not significantly differ by location (P>0.05). However, taxa richness was significantly higher in OU-4 than in the reference area (Table 5-11). Based on these results, the condition of the terrestrial invertebrate community within OU-4 appears to be similar to or more robust in terms of diversity than that found in the reference areas. Overall, the results suggest no adverse effect of PCBs or other COPCs on the soil invertebrate community.

5.6.4 Fish Community

As discussed in Section 2.1, fish community surveys were conducted. Using data from these surveys, fish communities were compared between OU-4 and reference locations. The community measures compared included abundance (fish catch per unit effort), richness, Shannon-Wiener Diversity, and Simpsons Dominance.

Similar to benthic invertebrates, different trends were assessed with three-way ANOVA with interaction terms that assess if changes between OU-4 and reference were different among years or habitats. The measure was transformed if necessary to meet assumptions of the parametric ANOVA model. When location or an interaction term with location (OU-4, reference) was significant with a P-value < 0.05, the means were compared to determine if OU-4 measures are lower than reference (percent decrease between OU-4 and reference were estimated). In the case of tolerance, higher values in OU-4 locations would indicate poor/impaired conditions and possible adverse effect from COPCs (percent increase between OU-4 and reference was estimated).

The results of the measures are presented in Tables 5-12a through 5-12d. The three-way ANOVA results are presented in Table 5-13. The interactions involving location that are considered significant have bolded P-values in Table 5-13. If an interaction term is significant with location, non-parallel trends are plotted for OU-4 and reference as shown in Figure 5-3. The ANOVA indicates no significant difference in diversity (Table 5-13). Although abundance and richness are significantly different by location and year (Table 5-13), the mean fish abundance and species richness did not significantly differ by location when both years (2006 and 2007) were combined, but were higher in OU-4 than reference in 2007 and lower in OU-4 in 2006 (significant interaction of year and location; Tables 5-12a and 5-12b and Figure 5-3), cancelling out an effect of location. Simpsons Dominance Index results indicate a significant interaction

between habitat and location (P = 0.051), with backwaters having higher dominance in OU-4 than reference and the reverse for the creek runs (Table 5-12d and Figure 5-3). Based on these results, the condition of the fish community within OU-4 appears to be similar to that found in the reference areas and the results suggest no adverse effect of PCBs or other COPCs on the fish community.

In addition to the community analysis, during this fish sample processing, all retained fish were examined for external anomalies and any apparent abnormalities were recorded. Anomalies were characterized based on the system outlined in the RBP guidance (Barbour et al. 1999) for occurrence of external deformities, erosions, lesions, and tumors (DELTs). Percent of fish with DELT anomalies has been shown to be a useful metric for assessing fish health (Barbour et al. 1999) as a high percentage of DELT anomalies can indicate pollution stress to the fish community. Non-DELT anomalies such as hook scars were recorded, but not counted in the calculation of percent of fish with DELT anomalies.

The percentage of fish with DELT anomalies at the reference locations ranged from 0.71% at ecological reference area (ERA)-2 to 1.0% at ERA-1 for a total percent DELTs of 0.84% observed within the combined reference locations (Table 5-14). Percent DELTs within OU-4 sample locations ranged from 0% at the five most upstream OU-4 locations to 1.3% at ELA-2 for a total of 0.37% DELTs for the combined OU-4 sample locations. The instances of DELT anomalies was more than twice as high at the reference locations than the OU-4 locations, and six of the nine OU-4 locations had no DELT anomalies while all three of the reference locations had fish with DELTs. Moreover, the highest DELTs observed for OU-4 were found in the lower reach where PCB concentrations are lowest. Based on these results, the fish community within OU-4 appears healthy and is comparable in condition to the reference areas.

5.6.5 Bird Community

As discussed in Section 2.1, aquatic/semi-aquatic bird community surveys were conducted for OU-4. Using data from these surveys, aquatic/semi-aquatic bird communities along Choccolocco Creek were evaluated for significant differences between reaches (upper, middle, and lower). Aquatic bird communities were dominated by ducks, mallards, herons, egrets, and kingfishers. Community measures evaluated included abundance, richness, Shannon-Wiener Diversity, and Simpsons Dominance. Because birds were counted from a boat travelling from upstream to downstream, absolute values across habitats or between OU-4 and reference are not compared or interpreted, but rather relative differences between upper, middle, and lower reaches were evaluated. Trends were assessed with two-way ANOVA that tests if changes between reaches were different and evaluates if there is an interaction of the seasons on the effect of the location. Interaction terms were not included because of limited sample size (n = 1 for each season/habitat).

The results of the measures are presented in Tables 5-15a through 5-15d. The two-way ANOVA results are presented in Table 5-16. The results suggest that mean aquatic bird abundance, richness, diversity, and dominance do not differ significantly among reaches. Overall, the results suggest no effect of PCBs or other COPCs on the aquatic/semi-aquatic bird community. In addition, no upstream to downstream community trend was apparent.

As discussed in Section 2.1, terrestrial bird community surveys were conducted for OU-4. Using data from these surveys, terrestrial bird communities were compared between floodplain OU-4 and reference locations. Bird communities were dominated by eastern meadowlark (*Sturnella magna*), European starling (*Sturnis vulgaris*), cedar waxwing (*Bombycilla cedrorum*), Carolina chickadee (*Poecile carolinensis*), blue-

gray gnatcatcher (*Polioptila caerulea*), wren species (Troglodytidae), tufted titmouse (*Baeolophus bicolor*), blue jay, eastern bluebird (*Sialia sialis*), and eastern phoebe (*Sayornis phoebe*). Community measures evaluated for birds included abundance, richness, Shannon-Wiener Diversity, and Simpsons Dominance. Trends were assessed with three-way ANOVA with interaction terms that test if changes between OU-4 and reference were different among habitats or years. The measures were transformed if necessary, to meet assumptions of the parametric ANOVA model.

The results of the measures are presented in Tables 5-17a through 5-17d. The three-way ANOVA results are presented in Table 5-18. The results suggest that mean abundance and species richness are significantly higher in OU-4 than in the reference areas. Diversity and dominance do not significantly differ by location ($P>0.05$). Based on these results, the condition of the terrestrial bird community within OU-4 appears to be similar and possibly more diverse compared to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial bird community.

5.6.6 Mammal Community

As discussed in Section 2.1, aquatic/semi-aquatic mammal community surveys were conducted for OU-4. Using data from these surveys, aquatic/semi-aquatic mammal communities along Choccolocco Creek were evaluated for significant differences between reaches (upper, middle, and lower). Aquatic mammal communities were dominated by muskrat, raccoon and beaver. Community measures evaluated included abundance, richness, Shannon-Wiener Diversity, and Simpsons Dominance. Because mammals were counted from a boat travelling from upstream to downstream, absolute values across habitats or between OU-4 and reference are not compared or interpreted, but rather relative differences between reaches evaluated. Trends were assessed with two-way ANOVA that tests if changes between reaches were different and evaluates if there is an interaction of the seasons on the effect of the location. Interaction terms were not included because of limited sample size.

The results of the measures are presented in Tables 5-19a through 5-19d. The two-way ANOVA results are presented in Table 5-20. The results suggest that mammal abundance may show a decreasing trend from up to downstream in most seasons (Table 5-19a, Figure 5-4). However, other community measures (richness, diversity, dominance) did not significantly differ among reaches. Overall, the results suggest effect of PCBs or other COPCs on the aquatic/semi-aquatic mammal communities are unlikely.

As discussed in Section 2.1, terrestrial mammal community surveys were conducted for OU-4. Using data from these surveys, terrestrial mammal communities were compared between floodplain OU-4 and reference locations. Small mammals were trapped but are included in a separate analysis (see below). The terrestrial mammal community was dominated by white-tailed deer and coyotes, and nine-banded armadillo (*Dasypus novemcinctus*). Community measures compared were abundance, richness, Shannon-Wiener Diversity, and Simpsons Dominance. Mammal signs or observations of actual animals were counted in 2006 and 2007 across three habitats (forested floodplain, maintained field, successional field) on fixed width belt transects 200 meters (m) long. Transect widths varied by visibility in the habitat type (50 m in floodplain forest, 100 m in successional field, 200 m in maintained field). Note that mammal sign was not thoroughly searched in such a wide area and thus data should not be compared across habitat. Habitat is just included to adjust for its effect when evaluating location effects. Trends were assessed with three-way ANOVA that take into account habitat and year effects before assessing location affects. Interactions were not included due to limited number of observations. Sample size was small for

diversity and dominance (because no mammal sign on many transects), providing little power to detect differences for those measures.

Sample size was small for diversity and dominance (because there was no mammal sign on many transects), providing little statistical power to detect differences for those measures. The results of the measures are presented in Tables 5-21a through 5-21d. The two-way ANOVA results are presented in Table 5-22. Mean abundance and species richness were higher, although not significantly so, in OU-4 compared to reference. Diversity and dominance do not significantly differ between OU-4 and reference locations. Based on these results, the condition of the large mammal community within OU-4 appears to be similar to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial large mammal community.

Small mammal communities were compared between floodplain OU-4 and reference locations. Small mammal communities were dominated by the cotton mouse, hispid cotton rat, harvest mouse, deer mouse, and house mouse (*Mus musculus*). Community measures compared were abundance, richness, Shannon-Wiener Diversity, and Simpsons Dominance. Trends were assessed with Poisson GLM or three-way ANOVA with interaction terms that test if changes between OU-4 and reference were different among habitats or years. The measures were transformed if necessary, to meet assumptions of the parametric ANOVA model. Only the interaction of habitat and location could be included because reference areas were not sampled in fall 2006 or winter 2007. The sample size for reference locations consisted of six traplines (two in each habitat type) compared to 36 traplines in OU-4.

The results of the measures are presented in Tables 5-23a through 5-23d. The two-way ANOVA results are presented in Table 5-24. The ANOVA indicate mean abundance and species richness (Tables 5-23a and 5-23b), though lower in OU-4 than reference by 10% and 21%, respectively, do not significantly differ between reference and OU-4 locations. Diversity and dominance (Tables 5-23c and 5-23d) did not significantly differ by location, either ($P>0.05$, Table 5-24). Based on these results, the condition of the small mammal community within OU-4 appears to be similar compared to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial small mammal community.

6 OU-4 RISK CHARACTERIZATION

Section 6 Summary

The results of the MEs for each of the receptors are presented in this section as LOEs. For each receptor group, these LOEs vary in importance depending on the specific uncertainties inherent in the inputs to the evaluation. When applicable, the various LOEs include 1) HQs (based on abiotic media-specific benchmarks, modeled dietary exposures and TRVs, measured dietary exposures and TRVs, and/or , measured tissue COPC concentrations relative to CTCs), 2) site-specific toxicity bioassays for benthic invertebrates (evaluated as comparision of OU-4 sediment sample PCB and mercury concentrations to site-specific toxicity threhsolds developed based on the bioassays), 3) comparison of biological community metrics between OU-4 and reference habitats or within reaches, 4) comparison of site-specific COPC concentrations in soil, sediment, or biological tissue to concentrations in reference areas or among OU-4 AAs, and 5) qualitative ecological community evaluations.

PCBs and mercury are the only COPCs that appear to be elevated within OU-4 compared to reference concentrations and to also have an apparent upstream to downstream trend. PCBs are considered the primary driver of site-related risk within OU-4. One exception to this is for mercury in EU C2 sediment. A brief overview of PCB risk findings includes:

Ecological Community PCB HQ/Sample Comparison Summary

- Aquatic life HQs based on surface water AWQC are greater than 1 based on chronic criteria, but less than or equal to 1 based on acute criteria.
- Surface water HQs based on receptor-specific chronic criteria are all less than or equal to 1, except for aquatic plants in Snow Creek (C1).
- The majority of the surface sediment concentrations of PCBs in OU-4 (77%; n=268) are less than the lowest site-specific toxicity threshold for benthic invertebrates and 88% are less than the low risk threshold. Tissue LOAEL HQs for benthic invertebrates are less than or equal to 1.
- Fish tissue LOAEL HQs exceed 1 for predator fish throughout OU-4, for bottom fish in UAA and LAA, and for all fish in the LAA. Forage fish LOAEL HQs are equal to 1 throughout OU-4.
- Terrestrial plant NOAEL-equivalent HQs are less than or equal to 1, except in C1 West EU.
- Terrestrial invertebrate soil LOAEL HQs are less than 1, except in C1 West EU. Tissue LOAEL HQs for terrestrial invertebrates are less than or equal to 1.

Wildlife PCB HQ Summary

- Dietary modeled and measured HQs based on no-effect level TRVs are greater than 1 in the upper and middle reaches for most receptors, and greater than 1 throughout OU-4 for some receptors (primarily aquatic receptors).
- Dietary modeled and measured HQs based on LOAEL TRVs for piscivorous birds and mammals HQs were greater than 1 throughout OU-4.
- For non-piscivorous birds, dietary LOAEL HQs based on the mid-range sensitivity TRVs in the UAA reaches were generally greater than 1 but less than 10 and less than or equal to 1 in the lower reaches. HQs based on high-sensitivity TRVs were greater than 1 for terrestrial and aquatic birds in throughout OU-4.
- For non-piscivorous mammals, dietary LOAEL HQs were greater than 1 for the bat in the UAA reaches and most other HQs were less than or equal to 1 for the bat and other mammals.
- For mammals and birds, tissue-based HQs based on LOAEL CTCs were less than or equal to 1 for most receptors throughout OU-4, except for piscivorous birds throughout OU-4 and hawk in the UAA reaches based on the mid-sensitivity CTC. Piscivorous birds and hawk have LOAEL HQs greater than 1 throughout OU-4 based on the high sensitivity CTC.
- The highest modeled HQs are estimated for wildlife exposure to media in C1 West EU. Measured HQs were generally lower and less variable among the EUs than modeled HQs.

Community Metrics Summary

- Community metrics indicate that receptor communities within OU-4 are similar to or more robust than those observed in reference areas in most cases. In cases where reference comparisons could not be made, an up to downstream gradient of conditions was not observed indicating that variations in community were not PCB-related.

Risk characterization consists of three parts: (1) the risk estimation and description, which presents the results for the MEs for each AE; (2) the uncertainty analysis, which describes key uncertainties and whether they are likely to over or under estimate exposure or risk; and (3) the risk findings, which provide an integrated interpretation of the full group of MEs and their associated uncertainty for each AE to draw risk conclusions. This risk characterization is a WOE assessment based on an amalgamation of the existing data that are available for OU-4, and appropriate computations and interpretations utilizing those data.

A range of HQs and OU-4 sample comparisons provide the primary LOE used in this OU-4 BERA. The range includes:

1. HQs based on estimated EPCs in abiotic media compared to literature-derived benchmarks for lower trophic level organisms;

2. Individual sample concentration comparisons to site-specific toxicity thresholds for benthic invertebrates;

3. HQs based on dietary doses in wildlife food web models estimated using modeled prey tissue concentrations compared to literature-derived dietary TRVs;

4. HQs based on dietary doses in wildlife food web models estimated using measured prey tissue concentrations compared to literature-derived dietary TRVs; and

5. HQs based on measured biota tissue concentrations compared to literature-derived tissue-based CTCs.

Additionally, secondary LOEs included in this OU-4 BERA to support the risk characterization include:

1. Site-specific field survey data statistically evaluating potential differences in community metrics between the OU-4 AAs and reference habitat areas;

2. Comparisons between site-specific COPC concentrations in soil, sediment, or biological tissue to concentrations in reference areas; and

3. Observations and qualitative survey results for wildlife present in OU-4.

Risk estimates for each receptor group based on these LOEs are presented below in Section 6.1. Section 6.2 presents an evaluation of key uncertainties in the exposure and effects assumptions contained in this OU-4 BERA and their effect on the risk estimates. Section 6.3 contains the risk findings based on a WOE evaluation, which provides an integrated interpretation of the LOEs and their associated uncertainty for the evaluation of each AE.

6.1 Risk Estimation and Description

This section discusses the results for MEs for each of the seven AEs. The MEs represent the LOEs described above, by which each AE is assessed. For each receptor group, these LOEs vary in importance depending on the strengths of the data and specific uncertainties inherent in the inputs to the evaluation. The LOEs are described in more detail below and the WOE for the LOEs is discussed in Section 6.3.

Hazard Quotients

HQs are an important LOE for risk characterization when sufficient exposure and toxicity data exist. HQs are unitless ratios, calculated by dividing the receptor's estimated exposure by a comparable toxicity benchmark or TRV. Due to uncertainties in the uptake, toxicity, and exposure terms included in the calculation, HQs are reported only to one significant digit in this OU-4 BERA (for example, if the estimated HQ is 5.6, there is only enough confidence in the estimated HQ to report a value of 6).

For lower trophic-level receptors, the HQ is the ratio of the media-specific EPC and the receptor-specific toxicity benchmark:

$$HQ_x = \frac{EPC_x}{benchmark_x} \quad \text{Equation 5}$$

Where:

HQ_x	HQ for COPC "x" (unitless)
EPC_x	media-specific EPC for COPC "x" (mg/kg dw or mg/L)
$benchmark_x$	media-specific toxicity benchmark for COPC "x" (mg/kg dw or mg/L)

For wildlife in this OU-4 BERA, the HQ is the ratio of a modeled dietary daily dose or a measured tissue concentration to a comparable TRV. HQs based on modeled daily dose for wildlife are calculated as follows:

$$Dietary\ HQ_x = \frac{ADD_{x_{pot}}}{Dietary\ TRV_x} \quad \text{Equation 6}$$

Where:

Dietary HQ_x	HQ for COPC "x" based on dietary exposure (unitless)
ADD_{xpot}	potential average daily dose from COPC "x" (mg/kg BW-d) from Equation 1 (Section 4)
Dietary TRV_x	dietary TRV for COPC "x" for avian- or mammalian-specified receptor (mg/kg BW-d; Table 5-2b)

The dietary dose was estimated two ways: using prey tissue concentrations modeled from abiotic media EPCs and BAFs, and using measured tissue EPCs.

Biota tissue for mammals, fish, and invertebrates was collected in OU-4 BSAs and compared to CTCs to estimate tissue HQs. Bird eggs were not collected in OU-4, but egg COPC concentrations were estimated using abiotic media EPCs and BAFs. HQs for tissue-based exposures were calculated for bird eggs, small mammals, fish, and invertebrates as follows:

$$Tissuex_i\ HQ_x = \frac{Tissuex_i\ EPC_x}{Tissuex_i\ CTC_x} \quad \text{Equation 7}$$

Where:

$Tissue_i\ HQ_x$	HQ for COPC "x" for tissue "i" (unitless)
$Tissue_i\ EPC_x$	EPC from COPC "x" (mg/kg dw), and
For mammals, fish, invertebrates	$Tissue_i\ EPC_x$ = AA-wide 95%UCL for measured tissue
For bird eggs	$Tissue_i\ EPC_x = EPC_{x\ of\ s} * BAF_{x\ of\ i}$

Where:

$EPC_{x\ of\ s}$	EPC from COPC "x" (mg/kg dw) in soil or sediment;
$BAF_{x\ of\ l}$	soil/sediment-to-tissue "i" bioaccumulation factor from COPC "x" (unitless; see Equation 2); for egg tissue concentrations, TCo factors were used (see Section 4.4).
$Tissue_i\ CTC_x$	Tissue CTC for COPC "x" for tissue type (mg/kg dw; Table 5-2b)

For plants and soil invertebrates, HQs were calculated based on a single toxicity benchmark (Table 5-2b) representing a level at or below which adverse effects would not be expected (NOAEL-equivalent). For PCBs and mercury, LOAEL-equivalent soil benchmarks for invertebrates were also used to calculate HQs. For such receptors, interpretations of the exceedances of the benchmarks (which are conservative) are generally uncertain, and it is not clear whether an adverse effect would result. For aquatic life, HQs were estimated based on chronic and acute benchmarks (Table 5-2b). For benthic invertebrates, a range of site-specific toxicity thresholds (Table 5-2a) were compared to OU-4 sample concentrations of PCBs and mercury and samples were also compared to both TEC and PECs for all COPCs. HQs and sediment comparisons for lower plants and invertebrates are described in Sections 6.1.1 through 6.1.3. For fish, HQs were calculated based on comparison to water-based chronic and acute benchmarks and tissue-based exposure (Section 6.1.4). For birds and mammals, HQs were calculated based on modeled and measured dietary exposure as well as tissue-based exposure and are discussed in Sections 6.1.5 and 6.1.6. The risk calculations for birds and mammals are presented in Appendix E for metals and PCBs. The risk evaluation for PCDD/PCDFs and DL-PCBs was conducted separately and is presented in Appendix F. Qualitative evaluation of possible risk to amphibians and reptiles is discussed in Section 6.1.7.

Proper interpretation of HQs is critical to the risk assessment process and risk management decision-making. The NOAEL toxicity values represent a toxicological threshold below which there is high confidence in a finding of no unacceptable risk (i.e., risk is considered *de minimis*[12]). The LOAEL toxicity values represent a threshold above which risk is possible, and further evaluation may be needed. In between these two values, the exact concentration at which toxicological effects might be observed is uncertain.

Most NOAEL and LOAEL-based toxicity values reflect individual-level effects such as survival, growth, or reproduction of individual organisms in toxicity tests. Extrapolation from individual-level effects to population levels effects is uncertain. For this OU-4 BERA, LOAEL HQs greater than 1 based on individual-level effects were considered to indicate the potential for population-level impacts, and these LOAEL HQs were primarily used to evaluate non-threatened and endangered species for which protection at the population level is appropriate. For threatened and endangered species that potentially occur within

[12] *De minimis* risk is defined as negligible or not of societal concern (National Library of Medicine Toxicology Glossary - Risk De minimis Retrieved on August 11, 2011).

OU-4, protection at the individual level is warranted. NOAEL HQs were used in this OU-4 BERA to assess the potential for unacceptable risk to individuals of threatened and endangered species.

As described in detail in previous sections, a range of HQs was calculated for the receptors and COPCs evaluated in this OU-4 BERA. The HQs that were calculated are summarized in Table 6-1. Additionally, NOAEL-based HQs were calculated for PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ for birds, mammals, and fish, as described in Appendix F.

The HQ results for receptors exposed to media in reaches C1 through C10 are summarized for each AE below and presented in Tables 6-2a and 6-2b and 6-3a and 6-3b for aquatic receptors using literature-based dietary TRVs for birds and mammals. Table 6-4a and 6-4b and Figures 6-1 through 6-3 present a point-by point analysis of PCB, mercury, and non-mercury metals sediment concentrations relative to a range of site-specific toxicity thresholds for benthic invertebrates (Table 6-4a for PCBs and mercury) and relative to literature benchmarks (Table 6-4b for all COPCs). Dietary HQs are summarized in Tables 6-5a and 6-5b and 6-6a and 6-6b for terrestrial receptors, Tables 6-7a, 6-7b, 6-8a and 6-8b for wildlife with mixed diet of aquatic and terrestrial prey, and Tables 6-9 and 6-10 for modeled egg tissue-based HQs. Tables ending in “a” present NOAEL and LOAEL dietary HQs based on modeled prey tissue concentrations. Tables ending in “b” present NOAEL and LOAEL dietary HQs calculated using measured biota tissue concentrations as the dietary exposure term. NOAEL and LOAEL HQs calculated from tissue EPCs and tissue-based CTCs are presented in Table 6-11. HQs calculated for surface water exposures for lower trophic levels and fish are presented in Table 6-12. The detailed dose and HQ calculations for all receptors and reaches are presented in Appendix E for PCBs and metals. For dioxin TEQ, risks are estimated as presented in Appendix F and summarized below.

Evaluation of Community Metrics

Another important LOE/ME for risk characterization is the evaluation and interpretation of site-specific biological community data. It balances the information and findings interpreted from the direct measure of COPC concentrations within OU-4 and calculated HQs estimated from literature-based toxicity and exposure data with actual data on the apparent seasonal diversity and abundance of various receptors within OU-4, relative to the reference areas/conditions or relative to upstream or downstream site areas. As such, community data provide a real world check on apparent ecological “health” relative to the predicted potential population risks developed from the HQ LOEs. Community- and habitat-based MEs for each AE are outlined in Table 2-16 and the analysis conducted for each receptor group is summarized in Table 5-3. These MEs are both qualitative and quantitative, depending on the data type.

The risk estimates and risk description based on the HQs and community metrics (as identified in Table 2-16) for each of the AEs are discussed in Sections 6.1.1 through 6.1.7.

Comparison of COPCs in OU-4 vs. Reference Media

Comparisons of biotic media concentrations within the three primary OU-4 Areas (UAA, MAA, and LAA) to reference areas are an additional supporting LOE for the risk characterization. This ME is included for most AEs. Soil and sediment comparisons are also made to provide context for the tissue comparisons and include evaluation of Snow Creek (C1), the three AAs within Choccolocco Creek (UAA, MAA, and LAA), and reference areas. The specific biotic tissue sampling areas or BSAs within the three AAs are shown on Figures 3-3a through 3-3j and are summarized in Table 4-3. Reference comparisons and/or trends in the tissue and soil or sediment data are discussed in Sections 6.1.1 through 6.1.7 by COPC for

the AEs and MEs selected in the problem formulation. When sample sizes and/or number of detections were sufficient, a statistical analysis comparing the AAs to each other and to reference areas was conducted using one-way ANOVAs. For PCBs and mercury in sediment, soil, and all measured tissue types except for PCBs in grasshoppers/crickets, sample size was sufficient for statistical analysis (Tables 6-13, 6-14, and 6-15 respectively). In addition, the ANOVA was conducted for non-mercury metals in sediment (Table 6-13). Insufficient sample size or detections precluded quantitative analysis of non-mercury metals and PCDD/PCDF in soil and biotic tissues. For these COPCs, a qualitative evaluation of the AAs and reference areas is provided. Figures 6-4 through 6-9 present box plots of the soil, sediment, and tissue data for PCBs and mercury for OU-4 and reference locations. Figures 6-10 through 6-14 present box plots for the non-mercury metals in sediment and soil. For soil and sediment, box plots are provided that show the complete OU-4 BERA dataset as well as the dataset used for BAF development (i.e., the soil and sediment locations that were sampled concurrent with the tissue sampling as a part of the Phase 2 Ecological sampling). Figures 6-15 through 6-20 present the average soil or sediment and tissue concentrations of non-mercury metal and PCDD/PCDFs in the reference areas and three AAs (UAA, MAA, and LAA). Soil and sediment data included on these plots are from the Phase 2 sampling only for comparison to the associated tissue types.

Results for each of these LOEs for each of the AEs are discussed below.

6.1.1 AE 1: Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities

Risks to plants were evaluated based on four MEs (1a – 1d) as described below. The USFWS (2014) lists four threatened and endangered flowering plant species as potentially occurring within Calhoun County, Alabama. However, no threatened and endangered plant species have been recorded during surveys within OU-4. LOAEL HQs described below are considered appropriate for protection of plant populations within OU-4.

6.1.1.1 ME 1a: Concentrations of COPCs in OU-4 soils (including floodplain soils), surface water, and sediments relative to literature-based toxicity benchmarks for survival, growth, or reproduction.

Aquatic plants were quantitatively evaluated based on surface water concentrations compared to ADEM WQS and NAWQC. Because surface water was not measured in each EU and because of the dynamic nature of surface water, it is difficult to estimate EU-specific concentrations. Thus, the EPCs for surface water are based on the three AAs, reach C1, and the whole dataset for OU-4 (Table 4-14) and compared with the surface water benchmarks (Table 5-2b). As shown in Table 6-12, for aquatic life exposed to surface water, site-wide HQs based on chronic ADEM WQS/NAWQC are greater than 10 for PCBs, barium, lead, and mercury, when based on the methylmercury-based ADEM WQS. The site-wide HQ for mercury is equal to 1 when using the NAWQC chronic surface water benchmark. For the remaining COPCs, chronic HQs are less than or equal to 1. The HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs. The HQs based on chronic benchmarks specific to aquatic plants are all less than or equal to 1.

Aquatic plant HQs based on Snow Creek (C1) EPCs are similar to site-wide HQs (Table 6-12). For aquatic life, including aquatic plants, exposed to surface water, C1 HQs based on chronic ADEM WQS/NAWQC or Tier II aquatic life benchmark (Suter and Tsao 1996) are greater than 10 for PCBs, barium, lead, and mercury, when based on the methylmercury-based ADEM WQS. For the remaining COPCs, chronic HQs are less than or equal to 1 except for vanadium. The C1 HQ for mercury is equal to 1 when using the NAWQC chronic surface water benchmark. The C1 HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs, except barium (HQ=2). The C1 HQs based on chronic benchmarks specific to aquatic plants (available for PCBs, chromium, lead, and mercury) are all less than or equal to 1, except for PCBs (HQ=4).

For the UAA, MAA, and LAA, surface water HQs are lower than in Snow Creek. For UAA, aquatic life HQs based on chronic ADEM WQS/NAWQC are less than 1 except for PCBs and barium. Mercury and cobalt were not detected in UAA surface water. The UAA HQs based on the acute ADEM WQS are less than or equal to 1 for all detected COPCs. The UAA HQs based on chronic benchmarks specific to aquatic plants are all less than or equal to 1. For the MAA and LAA, aquatic life HQs based on chronic ADEM WQS/NAWQC are less than 1 except for PCBs and barium, and mercury based on the ADEM WQS in the LAA only. The MAA and LAA HQs based on the acute ADEM WQS/NAWQC and based on chronic benchmarks specific to aquatic plants are less than or equal to 1 for all COPCs.

For terrestrial plants exposed to soils (Table 6-5a), HQs were estimated using NOAEL-equivalent literature-based toxicity benchmarks (Table 5-2b). LOAEL-equivalent toxicity benchmarks were not available and therefore LOAEL-equivalent HQs could not be estimated for terrestrial plants. Plant NOAEL-equivalent HQs for PCBs are less than or equal to 1 in all the reaches/EUs and AAs except for C1 West EU, where the HQ is less than 10.

The HQs for all other COPCs are greater than 1, except for lead in most, and mercury in C2 Central and South EUs. The lead HQs that are greater than 1 are low in magnitude (i.e., less than or equal to 2). Chromium HQs are greater than 10 in all EUs, and range up to 55 in C3 South EU. Mercury HQs are greater than 1 in all EUs except C2 Central and South EUs and range up to 20. Vanadium HQs exceed 1 in all EUs and range up to 16. The uncertainties associated with the terrestrial plant benchmarks are discussed in Section 6.2.

6.1.1.2 ME 1b: Body burdens of COPCs in OU-4 plant tissue as compared to reference area(s) plant tissue.

PCBs were measured as homologs in aquatic and terrestrial plants. The average concentrations in plant tissue samples collected within or near the BSAs are presented on Figure 6-5a for aquatic plants and Figure 6-6 for terrestrial plants. For aquatic plants, PCBs were detected in all OU-4 AAs and in the reference areas. Mean reference area PCB tissue concentrations are statistically lower than mean PCB concentrations in UAA and MAA (Table 6-15). There are no statistically significant differences between mean aquatic plant concentrations within the OU-4 AAs (Table 6-15). For terrestrial plants, PCBs were detected infrequently, and only in the UAA (1 of 18 samples) and MAA (2 of 18 samples). Statistical differences between the AAs and reference areas were not detected. However, based on the very few detected samples, mean terrestrial plant concentrations are higher in the UAA than in the LAA (Table 6-15). The plant tissue PCB data collected from the BSAs indicates low (<2.0 mg/kg dw) plant PCB concentrations that are relatively consistent between the OU-4 Areas and the reference areas. This

pattern is not consistent with sediment and soil PCB concentrations, which are higher in the OU-4 Areas than in the reference areas (Tables 6-13 and 6-14, and Figure 6-4) and may indicate limited uptake of PCBs by plants.

Mean mercury concentrations in tissue samples collected within or near the BSAs are presented on Figure 6-8a for aquatic plants and Figure 6-9 for terrestrial plants. Mercury was detected infrequently in both aquatic and terrestrial plant tissue (Table 6-15). Mercury was not detected in terrestrial plants from the UAA and LAA and rarely detected in plants from the MAA (2 of 18 samples) and reference areas (2 of 14 samples). Mean reference area mercury concentrations in aquatic plant tissue are statistically lower than mean mercury concentrations in aquatic plants in the three OU-4 AAs, but there are no statistically significant differences between mean plant concentrations among the OU-4 AAs (Table 6-15). For terrestrial plants, there were no significant differences between mean terrestrial plant concentrations between the OU-4 AAs and reference areas, and among the OU-4 AAs (Table 6-15).

For non-mercury metals, the tissue datasets were too small to conduct statistical comparisons. Only qualitative comparisons were conducted. For aquatic and terrestrial plants, the average concentrations in tissue samples for each OU-4 Area and the reference areas are presented on Figures 6-15 through 6-19. For these metals, concentrations in the OU-4 Areas are generally similar to or lower than in the reference areas, suggesting that metals detected in plant tissue along Choccolocco Creek are not different from reference areas. One exception is lead in aquatic plant tissue, which is higher in OU-4 tissue than in reference area aquatic plant tissue. While mean lead in UAA aquatic plant tissue is higher than in the reference areas, mean tissue concentrations in the MAA and LAA are similar to those in the reference areas. Lead concentrations in sediment do not show the same decreasing trend. By comparison, terrestrial plant tissues collected in all OU-4 Areas and the reference areas contained lead detected above the RL only in the LAA, at concentrations very near the detection limit.

Datasets for TEQ were also insufficient for statistical comparisons. Instead, qualitative comparisons were conducted. For PCDD/PCDF TEQ (Figure 6-20), aquatic and terrestrial plant tissue from the reference areas is not available for comparison to OU-4 Area plant tissue, which was collected only in the UAA and MAA. For aquatic plants, mean tissue PCDD/PCDF TEQ concentrations are about 12 times higher in the UAA than in the MAA; however, mean sediment PCDD/PCDF TEQ concentrations are higher in the MAA than in the UAA. In terrestrial plants, mean PCDD/PCDF TEQ concentrations are lower in the UAA than in the MAA, but soil PCDD/PCDF TEQ concentrations are slightly higher in the UAA. Trends in the PCDD/PCDF TEQ data are difficult to discern due to the small sample size of the datasets, which consist of only one or two samples in each BSA.

6.1.1.3 ME 1c: Qualitative observations of plant condition and discoloration in OU-4 as compared to the reference area(s).

During the course of the Phase 1 and 2 ecological surveys and tissue sampling used to support this OU-4 BERA, incidental observations were made of plant condition. Field observers noted no apparent differences in plant condition between the OU-4 and reference area plant communities. In addition, no discoloration or stress was observed in OU-4 outside the normal plant life cycles and natural processes.

6.1.1.4 ME 1d: Comparison of aquatic/terrestrial plant community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- for each habitat type in OU-4 to the reference area(s).

As discussed in Section 5.6.1, terrestrial vegetation communities were evaluated for OU-4 by comparing measures of species richness, diversity, dominance, and overall plant cover between reaches and sampling periods. The results of these measures are presented in Tables 5-4a through 5-4e and Table 5-5. The results indicate significantly lower species richness and overall plant cover in the middle reaches (MAA) when compared to the upper reaches (UAA), suggesting that the differences in species richness and plant cover are not due to PCBs or other COPC concentrations alone as there is no apparent similar concentration difference in soil or sediment in the middle and upper reaches. Due to limited data, quantitative comparisons of floodplain OU-4 to reference conditions could not be made for vegetation communities. Overall, the results suggest no adverse effect of PCBs or other COPCs on vegetation communities within OU-4.

A quantitative evaluation could not be completed for aquatic plant communities. However, based on the field observations during the Phase 1 and 2 ecological surveys, the aquatic plant community within OU-4 and reference habitats surveyed appeared to be limited in availability and dominated primarily by alligator weed.

6.1.2 AE 2: Survival, Growth, and Reproduction of Benthic Invertebrate Communities

Risk to benthic invertebrate communities was evaluated based on three MEs (2a –2c) as described below.

6.1.2.1 ME 2a: Concentration of COPCs in OU-4 surface sediments compared to site-specific toxicity thresholds derived from the OU-4 sediment bioassay program for PCBs and mercury, and literature-derived toxicity benchmarks.

6.1.2.1.1 Sediment

For benthic invertebrates exposed to sediment (Table 6-4a and b and Figures 6-1, 6-2 and 6-3), individual OU-4 sample concentrations were compared to site-specific toxicity thresholds for PCBs and mercury. Site-specific toxicity thresholds were developed based on the OU-4 sediment toxicity testing program. For non-mercury metals, comparisons were made between OU-4 concentrations and literature-based toxicity benchmarks.

A point-by-point comparison was made for of each of 268 surface sediment samples in OU-4 with measured PCB concentrations to the site-specific toxicity thresholds. The results are summarized in Table 6-4a and on Figure 6-1. Sediments concentrations were compared to the EC0*, EC10*, and EC20* of the most sensitive endpoint (i.e., *Hyalella azteca* 42-day young/female [normalized to survival]). For total PCBs (mg/kg dw), only 4% of sediment samples would be classified as high risk (i.e., exceed EC20*) and these are mostly in reach C1 and C2. Another 7% are classified as moderate risk and 12% as low risk, while 77% of samples are below the EC0* value. For TOC-normalized PCBs, 67% are below the EC0* value. As discussed in Section 5.1, the low range of OC values in the majority of OU-4 sediment samples

makes the application of OC-normalization uncertain in terms of its influence on PCB concentrations. As such, these values are not useful for estimating exposure-based risk for benthic communities across OU-4. Sediments (n=91) were also compared to the site-specific mercury values (Table 6-4a Figure 6-2). Eighty percent of samples are below the EC20* value (1.0), which is very close to the PEC for mercury (1.1), indicating little risk to benthic invertebrates from mercury concentrations.

A point-by-point comparison was also made for PCBs and metals in sediment to literature-based toxicity benchmarks from MacDonald et al. (2000b). The number of samples exceeding the TECs and PECs are presented on Table 6-4b and in Figures 6-1 through 6-3. For PCBs, 40% of the 268 OU-4 surface sediment samples exceed the PEC. Sediment concentrations exceeding the PEC are distributed throughout OU-4, but only consistently exceed this value in reach C1 (i.e., Snow Creek). Seventy-nine percent of OU-4 surface sediment samples exceed the TEC. As noted above, sediment samples (n=91) were also compared to literature benchmarks for mercury (Table 6-4b and Figure 6-2). Only 20% of samples exceed the PEC, indicating little risk to benthic invertebrates from mercury concentrations, and 88% of sediment samples exceed the mercury TEC values. The literature-based benchmarks for PCBs and mercury are presented for informational purposes in this OU-4 BERA, but are of limited relevance for OU-4 because site-specific toxicity thresholds were developed based on a dose-response from sediment toxicity tests conducted with OU-4 sediment containing a range of PCB concentrations.

The site-specific toxicity thresholds clearly demonstrate that the literature benchmarks are overly conservative and not applicable to OU-4. This is further corroborated when considering that the USFWS (2015) found that bivalves are less sensitive to OU-4 sediments than either the midge or amphipod evaluated under the site-specific sediment toxicity program. This is important, as two threatened and endangered mollusc species have been observed within Choccolocco Creek and may be found in OU-4. These include the painted rocksnail and Tulotoma snail. The USFWS (2014) lists eight threatened and endangered clam species as potentially occurring within Calhoun County, Alabama. In addition, one sensitive snail species, Wicker Ancylid limpet, formerly thought to be extinct, has been observed in lower Choccolocco Creek (Zielinski 2011). The presence of these animals in OU-4 is indicative of the quality of habitat and health of the system.

For benthic invertebrates exposed to non-mercury metals in sediment, no OU-4 samples exceed the PECs for chromium or lead (Table 6-4b and Figure 6-3). Only 7% of sediment samples (one sample in reach C1 and one sample in reach C5) exceed the chromium TEC, and 18% of sediment samples (five total samples throughout OU-4) exceed the lead TEC. In addition, the results of the AVS-SEM analysis (discussed in Section 5.1) showed that divalent metals are not likely bioavailable in OU-4 sediments (see Table C-2). For these reasons, risk to benthic invertebrates from these metals in OU-4 is expected to be low. Sediment benchmarks are not currently available for barium, cobalt, and vanadium. These COPCs are discussed in the uncertainty analysis (Section 6.2).

6.1.2.1.2 Surface Water

In addition to the sediment-based analysis, the ME for benthic invertebrates specifies that surface water exposures be evaluated. However, the ADEM WQS and NAWQC are based on aqueous toxicity testing data for species that inhabit the water column (including aquatic plants, invertebrates, and fish). These benchmark values were not derived for benthic species and do not apply to benthic invertebrates. As benthic invertebrate exposure to COPCs is primarily via the sediment, evaluation of surface water

concentrations was not considered to be as useful for predicting toxicity as evaluation of sediment concentrations. Surface water benchmarks for benthics are not available and exposure to surface water is a less important route of exposure for these species, however, surface water HQs are provided to assess aquatic invertebrates potentially inhabiting the water column in Choccolocco Creek, and as an uncertain estimate of risk to benthic invertebrates due to surface water exposure.

Aquatic invertebrates as part of aquatic life were evaluated based on surface water concentrations compared to ADEM WQS and NAWQC. HQs based on Snow Creek (C1) EPCs are similar to site-wide HQs (Table 6-12). For aquatic life, including aquatic invertebrates, exposed to surface water, C1 HQs based on chronic ADEM WQS/NAWQC are greater than 10 for PCBs, barium, lead, and mercury, when based on the methylmercury-based ADEM WQS. For the remaining COPCs, chronic HQs are less than or equal to 1 except for vanadium. The C1 HQ for mercury is equal to 1 when using the NAWQC chronic surface water benchmark. The C1 HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs, except barium (HQ=2). The C1 HQs based on chronic benchmarks specific to aquatic invertebrates (available for PCBs, cobalt, mercury, and vanadium) are all less than or equal to 1, except for cobalt (HQ=3).

For the UAA, MAA, and LAA, surface water HQs are lower than in Snow Creek. For UAA, aquatic life HQs based on chronic ADEM WQS/NAWQC or Tier II aquatic life thresholds (Suter and Tsao 1996) are less than 1 except for PCBs and barium. Mercury and cobalt were not detected in UAA surface water. The UAA HQs based on the acute ADEM WQS are less than or equal to 1 for all detected COPCs. The UAA HQs based on chronic benchmarks specific to aquatic invertebrates are all less than 1. For the MAA and LAA, aquatic life HQs based on chronic ADEM WQS/NAWQC are less than 1 except for PCBs and barium, and mercury based on the ADEM WQS in the LAA only. The MAA and LAA HQs based on the acute ADEM WQS/NAWQC and based on chronic benchmarks specific to aquatic invertebrates are less than or equal to 1 for all COPCs.

Uncertainty associated with using the aquatic invertebrate benchmarks for benthic invertebrate exposure to COPCs in surface water is discussed in Section 6.2.

6.1.2.2 ME2b: Measured body burdens of COPCs in OU-4 benthic invertebrate tissue as compared to reference area(s) benthic invertebrate tissue and literature-derived CTCs, as available.

6.1.2.2.1 Comparison to Tissue CTCs

COPC concentrations were measured in aquatic invertebrate tissue collected in OU-4, including for benthic invertebrates (odonatan larvae), emergent insects, molluscs, and crayfish. Tissue EPCs were calculated for each AA (Table 4-15), and were compared to NOAEL and LOAEL CTCs derived for these tissues for PCBs and mercury (Table 5-2b). For PCBs and mercury, tissue NOAEL and LOAEL HQs are less than 1 in all AAs and tissues (Table 6-11).

6.1.2.2.2 Comparison to Reference

PCBs were measured as total homologs in benthic invertebrates. PCB concentrations in benthic invertebrate tissue samples collected within or near the BSAs are presented on Figures 6-5a and 6-5b.

PCBs were detected in all OU-4 Areas. Mean tissue PCBs follow a general decreasing trend when moving away from the Facility in a downstream direction for most tissue types. Statistically significant differences among the AA mean concentrations exist for benthic invertebrates (odonata) and crayfish for which the UAA and MAA means are greater than the LAA mean concentrations, and for emergent insects for which the UAA mean is greater than the MAA and LAA mean concentrations (Table 6-15). No significant differences were apparent among the AA means for mollusc tissue. However, for all four tissue types (odonata, emergent insect, crayfish, and mollusc), all tissue concentrations in all OU-4 AAs were significantly greater than in reference areas. Note that PCBs were not detected in benthic invertebrate tissue in the reference areas. Tissue PCB concentrations in benthic invertebrates follow generally the same trend as sediment PCB concentrations measured as total Aroclors (Figure 6-5), which show a decreasing trend in the downstream direction.

Mean mercury concentrations in benthic invertebrate tissue samples collected within or near the BSAs are presented on Figures 6-8a and 6-8b. Mercury was detected in benthic invertebrate tissue in all OU-4 Areas and the reference areas. Mean mercury concentrations in the four benthic invertebrate tissues (odonatan, emergent insects, crayfish, and molluscs) are higher in the OU-4 AAs than in reference areas, except for emergent insects in the MAA and molluscs in the MAA and UAA (Table 6-15). This is consistent with mercury concentrations in sediment, which are higher in OU-4 AAs than in reference areas (Table 6-13 and Figure 6-7). Pairwise comparison among the OU-4 AAs indicate that mercury concentrations in odonatan larvae are higher in the LAA and MAA than in the UAA, and that mercury concentrations in molluscs are higher in the LAA than in the UAA and MAA. There was no statistically significant difference between mean mercury tissue concentrations among AAs for emergent insects or crayfish. A decreasing trend in the downstream direction is not apparent for mercury in benthic invertebrate tissue, which is consistent with the relatively similar mercury concentrations detected in sediment in the OU-4 Areas.

For non-mercury metals, the tissue datasets were not sufficient for statistical analysis. Qualitative comparisons are provided below. Average concentrations in benthic invertebrate tissue samples for each OU-4 Area and the reference areas are presented on Figures 6-15 through 6-19. For barium, chromium, cobalt, and vanadium, concentrations in the OU-4 Areas are generally similar to or lower than in the reference areas, differing by less than a factor of 2 between all BSAs. For lead, mean benthic invertebrate tissue concentrations are 2 to 3 times greater in the OU-4 Areas than in the reference areas, similar to lead concentrations in sediment. However, a concentration gradient is not apparent in any direction for lead in benthic invertebrate tissue or sediment.

Datasets for TEQ were also insufficient for statistical comparisons. Instead, qualitative comparisons were conducted. For PCDD/PCDF TEQ (Figure 6-20), benthic invertebrate tissue from the reference areas is not available for comparison to OU-4 tissue, which was collected only in the UAA and MAA. Mean tissue PCDD/PCDF TEQ concentrations are about two times higher in the UAA than in the MAA, whereas mean sediment PCDD/PCDF TEQ concentrations are similar between these two areas. Trends in the PCDD/PCDF TEQ data are difficult to discern due to the small sample size of the datasets, which consist of two samples in each BSA.

6.1.2.3 ME 2c: Comparison of benthic invertebrate community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s).

As discussed in Section 5.6, benthic invertebrate communities were statistically evaluated for OU-4 and compared to reference areas. This included measures of abundance, richness, tolerance, and diversity developed from 158 observations. The results of these analyses are presented in Tables 5-8a-e and 5-9, and Figure 5-2. The results of an ANOVA indicate there were some significant differences (P-value < 0.05) in benthic measures that were not consistent across habitats and seasons (Table 5-9). Abundance is similar or greater at OU-4 locations than reference. Taxa richness and diversity in OU-4 are similar to reference, with the exception of the fall 2006 event in the UAA. There are a few differences in the UAA compared to reference for EPT taxa and tolerance, but these are generally limited to one habit within an event. Percent EPT is equal or greater in OU-4 locations compared to reference. Therefore, there is no pattern of effects in OU-4 demonstrated by benthic measures. The results of an ANCOVA analysis on the community measures and PCB concentrations in similar habitats within a half mile distance of the sampling locations (Table 2-2) found no significant relationships. Based on these results of existing data, although there is variability in the benthic community for the two years evaluated, overall results suggest no adverse effect of PCBs or other COPCs on the benthic invertebrate community in OU-4. Overall condition within OU-4 can be considered comparable to reference areas.

6.1.3 AE 3: Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities

Risk to terrestrial invertebrates was evaluated based on three MEs (3a-3c) as described below. There are no known threatened and endangered terrestrial invertebrate species potentially occurring within Calhoun County, Alabama. LOAEL HQs described below are considered appropriate for protection of soil invertebrate populations within OU-4.

6.1.3.1 ME 3a: Concentrations of COPCs in OU-4 surface soils compared to literature-derived toxicity benchmark values.

For terrestrial invertebrates exposed to soils (Table 6-5a), HQs were estimated using NOAEL-equivalent literature-based toxicity benchmarks (Table 5-2b). LOAEL-equivalent toxicity benchmarks were not available for most COPCs except for PCBs and mercury, and therefore terrestrial invertebrate LOAEL-equivalent HQs were estimated only for PCBs and mercury (Table 6-6a). For terrestrial invertebrates exposed to soils (Table 6-5a), NOAEL-equivalent HQs are greater than 1 for most of the COPCs except for lead in all the reaches, mercury in C2 South EU, and PCBs in the MAA and LAA reaches (C5 – C10). For PCBs, NOAEL-equivalent HQs are mostly greater than 1, but less than 10 in Snow Creek (C1), the UAA, and most UAA EUs. Chromium HQs are all greater than 10 but mostly less than 100, and mercury HQs range from less than 1 to 59 in C3 Riparian EU with no apparent trend in the upstream or downstream direction.

LOAEL-equivalent HQs are less than 1 for PCBs in all AAs and EUs except C1 West (LOAEL HQ=6). For mercury, most EUs and AAs have HQs greater than 1, except for C2 South and Central EUs. Several EUs and AAs also have HQs greater than 10, with no apparent trend in the upstream to downstream direction.

Toxicity benchmarks are not available for vanadium; therefore, HQs could not be estimated. See Section 6.2 for a discussion of uncertainties associated with the available literature benchmarks and the lack of benchmarks for vanadium.

6.1.3.2 ME 3b: Measured body burdens of COPCs in OU-4 terrestrial invertebrate tissue as compared to reference area(s) terrestrial invertebrate tissue and literature-derived tissue-based CTCs, as available.

6.1.3.2.1 Comparison to Tissue CTCs

COPC concentrations were measured in terrestrial invertebrate tissue collected in OU-4, including for earthworms and terrestrial insects (grasshoppers and crickets). Tissue EPCs were calculated for each AA (Table 4-16), and were compared to NOAEL and LOAEL CTCs derived for these tissues for PCBs and mercury (Table 5-2b).

For PCBs, tissue NOAEL and LOAEL HQs are less than or equal to 1 for all AAs for earthworms (Table 6-11). PCBs were never detected in terrestrial insect tissue in the OU-4 AAs and therefore HQs were not calculated.

For mercury, tissue NOAEL and LOAEL HQs are less than 1 for all AAs and terrestrial invertebrate tissues.

6.1.3.2.2 Comparison to Reference

PCBs in terrestrial invertebrates were measured as total homologs. PCB concentrations in worms collected within or near the BSAs are presented on Figure 6-6. PCBs were not detected in OU-4 or reference area terrestrial insect tissue. Consistent with soil data (Figure 6-4), mean worm tissue PCBs follow a general decreasing trend when moving away from the Facility in a downstream direction. There were no statistically significant differences in mean worm PCB concentrations among the OU-4 AAs, however, UAA worms had higher PCB concentrations than in reference areas (Table 6-15). PCBs were not detected in worm tissue in the reference areas.

Mean mercury concentrations in terrestrial invertebrate tissue samples collected within or near the BSAs are presented on Figure 6-9. Mercury was detected in worms in all BSAs, but was detected in terrestrial insect tissue only in the LAA and UAA. Similar to PCBs, mean worm tissue mercury concentrations were not significantly different among OU-4 AAs, but UAA worms had higher mercury concentrations (about 10-fold) than in reference areas. For terrestrial insects, mean mercury tissue concentrations are similar in the UAA and LAA but only the UAA mean was significantly different from reference (Table 6-15). Mean mercury concentrations in terrestrial insect tissue are more than two orders of magnitude less than in worm tissue from the same OU-4 Areas, and do not indicate a close association with soil.

For non-mercury metals, the tissue datasets were not sufficient for statistical analysis. Qualitative comparisons are provided below. Average metal concentrations in terrestrial invertebrate tissue samples for each OU-4 Area and the reference areas are presented on Figures 6-16 for chromium, Figure 6-18 for lead, and Figure 6-19 for vanadium. For worms, chromium, lead, and vanadium, average tissue concentrations in the OU-4 AAs are generally higher than in the reference areas. However, a concentration gradient is not apparent in any direction for these metals. For chromium, mean worm tissue

concentrations are highest in the MAA and about 3 times greater in the OU-4 Areas than in the reference areas. Vanadium concentrations are similar, with mean concentrations in the OU-4 Areas less than 2 times greater than in the reference areas. It should be noted that soil concentrations are similar between the OU-4 Areas and the reference areas for chromium and vanadium. For lead, average worm tissue concentrations are highest in the MAA, about 4 times greater than in the LAA or UAA, and about 10 times greater than in reference area worm tissue. In comparison, mean soil lead concentrations are similar in the reference areas, LAA and MAA, differing by less than a factor of 2. Soil lead concentrations in the UAA are approximately 2 to 3 times higher than in the other areas. Terrestrial insect (grasshopper/cricket) tissue samples were collected only in the LAA and UAA. Chromium was not detected in terrestrial insects. Lead was detected in one UAA sample and vanadium was detected in both the UAA and LAA (one sample each was collected); however, all detected concentrations were less than 0.25 mg/kg dw.

No terrestrial invertebrate tissue samples were analyzed for dioxin TEQ and therefore, comparisons to reference areas cannot be made.

6.1.3.3 ME 3c: Comparison of terrestrial invertebrate community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s).

As discussed in Section 5.6.3, soil invertebrate communities were evaluated for OU-4 where measures for abundance, richness, diversity, and dominance were compared between OU-4 and reference locations. The results of these measures are presented in Tables 5-10a through 5-10d and Table 5-11. There are no differences between OU-4 and reference locations in mean abundance, diversity, and dominance while taxa richness was significantly higher in OU-4 than in the reference areas (Table 5-11). Based on these results, the condition of the terrestrial invertebrate community within OU-4 appears to be similar to or more robust in terms of diversity than that found in the reference areas. Overall, the results suggest no adverse effect of PCBs or other COPCs on the soil invertebrate community.

6.1.4 AE 4: Survival, Growth, and Reproduction of Fish Communities

Risk to fish communities was evaluated based on four MEs (4a – 4d) as described below. One threatened fish species, the blue shiner, has been observed in Choccolocco Creek and the USFWS (2014) lists the threatened pygmy sculpin, as potentially occurring within Calhoun County, Alabama. However, no threatened and endangered fish species have been observed within OU-4. LOAEL HQs described below are considered appropriate for protection of fish populations within OU-4.

6.1.4.1 ME 4a: Concentration of COPCs in OU-4 surface water and sediment compared to literature-derived toxicity benchmark values.

Fish communities were evaluated based on surface water concentrations compared to ADEM WQS, NAWQC, and Tier II thresholds (Suter and Tsao 1996). These toxicity criteria and thresholds are protective of aquatic life, including fish. As noted above in Section 6.1.1.1, EPCs for surface water are based on data for Snow Creek (C1), the three AAs (UAA, MAA, LAA), and the entirety of OU-4 (Table 4-14) and compared with the ADEM WQS and NAWQC (Table 5-2b). For aquatic life (including fish) exposed to surface water (Table 6-12), site-wide HQs based on chronic benchmarks are greater than 10

for PCBs, barium, lead, and mercury, when based on the methylmercury-based ADEM WQS. The site-wide HQ for mercury is equal to 1 when using the NAWQC chronic surface water benchmark. For the remaining COPCs, chronic HQs are less than or equal to 1. The HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs. The site-wide HQs based on chronic surface water fish-specific toxicity benchmarks are all less than 1 except for lead.

Fish HQs based on Snow Creek (C1) surface water EPCs are similar to site-wide HQs (Table 6-12). For aquatic life, including fish, exposed to surface water, C1 HQs based on chronic ADEM WQS/NAWQC are greater than 10 for PCBs, barium, lead, and mercury, when based on the methylmercury-based ADEM WQS. For the remaining COPCs, chronic HQs are less than or equal to 1. The C1 HQ for mercury is equal to 1 when using the NAWQC chronic surface water benchmark. The C1 HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs, except barium (HQ=2). The C1 HQs based on chronic benchmarks specific to fish (available for COPCs except barium) are all less than or equal to 1, except for lead (HQ=4).

For the UAA, MAA, and LAA, surface water HQs are lower than in Snow Creek. For the UAA, aquatic life HQs based on chronic ADEM WQS/NAWQC are less than 1 except for PCBs and barium. Mercury and cobalt were not detected in UAA surface water. The UAA HQs based on the acute ADEM WQS are less than or equal to 1 for all detected COPCs. The UAA HQs based on chronic benchmarks specific to fish are all less than 1. For the MAA and LAA, aquatic life HQs based on chronic ADEM WQS/NAWQC are less than 1 except for PCBs and barium, and mercury based on the ADEM WQS in the LAA only. The MAA and LAA HQs based on the acute ADEM WQS/NAWQC and based on chronic benchmarks specific to fish are less than 1 for all COPCs.

Fish benchmark values for sediment were not available and therefore sediment HQs for fish were not calculated.

6.1.4.2 ME 4b: Body burdens of COPCs in selected fish species from OU-4 as compared to those in the reference area(s) and tissue-based CTCs as available.

6.1.4.2.1 Comparison to Tissue CTCs

Tissue HQs were calculated from measured fish tissue EPCs calculated for the OU-4 AAs (Table 4-15) and fish tissue CTCs for PCBs, mercury, lead, and vanadium (Table 5-2b). Four types of fish tissue EPCs were calculated, based on the three individual fish tissue types (forage fish, bottom fish, and predator fish) and a combined all fish tissue EPC. Tissue NOAEL and LOAEL HQs are presented in Table 6-11.

For PCBs, LOAEL HQs exceed 1 for predator fish in all AAs, for bottom fish in the UAA and LAA, and all fish in the LAA. Forage fish LOAEL HQs do no exceed 1 in OU-4 AAs. NOAEL HQs for fish exceed 1 in all AAs and fish types, and predator fish NOAEL HQs exceed 10 in all three AAs.

For mercury, NOAEL and LOAEL HQs are less than or equal to 1 in all OU-4 AAs for forage fish, bottom fish, and all fish. The predator fish NOAEL and LOAEL HQs slightly exceed 1 in all three AAs.

For lead, NOAEL and LOAEL HQs are less than or equal to 1 in all OU-4 AAs for forage fish, bottom fish, predator fish, and all fish.

Vanadium was not detected in all tissue samples, and therefore HQs were calculated only for a subset of the fish types. In the UAA, vanadium was detected in forage fish only. Forage fish LOAEL HQs are equal to 1, and NOAEL HQs are greater than 10. Vanadium was not detected in fish tissue collected from the MAA. In the LAA, LOAEL HQs for bottom fish, predator fish, and all fish are less than 1, and NOAEL HQs for these groups are slightly greater than 1. Vanadium was not detected in forage fish in the LAA.

Dioxin TEQ concentrations for PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ estimated in fish tissue were also compared to NOAEL-based tissue CTCs protective of fish, as described in Appendix F. DL-PCB TEQ, PCDD/PCDF TEQ, and total TEQ fish tissue concentrations do not exceed the fish CTCs in any OU-4 or reference samples.

6.1.4.2.2 Comparison to Reference

Measured fish tissue PCB concentrations were compared between the OU-4 AAs and the reference areas as shown on Figure 6-5c. For PCBs, total Aroclors were measured in fish tissue. Forage fish, bottom fish, and predator fish were collected where available. For forage fish, bottom fish, and predator fish, mean tissue concentrations are statistically higher in the OU-4 AAs than in the reference areas, but there are no significant differences among the mean tissue concentrations in any of the OU-4 AAs (Table 6-15). As would be expected based on feeding strategy, mean forage fish PCB concentrations are lowest relative to other fish types. Predator fish have the highest PCB concentrations in all BSAs. PCB concentrations in reference area fish tissue are one to two orders of magnitude lower than in OU-4 Area fish tissue. For all three fish tissue types, there is no apparent decreasing trend in mean fish tissue PCB concentrations in the downstream direction. This pattern is consistent with sediment data collected as part of the Phase II investigation that included the fish tissue samples (Figure 6-4). However, a slight decreasing trend is observed in sediment Aroclor data using the complete OU-4 BERA dataset (Figure 6-4).

For mercury (Figure 6-8c), mean fish tissue concentrations for all fish tissue types are significantly higher in the more downstream AAs than in the UAA, and mean fish tissue mercury concentrations in these downstream AAs (LAA for bottom fish, LAA and MAA for forage fish, and LAA and MAA for predator fish) are significantly higher than in the reference areas (Table 6-15). A decreasing trend in the downstream direction is not apparent for mercury in fish tissue. In sediment however, mean mercury concentrations are significantly higher in the OU-4 Areas than the reference areas (Table 6-13 and Figure 6-7), differing by approximately 27 times in reach C1 to approximately 100 times in the UAA. This suggests sediment mercury concentrations are modified by other site and/or biotic factors affecting uptake and bioaccumulation of mercury in fish tissue, such that sediment mercury concentrations do not accurately predict mercury burdens in fish. Thus, fish tissue mercury concentrations are a more reliable indicator of dose than doses estimated from mercury measured in sediment.

Mean fish tissue concentrations in each OU-4 Area and the reference areas are presented for non-mercury metals on Figures 6-15 through 6-19. Data were not sufficient for statistical analysis, and only qualitative comparisons are provided. Similar to other tissue types and sediment data, barium, chromium, cobalt, and vanadium concentrations in the OU-4 Areas are generally similar to or lower than in the reference areas, suggesting that metals detected in fish tissue along Choccolocco Creek are not different from the reference areas. For lead, a slight decreasing trend from UAA to LAA is suggested in bottom fish tissue; however, bottom fish tissue concentrations in the LAA and MAA are similar to those in the reference areas. Lead in predator fish is similar in all BSAs where tissue was collected. Mean lead

concentrations in forage fish tissue are about 7 times greater in UAA tissue than in LAA tissue; however, a definitive decreasing trend is not apparent, as forage fish tissue data are not available in the MAA or reference areas.

PCDD/PCDF TEQ data for the three fish tissue types are presented on Figure 6-20. Similar to the metals, dioxin data are not sufficient for statistical comparisons. PCDD/PCDF TEQ concentrations were not measured in all areas for all tissue types. Notably, only bottom fish tissue data are available from the reference areas and therefore, comparisons of fish tissue PCDD/PCDF TEQ between OU-4 and reference areas are limited. Mean PCDD/PCDF TEQ concentrations are quite variable and a spatial trend is not apparent. Similar to mean PCDD/PCDF TEQ concentrations in sediment, mean PCDD/PCDF TEQ concentrations are highest in the LAA for forage fish and predator fish. Mean forage fish tissue concentrations in the MAA and UAA are 9 and 62 times lower than in the LAA, respectively. For predator fish, mean PCDD/PCDF TEQ concentrations in UAA and reference areas are 5 and 52 times lower than in LAA, respectively. For bottom fish, which were collected in LAA and UAA only, mean PCDD/PCDF TEQ concentrations in LAA are about one-half bottom fish tissue concentrations in MAA.

6.1.4.3 ME 4c: Comparison of fish community structure metrics -- including species diversity, total abundance, number of taxa, and taxa dominance -- from OU-4 to the reference area(s).

As described in Section 5.6.4, fish communities were evaluated for OU-4 where measures for abundance, species richness, diversity, and dominance were compared between OU-4 and reference locations. The results of the measures are presented in Tables 5-12a through 5-12d, Table 5-13, and Figure 5-3. No differences in diversity are observed while the results for abundance and richness are equivocal. Simpson's dominance results indicate a significant interaction between habitat and location ($P = 0.051$), with backwaters having higher dominance in OU-4 than reference areas and the reverse for the creek runs (Table 5-12d and Figure 5-3). Based on these results, the condition of the fish community within OU-4 appears to be similar to that found in the reference areas and the results suggest no adverse effect of PCBs or other COPCs on the fish community, despite the higher relative fish tissue concentrations in OU-4 fish samples compared to reference fish tissue.

6.1.4.4 ME 4d: Fish health assessment using anomaly codes similar to those in the Rapid Bioassessment Protocol (Barbour et al. 1999). Observations may include disease, deformities, external parasites, fin erosion, lesions, tumors, sex ratio, and age structure.

As described in Section 5.6.4, DELT anomalies were assessed in fish from OU-4 and reference areas and results are presented in Table 5-14. Overall, the occurrence of DELT anomalies is low in fish communities from OU-4 and the reference locations. The percentage of fish with DELT anomalies at the reference locations is higher than those observed in OU-4 with the instances of DELT anomalies more than twice as high at the reference locations than the OU-4 locations. Based on these results, the fish community within OU-4 appears healthy and is comparable in condition to the reference areas, despite the higher relative fish tissue concentrations in OU-4 fish samples compared to reference fish tissue.

6.1.5 AE 5: Survival, Growth, and Reproduction of Birds

Risk to birds was evaluated based on three MEs (5a – 5c) as described below. The USFWS (2014) lists one threatened and endangered bird species (Red-cockaded woodpecker) as potentially occurring within Calhoun County, Alabama. However, no threatened and endangered birds have been observed within OU-4. LOAEL HQs described below are considered appropriate for protection of bird populations within OU-4.

6.1.5.1 ME 5a and 5c: Compare an estimated dietary daily dose of COPCs in prey base in OU-4 to relevant dietary TRVs and Compare predicted OU-4 egg COPC concentrations to egg-based TRVs and predicted concentrations in the reference area(s).

For OU-4, several aquatic and terrestrial birds were evaluated. In addition, birds with mixed aquatic and terrestrial diets were evaluated. A range of HQs were estimated for these receptors as shown in Table 6-1. For these receptors, the dietary NOAEL and LOAEL HQs are presented in Tables 6-2a 6-2b, 6-3a and 6-3b for aquatic receptors, Table 6-5a, 6-5b, 6-6a, and 6-6b for terrestrial receptors, and Tables 6-7a, 6-7b, 6-8a, and 6-8b for mixed diet receptors. Tables ending with an “a” correspond to modeled dietary HQs, whereas Tables ending with a “b” correspond to dietary HQs based on measured prey tissue concentrations. Additionally, because eggs were not collected in OU-4, modeled egg tissue NOAEL and LOAEL HQs were calculated and are presented in Tables 6-9 and 6-10, respectively. Summary tables for receptors, COPCs, and EUs/AAs with LOAEL HQs greater than 1 are provided in the section below. DioxinTEQ data were evaluated in Appendix F, with results summarized below.

Note that OU-4 tissue samples were collected only from some EUs in the UAA (C2, C3, and C4), MAA (C5), and LAA (C7). In the measured tissue HQ estimates presented in the sections below, AA-wide tissue EPCs are used in the HQ calculations for all EU and AA scenarios. For Snow Creek, UAA-wide tissue EPCs were selected to estimate measured HQs in C1 EUs. Uncertainties associated with this assumption are discussed in Section 6.2

6.1.5.1.1 Hazard Quotients

Aquatic Birds

Aquatic birds exposed to sediment and aquatic prey in the sediment EUs include the tree swallow (aquatic-feeding insectivore), spotted sandpiper-2 (aquatic ground-feeding invertivore), kingfisher-1 and -2 (piscivore), osprey (piscivore), and great blue heron (wading carnivore). For these receptors, the modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-2a through 6-3b. The modeled egg tissue NOAEL and LOAEL HQs are presented in Tables 6-9 and 6-10, respectively. A comparison of the three types of HQs (modeled dietary, measured dietary, and modeled tissue) is presented in Tables 6-16a through 6-16d for PCBs based on mid-sensitivity TRVs/CTCs, PCBs based on high-sensitivity TRVs/CTCs, mercury, and metals, respectively. Only receptors, EUs, and COPCs with LOAEL HQs greater than 1, which indicate the potential for risk to aquatic bird populations, are summarized in Tables 6-16a through 6-16d. For the remaining receptors, EUs, and COPCs, estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than or equal to 1) or *de minimis* (NOAEL HQs less than or equal to 1).

For PCBs based on mid-sensitivity TRVs/CTCs (Table 6-16a):

- Modeled dietary LOAEL HQs exceed 1 for all aquatic avian receptors in one or more EUs or AAs. The highest modeled HQs are in reaches C1 and C2, where modeled HQs exceed 10 for all aquatic birds based on the mid-sensitivity TRV. The elevated HQs in reaches C1 and C2 are due primarily to the generally higher sediment concentrations in these EUs relative to more downstream areas of OU-4. For reach C2, note that modeled LOAEL HQs based on UAA-wide sediment EPCs exceed 10 only for the tree swallow and great blue heron. For most receptors, modeled LOAEL HQs are at or below 2 in the downstream EUs (C5 through C10), and for modeled LOAEL HQs based on MAA- and LAA-wide EPCs. Modeled NOAEL HQs are less than or equal to 1 for tree swallow in the MAA, LAA, and associated EUs. NOAEL HQs are also less than or equal to 1 for most aquatic receptors in reach C6 and for kingfisher–2 and osprey in reach C9.
- Measured dietary LOAEL HQs exceed 1 for the piscivorous avian receptors in all EUs and AAs, with no clear upstream to downstream trend. This is due to the use of AA-wide measured fish tissue EPCs, which are relatively constant in OU-4. Measured LOAEL HQs for tree swallow also exceed 1 in Snow Creek (C1), the UAA and UAA EUs (C2 through C4). Measured LOAEL HQs are generally lower than modeled dietary HQs. Measured NOAEL HQs are less than or equal to 1 for the spotted sandpiper–2 in reaches C3 through C10, and for the tree swallow in the MAA, LAA, and associated reaches.
- Modeled Egg LOAEL HQs exceed 1 only for piscivorous receptors in some of the EUs. Egg LOAEL HQs exceed 10 for the great blue heron and osprey in reaches C1 and C2, and great blue heron in C4 and the UAA. LOAEL HQs exceed 1 for kingfisher (1 and 2) in reaches C1 and C2, and osprey and great blue heron in some of the MAA and LAA reaches. NOAEL HQs are less than or equal to 1 for tree swallow, spotted sandpiper–2, and kingfisher (both scenarios) in most EUs/AAs downstream of reach C2.

For PCBs based on high-sensitivity TRVs/CTCs (Table 6-16b):

- Modeled dietary LOAEL HQs exceed 10 for all aquatic avian receptors in one or more EUs or AAs. Most EUs and AAs have LOAEL HQs greater than 10 for all receptors, except the tree swallow which has LOAEL HQs greater than 10 only in Snow Creek (C1, the UAA, and UAA reaches [C2-C4]). The highest modeled LOAEL HQs are in reaches C1 and C2, where modeled LOAEL HQs exceed 100 for all aquatic birds based on the high-sensitivity TRV. Modeled LOAEL HQs based on UAA-wide sediment EPCs exceed 10 for all aquatic avian receptors. Only tree swallow has NOAEL HQs less than or equal to 1 in two reaches (C6 and C9).
- Measured dietary LOAEL HQs exceed 10 for the piscivorous avian receptors in all EUs and AAs, with no clear upstream to downstream trend. This is due to the use of AA-wide measured fish tissue EPCs, which were relatively constant in OU-4. Measured HQs for tree swallow also exceed 10 in reach C1, the UAA, and UAA EUs (C2 through C4). Measured HQs for spotted sandpiper-2 exceed 1 in all EUs and AAs. Measured HQs are generally lower than modeled dietary HQs. NOAEL HQs exceed 1 for all receptors in all EUs.
- Modeled Egg LOAEL HQs based on the high sensitivity CTC exceed 10 for all receptors in reach C1, for osprey and great blue heron in most EUs and AAs, and kingfisher (both scenarios) in C2 and the UAA. LOAEL HQs are also greater than 1 for kingfisher (both scenarios) and spotted sandpiper - 2 in most EUs and AAs. Tree swallow LOAEL HQs greater than 1 but less than or equal to 10 are limited

to reaches C2, C4, and the UAA. For tree swallow, the EUs associated with MAA and LAA have LOAEL and NOAEL HQs less than or equal to 1. NOAEL HQs for spotted sandpiper–2 and kingfisher–2 also have NOAEL HQs less than or equal to 1 in reach C6.

For mercury (Table 6-16c):

- Modeled dietary LOAEL HQs are less than or equal to 1 for most receptors and EUs/AAs. LOAEL HQs exceed 1 for spotted sandpiper–2 in all EUs except reach C1; although, most HQs are low in magnitude (≤ 3). In reach C2, HQs are near or greater than 10 for all aquatic avian receptors. The UAA HQs also exceed 1 for five of the six receptors. NOAEL HQs are less than or equal to 1 for tree swallow in the MAA, MAA EUs (C5 through C6), and most LAA EUs. NOAEL HQs are also less than or equal to 1 for osprey in most EUs, and for kingfisher (both scenarios) in reaches C1, C3, and C4, and for great blue heron in reach C1.
- Measured dietary LOAEL HQs are less than or equal to 1 for tree swallow and osprey in all EUs/AAs, and for kingfisher–2 except in reach C2. Kingfisher–1 and spotted sandpiper–2 also had LOAEL HQs greater than 1 in LAA and the LAA EUs (C7 through C10), and great blue heron LOAEL HQs were greater than 1 in all EUs/AAs; however, these LOAEL HQs are low in magnitude. The only LOAEL HQ greater than 10 was for spotted sandpiper–2 in reach C2. NOAEL HQs are less than or equal to 1 only for kingfisher–1 in reaches C1, C3, and C4.
- Modeled egg LOAEL HQs exceed 1 only for osprey and great blue heron in reach C2, and great blue heron using UAA-wide sediment EPCs. All other receptors and EUs/AAs have *de minimis* risk (NOAEL HQs less than or equal to 1), as estimated using modeled egg concentrations.

For other metals (Table 6-16d):

- Modeled dietary LOAEL HQs exceed 1 for some receptors-COPC pairs in some EUs/AAs, with no obvious spatial trends. LOAEL HQs are greater than 1 for the most metals (barium, chromium, lead, and vanadium) and receptor pairs in reaches C5 and C6, and the MAA-wide area. For chromium, tree swallow LOAEL HQs are greater than 1 in all EUs and AAs except for reaches C7 and C8. For vanadium, spotted sandpiper–2 LOAEL HQs are greater than 1 in all EUs/AAs except reaches C4, C7, and C8. For the remaining receptors and metals with LOAEL HQs greater than 1, most EUs have HQs less than or equal to 1, exceedances low in magnitude (≤ 3), and do not follow an upstream to downstream trend. NOAEL HQs are less than or equal to 1 for all metals and receptor pairs in reaches C7 and C8, and for many other EUs/AAs throughout OU-4.
- Measured LOAEL HQs are less than or equal to 1 for all metals, receptors, and EUs/AAs except for spotted sandpiper–2 and vanadium, for which low magnitude HQs (≤ 3) are estimated in a few EUs and all four areas (C1, UAA, MAA, LAA). Except for spotted sandpiper-2 for lead and vanadium, all metals and receptor pairs have NOAEL HQs less than or equal to 1. For spotted sandpiper-2 and lead, a few EUs in reach C1, the UAA, and MAA have NOAEL HQs greater than 1, but LOAEL HQs less than or equal to 1. For spotted sandpiper -2 and vanadium, only reaches C7 and C8 have NOAEL HQs less than or equal to 1.

For dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.

- For aquatic birds in all AAs, all PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ NOAEL HQs were less than or equal to 1.

Terrestrial Birds

Terrestrial birds exposed to soil and terrestrial prey in the floodplain soil EUs include the mourning dove (herbivore), blue jay (omnivore), the Carolina wren-1 (ground-feeding invertivore), and the red-tailed hawk (carnivore). For these receptors, the modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-5a through 6-6c. The modeled egg tissue NOAEL and LOAEL HQs are presented in Tables 6-9 and 6-10, respectively. A comparison of the three types of HQs (modeled dietary, measured dietary, and modeled tissue) is presented in Tables 6-17a through 6-17d for PCBs, mercury, and metals, respectively. Only those receptors, EUs, and COPCs with LOAEL HQs greater than 1, which indicate the potential for risk to terrestrial bird populations, are summarized in Tables 6-17a through 6-17d. For the remaining receptors, EUs, and COPCs, estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than or equal to 1) or *de minimis* (NOAEL HQs less than or equal to 1).

For PCBs based on mid-sensitivity TRVs (Table 6-17a):

- Modeled dietary LOAEL HQs are less than or equal to 1 in most EUs/AAs. LOAEL HQs greater than 1 were estimated for Carolina wren–1 and hawk in Snow Creek (C1), the UAA, and most UAA EUs (C2 through C4). Blue jay and mourning dove also have LOAEL HQs greater than 1 in C3 South and C3 North (blue jay only). LOAEL HQs exceed 10 for all terrestrial avian receptors in C1 West. The elevated HQs in C1 are due primarily to the generally higher soil concentrations in this EU relative to other areas of OU-4. Modeled LOAEL HQs based on UAA-wide sediment EPCs are lower in magnitude than for the individual UAA EUs (C2 through C4). For all receptors, modeled LOAEL HQs are less than or equal to 1 in the downstream EUs (C5 through C10), and for modeled LOAEL HQs based on MAA- and LAA-wide EPCs. Modeled NOAEL HQs are less than or equal to 1 for most receptors in most MAA EUs (C5 through C6), for mourning dove and blue jay in most C2 EUs, and for Carolina wren-1 in C2 South EU.
- Measured dietary LOAEL HQs are less than or equal to 1 for mourning dove and blue jay in all EUs/AAs except C1 West. Additionally, LOAEL HQs exceed 1 for the Carolina wren–1 and hawk in reach C1, the UAA, and UAA EUs (C2 through C4), and in the MAA and MAA EUs (C5 and C6) for the hawk. Similar to the results for aquatic birds, measured HQs are generally lower than modeled dietary HQs. NOAEL HQs are less than or equal to 1 for mourning dove in reach C1 East, the UAA and MAA EUs (C1 through C6, except for C1 West), and for blue jay and Carolina wren–1 in C5 and C6 EUs.
- Modeled Egg LOAEL HQs exceed 1 only for two receptors in some of the EUs. Egg LOAEL HQs exceed 10 for the hawk in C1 EUs, and exceed 1 for some UAA EUs. Blue jay LOAEL HQs exceed 1 in C1 West only. NOAEL HQs were less than or equal to 1 for mourning dove, blue jay, and Carolina wren–1 in reaches C1 through C6 (except for C1 West). NOAEL HQs for hawk were also less than or equal to 1 in C5 and C6 EUs.

For PCBs based on high-sensitivity TRVs (Table 6-17b):

- Modeled dietary LOAEL HQs greater than 10 were estimated for Carolina wren–1 and hawk in Snow Creek (C1), the UAA, and most UAA EUs (C2 through C4), and C6 South for Carolina wren–1, and the remaining EUs and AAs have LOAEL HQs greater than 1 but less than or equal to 10, except for

C9 South, which have a LOAEL HQ less than or equal to 1. Blue jay also has LOAEL HQs greater than 10 in C1 EUs, the UAA, and some UAA EUs, and LOAEL HQs greater than 1 in most MAA and LAA EUs. Mourning dove LOAEL HQs greater than 10 are limited to C1 West and C3 South, and LOAEL HQs greater than 1 were estimated for most remaining UAA EUs. Modeled LOAEL HQs based on UAA-wide sediment EPCs are lower in magnitude than in the individual EUs. Modeled NOAEL HQs are less than or equal to 1 only for mourning dove and blue jay in C9 South EU and for mourning dove in C2 South EU.

- Measured dietary LOAEL HQs greater than 10 were estimated for the hawk in all EUs and AAs, and for the Carolina wren–1 in C1, the UAA, and UAA EUs (C2 through C4). Carolina wren–1 LOAEL HQs for the remaining MAA and LAA EUs and AAs are greater than 1 but less than or equal to 10. For the blue jay, LOAEL HQs are greater than 1 in C1, the UAA, and UAA EUs (C2 through C4), except for C1 West and C3 South, which have LOAEL HQs greater than 10. LOAEL HQs are less than or equal to 1 for mourning dove in most EUs except for C1 EUs, and C3 EUs and the UAA. Measured LOAEL HQs are generally lower in magnitude than modeled dietary LOAEL HQs. Measured NOAEL HQs are less than or equal to 1 only for mourning dove in C2 South .
- Modeled egg LOAEL HQs based on the high-sensitivity TRV exceed 1 for hawk in most EUs and AAs, and exceed 10 in C1, the UAA, and UAA EUs (C2 through C4). For the remaining receptors, all three have LOAEL HQs greater than 10 in C1 West, and greater than 1 but less than or equal to 10 in C3 South (and C3 North for the blue jay). For these receptors (mourning dove, blue jay, and Carolina wren–1), the remaining EUs and AAs have LOAEL HQs less than or equal to 1. Additionally, NOAEL HQs are less than or equal to 1 for mourning dove, blue jay, and Carolina wren–1 in the MAA, LAA, and associated EUs (C5 through C10 EUs) as well as in some C2 EUs.

For mercury (Table 6-17c):

- Modeled dietary LOAEL HQs exceed 1 in most EUs and AAs (except C2 South) for Carolina wren–2. Modeled LOAEL HQs for the remaining receptors and EUs/AAs are primarily low in magnitude (≤ 3) or less than or equal to 1. NOAEL HQs less than or equal to 1 were estimated for mourning dove and hawk in many OU-4 EUs/AAs, with no clear spatial pattern to the HQs. Blue jay NOAEL HQs less than or equal to 1 were also estimated for C2 South and Central EUs. Mercury was not measured in floodplain soil in C1 and floodplain soil was not sampled in C10.
- Measured dietary LOAEL HQs are similar in magnitude to the modeled dietary HQs. Measured LOAEL HQs are less than or equal to 1 in all EUs/AAs for mourning dove, and less than or equal to 1 or low in magnitude (≤ 3) for all EUs/ AAs for blue jay and hawk. LOAEL HQs for Carolina wren–2 exceed 1 in all EUs and AAs, and HQs exceed 10 in C3 North and C3 South. Similar to the modeled HQs, NOAEL HQs less than or equal to 1 were estimated in some EUs/AAs for hawk and mourning dove, but no spatial trend is apparent.
- Modeled egg NOAEL and LOAEL HQs are less than or equal to 1 for all terrestrial avian receptors and EUs/AAs.

For other metals (Table 6-17d):

- Modeled dietary LOAEL HQs exceed 1 only for Carolina wren-1 for chromium, lead, and vanadium in some EUs/AAs. For vanadium, LOAEL HQs are greater than 1 in all EUs/AAs. For chromium and

lead, LOAEL HQs greater than 1 were estimated in a few EUs, but most exceedances are low in magnitude (≤ 3), and did not follow an upstream to downstream trend. Chromium NOAEL HQs less than or equal to 1 were estimated for Carolina wren-1 for most EUs. For lead, NOAEL HQs were estimated in five EUs throughout OU-4. Metals were not measured in floodplain soil in C1 and floodplain soil was not sampled in C10.

- Measured LOAEL HQs are greater than 1 for Carolina wren–1 for vanadium and lead in all EUs and AAs, and chromium in three UAA EUs. An upstream to downstream trend is not apparent for these HQs, and the magnitude of the LOAEL HQs is low (≤ 3) for chromium and vanadium. For chromium, NOAEL HQs less than or equal to 1 were estimated for the MAA, LAA and most OU-4 EUs.

For Dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.
- For PCDD/PCDF TEQ and DL-PCB TEQ, HQs were less than or equal to 1 for all terrestrial birds in all AAs. For total TEQ, HQs exceeded 1 only for Carolina wren - 1 (and mixed diet scenario 2, as discussed below) in the LAA when based on the total TEQ EPC. When the total TEQ HQ is calculated using the sum of the PCDD/PCDF HQ and DL-PCB HQ (toxicity unit approach), Carolina wren total TEQ HQs in the LAA are equal to 1.
- For the Carolina wren - 1, the majority of the contribution to the total TEQ concentration is from DL-PCBs, and total TEQ EPC resulting in a NOAEL HQ of 2 is considered to be unreliable due to characteristics of the total TEQ dataset.

Birds with Mixed Diets

As described in Section 4.5.2.1, mixed diet scenarios (assuming part terrestrial exposure and part aquatic exposure) were evaluated for spotted sandpiper–1 and Carolina wren–2. For spotted sandpiper–1, exposure for the terrestrial portion of the diet is assumed to occur in the riparian EUs. Similarly, the Carolina wren–2, which is assumed to feed on aquatic-feeding spiders and aquatic plants in addition to terrestrial invertebrates, was evaluated using the floodplain EUs for the terrestrial portion of the diet, and the aquatic portion of the diet was estimated using sediment.

For these receptors, the modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-7a through 6-8b. The modeled egg tissue NOAEL and LOAEL HQs are presented in Tables 6-9 and 6-10, respectively. A comparison of the three types of HQs (modeled dietary, measured dietary, and modeled tissue) is presented in Tables 6-18a through 6-18d for PCBs using the mid-sensitivity TRV/CTC, PCBs using the high sensitivity TRV/CTC, mercury, and metals, respectively. Only receptors, EUs, and COPCs with LOAEL HQs greater than 1, which indicates the potential for risk to bird populations, are summarized in Tables 6-18a through 6-18d. For the remaining receptors, EUs, and COPCs, estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than or equal to 1) or *de minimis* (NOAEL HQs less than or equal to 1).

For PCBs using the mid-sensitivity TRV/CTC (Table 6-18a):

- Modeled dietary LOAEL HQs are greater than 1 for both receptors in Snow Creek (C1), the UAA, and UAA EUs (C2 through C4). LOAEL HQs are less than or equal to 1 in all downstream (MAA and LAA) areas. HQs greater than 10 were estimated for Carolina wren–2 in C1 West and for spotted

sandpiper–1 in C2 Riparian. For reach C2, note that the UAA-wide LOAEL HQs are low in magnitude (≤ 3). NOAEL HQs less than or equal to 1 were estimated only for Carolina wren-2 in the MAA, LAA and most associated EUs (C5 through C10).

- Measured dietary LOAEL HQs are greater than 1 for both receptors in reach C1, the UAA, and UAA EUs (C2 through C4). NOAEL and LOAEL HQs are less than or equal to 1 in all downstream (MAA and LAA) areas. The measured HQs are similar to the modeled HQs, except for in areas with relatively high soil concentrations (C1 West and C2 Riparian).
- Modeled Egg NOAEL and LOAEL HQs are less than or equal to 1 for all mixed-diet avian receptors in all EUs and AAs.

For PCBs using the high sensitivity TRV/CTC (Table 6-18b):

- Modeled dietary LOAEL HQs are greater than 10 for both receptors in C1, the UAA, and UAA EUs (C2 through C4). LOAEL HQs are less than or equal to 1 in all downstream (MAA and LAA) areas. For the rest of the MAA and LAA EUs and AAs, LOAEL HQs for both receptors are greater than 1, except for the Carolina wren–2 in C9 South EU. No EUs or AAs have NOAEL HQs less than or equal to 1.
- Measured dietary LOAEL HQs follow the same exceedance pattern as the modeled HQs. LOAEL HQs are greater than 10 for both receptors in C1, the UAA, and all UAA EUs (C2 through C4). For the remaining AAs and EUs, LOAEL HQs are greater than 1 but less than or equal to 10.
- Modeled Egg LOAEL HQs are less than or equal to 1 for the Carolina wren–2 in the UAA, MAA, and LAA, and most EUs, except for C1 West. The MAA, LAA, associated EUs (C5 through C10), C3 North, and C2 South EUs have NOAEL HQs less than or equal to 1 for the Carolina wren–2. For the spotted sandpiper–1, LOAEL HQs are greater than 1 in C1, the UAA, and UAA Riparian EUs (C2 through C4). The MAA and LAA and associated EUs have NOAEL and LOAEL HQs less than or equal to 1 for spotted sandpiper–2.

For mercury (Table 6-18c):

- Modeled dietary LOAEL HQs for both receptors exceed 1 in all EUs and AAs. Modeled LOAEL HQs exceed 10 for the Carolina wren–2 in C2 North, South, and Central EUs, but are equal to 10 when using UAA-wide soil EPCs. For the spotted sandpiper–1, LOAEL HQs exceed 10 in C3 Riparian and C8 Riparian EUs, but are less than or equal to 10 for the UAA-wide and LAA-wide HQs.
- Measured dietary LOAEL HQs are similar in magnitude to the modeled dietary HQs. Measured HQs are greater than 1 in all EUs/AAs for both receptors. LOAEL HQs greater than 10 were estimated for Carolina wren-2 in C3 North and South EUs, and for spotted sandpiper–1 in the C2 Riparian EU.
- Modeled egg NOAEL and LOAEL HQs are less than or equal to 1 for both mixed diet receptors and all EUs/AAs.

For other metals (Table 6-18d):

- Modeled dietary LOAEL HQs exceed 1 for both receptors in all EUs and AAs for vanadium, most EUs and AAs for lead, and roughly half of the EUs for chromium. For lead and chromium however, HQs are low in magnitude (≤ 3) and do not follow an upstream to downstream trend. LOAEL HQs are less than or equal to 1 for both receptors in all EUs/AAs for barium and cobalt. All NOAEL HQs for vanadium

exceed 1. For lead, NOAEL HQs exceed 1 except for in C7 South for Carolina wren–2. For chromium, NOAEL HQs are less than or equal to 1 in some EUs throughout OU-4 for both receptors.

- Measured LOAEL HQs for lead and vanadium exceed 1 for both receptors in all EUs and AAs. Chromium HQs for Carolina wren-2 exceed 1 only in a few of the UAA EUs, and the HQs are low (2). For the remaining receptors and COPCs, LOAEL HQs are less than or equal to 1. All chromium NOAEL HQs are less than or equal to 1 for spotted sandpiper–1 and all EUs have chromium NOAEL HQs of 2 or less.

For Dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.
- For spotted sandpiper–1, PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ NOAEL HQs were less than or equal to 1 all AAs.
- For Carolina wren–2, only the total TEQ NOAEL HQ calculated using the LAA total TEQ EPC exceeded 1. As described above for Carolina wren–1, when the total TEQ HQ is calculated using the sum of the PCDD/PCDF HQ and DL-PCB HQ (toxicity unit approach), Carolina wren total TEQ HQs in the LAA are equal to 1.
- For Carolina wren-2, the majority of the contribution to the total TEQ concentration is from DL-PCBs, and total TEQ EPC resulting in NOAEL HQs of 2 is considered to be unreliable due to characteristics of the total TEQ dataset.

6.1.5.1.2 Comparison to Reference

Because bird egg tissue samples were not collected in OU-4, direct comparison of OU-4 and reference area tissue is not possible. In lieu of bird tissue data, comparisons were made based on the soil/sediment concentrations to understand the trends in dietary dose and egg tissue concentrations in OU-4 and reference areas (Figures 6-4 for PCBs, 6-7 for mercury, and 6-10 through 6-14 for nonmercury metals). Mean concentrations in the AAs were calculated using all data included in this OU-4 BERA, as soil and sediment EPCs for dietary and egg modeling were calculated from the same dataset and the modeled concentrations are directly correlated with the soil or sediment concentration estimates.

For PCBs measured as total Aroclors (Figure 6-4), both soil and sediment concentrations demonstrate a general decreasing gradient in the downstream direction. PCB concentrations in soil are significantly different between all OU-4 AAs, decreasing from C1 to the LAA, and all OU-4 AAs are significantly higher than reference areas (Table 6-14). In sediment, mean PCB concentrations in C1 are significantly higher than the other three AAs, which are not different from each other (Table 6-13). Means calculated from all the data are similar to mean concentrations calculated from only soil samples within/near the BSAs (Figure 6-4). PCBs were not detected in soil or sediment in the reference areas. The soil and sediment data are consistent with an upstream source of PCBs, consistent with known historical Site releases.

For mercury (Figure 6-7), soil and sediment concentrations are significantly higher in the OU-4 Areas than in the reference areas (Table 6-13 and 6-14). Similar to the pattern for PCBs, there is no difference between the mean mercury concentrations in sediment among the OU-4 AAs; however, mercury concentrations decrease from UAA to LAA in soil, with significant differences among each of the AAs.

For other metals (Figure 6-15 through 6-19), mean soil and sediment concentrations in the OU-4 Areas are similar to or lower than in the reference areas in almost all cases and do not indicate an upstream source. The exceptions include all metals in C1 sediment (based on two samples) which are somewhat higher than the other AAs and reference areas, and for lead in soil, where average concentrations are similar between the reference areas, LAA, and MAA, but about 2 to 3 times higher in UAA soil.

For PCDD/PCDF TEQ (Figure 6-20), mean concentrations in soil and sediment in the OU-4 Areas are higher than in the reference areas; however, there is no decreasing trend in the downstream direction. In fact, mean PCDD/PCDF TEQ concentrations are similar between MAA and UAA in soil (approximately 0.012 µg/kg dw), but are about 3 times higher in LAA soil. Sediment PCDD/PCDF TEQ concentrations are similar among the AAs (approximately 0.007 µg/kgdw), but show a decreasing trend from the LAA to the UAA. Similar to mean concentrations calculated from samples collected within/near the BSAs, this pattern does not indicate an upstream source of PCDD/PCDF TEQ in OU-4.

6.1.5.2 ME 5b: Comparison of avian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to reference area(s) or among OU-4 assessment areas.

As discussed in Section 5.6.5, reference data for aquatic bird community assessment were not available. Thus, for the aquatic/semi-aquatic bird community, measures for abundance, species richness, diversity, and dominance were compared between reaches onsite. The results of the measures are presented in Tables 5-15a through 5-15d, and Table 5-16. The results suggest that mean aquatic bird abundance, richness, diversity, and dominance do not differ significantly among reaches. Overall, the results suggest no effect of PCBs or other COPCs on the aquatic/semi-aquatic bird community. In addition, no upstream to downstream community trend was apparent.

For the terrestrial bird community, measures for abundance, species richness, diversity, and dominance were compared between OU-4 and reference locations. The results of the measures are presented in Tables 5-17a through 5-17d. The three-way ANOVA results are presented in Table 5-18. The results suggest that mean abundance and species richness are significantly higher in OU-4 than in the reference areas. Diversity and dominance do not significantly differ by location ($P>0.05$). Based on these results, the condition of the terrestrial bird community within OU-4 appears to be similar and possibly more diverse compared to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial bird community.

The uncertainties associated with the community evaluation are discussed in Section 6.2 and this LOE is weighted accordingly as discussed in Section 6.3.

6.1.6 AE 6: Survival, Growth, and Reproduction of Mammals

Risk to mammals was evaluated based on four MEs (6a – 6d) as described below. The USFWS (2014) lists two threatened and endangered mammal species (Indiana bat and grey bat) as potentially occurring within Calhoun County, Alabama. However, no threatened and endangered mammals have been observed within OU-4. LOAEL HQs described below are considered appropriate for protection of bird populations within OU-4.

6.1.6.1 ME 6a and 6b: Compare an estimated dietary daily dose of COPCs in prey base in OU-4 to relevant dietary TRVs and those in the reference area(s) and compare estimated body burdens of COPCs in selected mammal species in OU-4 to those in mammals from the reference area(s) and CTCs as available.

For OU-4, several aquatic and terrestrial mammals were evaluated. In addition, mammals with mixed aquatic and terrestrial diets were evaluated. A range of HQs were estimated for these receptors as shown in Table 6-1. For these receptors, the dietary NOAEL and LOAEL HQs are presented in Tables 6-2a 6-2b, 6-3a, and 6-3b for aquatic receptors, Table 6-5a, 6-5b, 6-6a, and 6-6b for terrestrial receptors, and Tables 6-7a, 6-7b, 6-8a, and 6-8b for mixed diet receptors. Tables ending with an "a" correspond to modeled dietary HQs, whereas Tables ending with a "b" correspond to dietary HQs based on measured prey tissue concentrations. Additionally, small mammal tissue samples collected from OU-4 BSAs were used to calculate AA-wide EPCs for tissue. The tissue EPCs were compared to NOAEL and LOAEL CTCs for mammals, as presented in Table 6-11. Summary tables for receptors, COPCs, and EUs/AAs with LOAEL HQs greater than 1 are provided in the section below. Dioxin TEQ data were evaluated in Appendix F, with results summarized below. Note that OU-4 tissue samples were collected only from some EUs in the UAA (C2, C3, and C4), MAA (C5), and LAA (C7). In the measured tissue HQ estimates presented in the sections below, AA-wide tissue EPCs are used in the HQ calculations for each EU and AA scenario. For Snow Creek, UAA-wide tissue EPCs were selected to estimate measured HQs in C1 EUs. Uncertainties associated with this assumption are discussed in Section 6.2.

6.1.6.1.1 Hazard Quotients

Aquatic Mammals

Aquatic mammals exposed to sediment and aquatic prey in the sediment EUs include the little brown bat (aerial-feeding insectivore), the river otter (piscivore), and the mink-2 (piscivore). For the bat, the small mammal PCB TRV was used. Mink and otter were evaluated using two PCB TRVs, based on either reproduction endpoints or growth endpoints. The modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-2a through 6-3b. Tissue HQs were not calculated for aquatic mammals because the small mammal data collected from OU-4 BSAs are not representative of these receptors. A comparison of the two types of HQs (modeled dietary and measured dietary) is presented in Tables 6-19a and 6-19b for PCBs and mercury, respectively. Only receptors, EUs, and COPCs with LOAEL HQs greater than 1, which indicate the potential for risk to aquatic mammal populations, are summarized in Tables 6-19a and 6-19b. For the remaining receptors, EUs, and COPCs, estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than or equal to 1) or *de minimis* (NOAEL HQs less than or equal to 1).

For PCBs (Table 6-19a):

- Modeled dietary LOAEL HQs exceed 1 for all aquatic mammalian receptors in one or more EUs or AAs. The highest modeled HQs are in C1 and C2, where modeled LOAEL HQs exceed 100 for mink and otter based on mink TRVs. In Snow Creek (C1), the UAA, and UAA EUs (C2 through C4), modeled LOAEL HQs exceed 10 for almost every EU and receptor pair based on their respective

TRV. The elevated HQs in C1 and the UAA are due primarily to the generally higher sediment concentrations in these EUs relative to more downstream areas of OU-4. For the bat (evaluated with the small mammal TRV), modeled NOAEL and LOAEL HQs are below 1 in the downstream EUs (C5 through C10), and for modeled NOAEL and LOAEL HQs based on MAA- and LAA-wide EPCs. Mink and otter HQs exceed 1 throughout OU-4, based on the two evaluated mink TRVs.

- Measured dietary LOAEL HQs exceed 10 for the piscivorous mammalian receptors (evaluated using mink TRVs) in all EUs and AAs, with no clear upstream to downstream trend. This is due to the use of AA-wide measured fish tissue EPCs, which are relatively constant in OU-4. Measured HQs for the bat, evaluated with the small mammal TRV, also exceed 1 in C1, the UAA, and UAA EUs (C2 through C4). Measured HQs are generally lower than modeled dietary HQs. NOAEL HQs are less than or equal to 1 for the bat in the MAA, LAA, and associated EUs (C5 through C10), based on the small mammal PCB TRV.

For mercury (Table 6-19b):

- Modeled dietary LOAEL HQs are less than or equal to 1 for most receptors and EUs/AAs. LOAEL HQs exceed 1 in reach C2 for the otter. LOAEL HQs for the bat in reach C2 exceed 10, and exceed 1 in the UAA-wide area. All other receptors and EUs/AAs have NOAEL and LOAEL HQs less than or equal to 1.
- Measured dietary NOAEL and LOAEL HQs are less than or equal to 1 for all aquatic mammalian receptors in OU-4 EUs and AAs.

For other metals (Tables 6-2a through 6-3b):

- Modeled dietary NOAEL and LOAEL HQs are less than or equal to 1 for all metals and aquatic mammalian receptors in OU-4 EUs and AAs.
- Measured dietary NOAEL and LOAEL HQs are less than or equal to 1 for all metals, receptors, and EUs/AAs.

For Dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.
- For aquatic mammals in all AAs, all PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ NOAEL HQs were less than or equal to 1.

Terrestrial Mammals

Terrestrial mammals exposed to soil and terrestrial prey in the floodplain soil EUs include the shrew-1 and -2 (ground-feeding invertivore), white-tailed deer (herbivore), the long-tailed weasel (carnivore), and the red fox-1 and -2 (carnivore). For these receptors, the small mammal PCB TRV was used. The modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-5a through 6-6b. The tissue NOAEL and LOAEL HQs for small mammals/shrews are presented in Table 6-11. A comparison of the three types of HQs (modeled dietary, measured dietary, and tissue) is presented in Tables 6-20a through 6-20c for PCBs, mercury, and metals, respectively. Only receptors, EUs, and COPCs with LOAEL HQs

greater than 1, which indicate the potential for risk to terrestrial mammal populations, are summarized in Tables 6-20a through 6-20c. For the remaining receptors, EUs, and COPCs, estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than 1) or *de minimis* (NOAEL HQs less than 1).

For PCBs (Table 6-20a):

- Modeled dietary NOAEL and LOAEL HQs are less than 1 in most EUs/AAs for herbivorous and carnivorous receptors (deer, weasel, fox -1 and -2). These receptors have LOAEL HQs greater than 1 in the C1 West EU only. For the invertivorous shrew (both scenarios), modeled LOAEL HQs are greater than 1 in Snow Creek (C1), the UAA, and most UAA EUs (C2 through C4), as well as in C6 South for shrew-1. LOAEL HQs are greater than 100 in C1 West and greater than 10 in C3 South EUs for both shrew scenarios. LOAEL HQs are less than or equal to 1 for all terrestrial receptors in the LAA EUs and most MAA EUs.
- Measured dietary LOAEL HQs are less than or equal to 1 for herbivorous and carnivorous receptors (deer, weasel, fox–1 and -2) in all EUs/AAs. For the deer, all EUs/AAs have NOAEL HQs less than or equal to 1 as well. For the fox, NOAEL HQs are less than or equal to 1 for C1 and UAA EUs (except C1 West). LOAEL HQs exceed 1 for the shrew (both scenarios) in C1 and the UAA and most UAA EUs (C2 through C4). In the MAA, LAA and associated EUs (C5 through C10), the NOAEL HQs do not exceed 1. The measured LOAEL HQs are generally lower than modeled dietary HQs, but follow the same pattern of exceedances.
- Tissue NOAEL and LOAEL HQs calculated for shrew are less than or equal to 1 in all OU-4 AAs, based on small mammal tissue collected from the BSAs and small mammal CTC.

For mercury (Table 6-20b):

- Modeled dietary LOAEL HQs exceed 1 in several EUs and AAs for shrew (both scenarios). The LOAEL HQs greater than 1 are primarily low in magnitude (≤ 3) and do not follow a spatial trend from upstream to downstream. NOAEL and LOAEL HQs for the remaining terrestrial receptors (deer, weasel, fox-1 and -2) are less than or equal to 1 in all OU-4 EUs and AAs. Mercury was not measured in floodplain soil in reach C1.
- Measured dietary LOAEL HQs for shrew are similar in magnitude to the modeled dietary HQs for shrew, but exceedances are limited to reach C1, the UAA and MAA, and associated EUs (C1 through C6). In the LAA and LAA EUs (C7-C10), NOAEL HQs are greater than 1 and LOAEL HQs are less than or equal to 1. Measured NOAEL and LOAEL HQs are less than or equal to 1 in all EUs/AAs for the remaining terrestrial receptors.
- Tissue NOAEL and LOAEL HQs could not be calculated, as mammal CTCs for mercury are not available.

For other metals (Table 6-20c):

- Modeled dietary NOAEL and LOAEL HQs are less than or equal to 1 for all metals and terrestrial mammalian receptors in OU-4 EUs and AAs, except for chromium for shrew (both scenarios) in the C3

South EU, which had LOAEL HQs greater than 1. Note that the UAA-wide LOAEL HQ for chromium is less than or equal to 1 for shrew.

- Measured dietary LOAEL HQs are less than or equal to 1 for all metals, receptors, and EUs/AAs. NOAEL HQs are less than or equal to 1 for all metals, receptors, and EUs/AAs except for shrew (both scenarios) and lead in all OU-4 EUs/AAs.
- Tissue HQs were not calculated for non-mercury metals.

For Dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.
- For terrestrial mammals in all AAs, all PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ NOAEL HQs were less than or equal to 1.

Mammals with Mixed Diets

Mammals exposed to soil and/or sediment and aquatic and terrestrial prey in the floodplain soil, riparian soil, and sediment EUs include the mink-1 (primary diet of fish and small mammals) and the raccoon-1 and -2 (omnivore). For these receptors, the small mammal PCB TRV was used for raccoon and the two mink TRVs were evaluated for mink-1. As described in Section 4.5.2.2, mixed diet scenarios (assuming part terrestrial exposure and part aquatic exposure) were evaluated for mink–1 and raccoon (both scenarios). For raccoon–1, exposure for the terrestrial portion of the diet was evaluated for both floodplain soil EUs and riparian EUs. For raccoon–2, only riparian soil was evaluated for the terrestrial portion of the diet. The mink–1, which is assumed to feed on small mammals in addition to aquatic prey, was evaluated using the riparian EUs for the terrestrial portion of the diet, and the aquatic portion of the diet was estimated using sediment.

The modeled and measured dietary NOAEL and LOAEL HQs are presented in Tables 6-7a through 6-8b. Tissue HQs were not calculated for mammals with mixed diets because the small mammal data collected from OU-4 BSAs are not representative of these receptors. A comparison of the two types of HQs (modeled dietary and measured dietary) is presented in Tables 6-21 for PCBs. Only receptors, EUs, and COPCs with LOAEL HQs greater than 1, which indicate the potential for risk to mammal populations, are summarized in Tables 6-21. For the remaining receptors, EUs, and COPCs (including all metals), estimated risk are either uncertain (NOAEL HQs greater than 1 but LOAEL HQs less than or equal to 1) or *de minimis* (NOAEL HQs less than or equal to 1).

For PCBs (Table 6-21):

- Modeled dietary LOAEL HQs are less than or equal to 1 in most EUs/AAs for raccoon (both scenarios), except for C1 East, C1 West, C1 Riparian, C2 Riparian, and C3 South EUs, where the HQs are greater than 1 but less than or equal to 12. The UAA-wide LOAEL HQ and all other AA and EU LOAEL HQs are less than or equal to 1 for raccoon. For the MAA, LAA, and associated EUs (C5 through C10), NOAEL HQs are less than or equal to 1 for raccoon (both scenarios). For raccoon–2, C3 Riparian EU also has a NOAEL HQ less than or equal to 1. For the mink, LOAEL HQs exceed 1 in all OU-4 EUs and AAs using the mink growth-based TRV, and exceed 1 in most EUs and AAs except for C6 Riparian and C9 Riparian EUs. The highest mink LOAEL HQs are in C1 and C2 riparian EUs, where HQs are greater than 30.

- Measured dietary LOAEL HQs are less than or equal to 1 for the raccoon (both scenarios) in all EUs/AAs. NOAEL HQs are less than or equal to 1 only for raccoon–1 in the MAA, LAA, and associated EUs (C5-C10). For mink-1, LOAEL HQs exceed 1, but are less than or equal to 10 in all OU-4 AAs and EUs based on the mink reproduction TRV. For the mink-1 based on the mink growth TRV, LOAEL HQs are greater than 10 in all EUs and AAs. The relatively constant measured HQs are due to the use of AA-wide fish tissue EPCs, which did not vary substantially along Choccolocco Creek.

For Dioxin TEQ (Appendix F):

- NOAEL HQs for PCDD/PCDF TEQs, DL-PCB TEQs, and total TEQs were calculated for each AA, as presented in Appendix F.
- For mixed-diet mammals in all AAs, all PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ NOAEL HQs were less than or equal to 1.

6.1.6.1.2 Comparison to Reference

Additionally, COPC concentrations in mammal tissues from the OU-4 Areas were compared to mammal tissue from the reference areas. Small mammals tissue samples were collected from mice, rats, voles, and shrews in all BSAs and the reference areas; tissue samples from other mammals were not collected. PCBs were measured as homologs in small mammal tissue. The average concentrations in small mammal tissue collected within or near the BSAs are presented on Figure 6-6. For terrestrial small mammal tissue, PCBs were detected in all OU-4 AAs and in the reference areas. Mean reference area PCB concentrations are about one-half those measured in small mammal tissue in the OU-4 AAs (Table 6-15). For UAA, this difference is statistically significant, but was only nearly significant for the MAA (P=0.06) and LAA (P=0.09). This pattern is generally consistent with the sediment and soil concentrations, which are higher in the OU-4 AAs than in the reference areas (Tables 6-13 and 6-14, and Figure 6-4). As no PCBs were detected in reference area soil, it is possible that small mammals collected in the reference areas forage within areas of OU-4. No decreasing trend in small mammal tissue PCB concentration is apparent moving in the downstream direction from UAA to LAA, possibly due to the mobility of these receptors.

Mean mercury concentrations in small mammal tissue collected within or near the BSAs are presented on Figure 6-9. For terrestrial small mammal tissue, mercury was detected in all OU-4 AAs and in the reference areas. There are no statistically significant differences between mean small mammal tissue within the OU-4 AAs and reference areas. This pattern is not consistent with the sediment and soil concentrations, which are higher in the OU-4 AAs than in the reference areas (Tables 6-13 and 6-14, and Figure 6-7). Similar to PCBs, there is no apparent concentration gradient for mercury in small mammal tissue.

For non-mercury metals, the tissue datasets are too small to conduct statistical comparisons. Only qualitative comparisons were conducted. For other metals, small mammal mean tissue concentrations in each OU-4 Area are presented on Figures 6-16, 6-18, and 6-19 for chromium, lead, and vanadium, respectively. Chromium was detected in small mammal tissue at similar mean concentrations in all OU-4 Areas and the reference areas (differing by less than two-fold) and are highest in the UAA and reference areas. This is similar to the pattern in soil, where mean chromium concentrations are highest in UAA and reference areas, but differ by a factor of two or less between all areas. Mean lead tissue concentrations

are highest in the MAA followed by the UAA, with concentrations in LAA similar to those in the reference areas. In comparison, mean soil lead concentrations are highest in UAA soil. In all OU-4 Areas and reference areas, lead concentrations in small mammal tissue average less than 10 mg/kg dw. Vanadium was only detected in small mammal tissue from the reference areas, and in soil this area had similar concentrations to the UAA and MAA. Overall, the tissue concentrations of non-mercury metals from the OU-4 Areas do not appear to be different from the reference areas.

Datasets for PCDD/PCDF TEQ are also insufficient for statistical comparisons. Instead, qualitative comparisons were conducted. For PCDD/PCDF, mean small mammal tissue concentrations are presented on Figure 6-20. Mean PCDD/PCDF TEQ concentrations in the OU-4 Areas are higher than in the reference areas by 1 to 2 orders of magnitude. Mean PCDD/PCDF TEQ concentrations in UAA are highest, about 3 times greater than in MAA but less than twice as great as in LAA; conversely, mean soil PCDD/PCDF TEQ concentrations are about 4 times greater in LAA than MAA or UAA (no soil samples from the reference areas were analyzed for PCDD/PCDF TEQ). No clear concentration gradient is apparent for PCDD/PCDF TEQ in the small mammal tissue or soil.

6.1.6.2 ME 6c: Comparison of mammalian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to the reference area(s) or among OU-4 assessment areas.

As discussed in Section 5.6.6, for aquatic/semi-aquatic mammal community, measures for abundance, species richness, diversity, and dominance were compared between OU-4 reaches. The results of the measures are presented in Tables 5-19a through 5-19d and Table 5-20. The results suggest that mammal abundance is significantly lower in the middle and lower reaches than in the upper reach (Table 5-19a, Figure 5-4). Other community measures (richness, diversity, dominance) did not significantly differ among reaches. Overall, the results suggest no effect of PCBs or other COPCs on the aquatic/semi-aquatic mammal community, despite higher tissue PCB concentrations in these animals compared to reference areas and dietary HQs greater than 1 for some receptors. In addition, no upstream to downstream trend is apparent for the community assessment metrics.

For the terrestrial mammal community, measures for abundance, species richness, diversity, and dominance were compared between OU-4 and reference. Sample size was small for diversity and dominance (because no mammal sign on many transects), providing little statistical power to detect differences for those measures. The results of the measures are presented in Tables 5-21a through 5-21d and Table 5-22. The results suggest that mean abundance, species richness, diversity, and dominance do not significantly differ between OU-4 and reference locations. Based on these results, the condition of the large mammal community within OU-4 appears to be similar to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial large mammal community.

For terrestrial small mammal community, measures for abundance, species richness, diversity, and dominance were compared between OU-4 and reference areas. The results of the measures are presented in Tables 5-23a through 5-23d and Table 5-24. Mean abundance and species richness, diversity, and dominance do not significantly differ between reference and OU-4 locations. Based on these results, the condition of the small mammal community within OU-4 appears to be similar to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial small mammal community.

6.1.6.3 ME 6d: Evaluate habitat suitability for the mink (Allen 1986) and river otter using habitat suitability index models or other methods as available.

During the Phase 1 studies for OU-4, aquatic surveys were conducted to characterize the use of Choccolocco Creek by aquatic wildlife. During these surveys, mink observations were recorded eight times. All mink records were observations of their tracks in primarily depositional areas (e.g., sand bars or near bank deposits) within Choccolocco Creek, and mink were recorded in each of the three OU-4 AAs.

To determine the suitability of the study area as habitat for mink, the USFWS Habitat Suitability Index (HSI) for Mink (Allen 1986) was reviewed. Mink are a highly adaptable, predatory, semiaquatic mammal that are generally associated with stream and river banks, lake shores, freshwater and saltwater marshes, and marine shore habitats (Allen 1986). Ideal mink habitat consists of a permanent water source with at least 75% canopy cover; canopy cover can be trees, shrubs, herbaceous vegetation or a mix of all three (Allen 1986). Areas with less dense vegetative cover adjacent to water provide less suitable habitat as a result of decreased cover for foraging, den sites, and prey.

Many of the prey items preferred by mink in the HSI model (e.g., crayfish, fish, waterfowl, and terrestrial small mammals and rabbits) were all observed in Choccolocco Creek or within the floodplain during the Phase 1 survey activities. Based on this prey availability, the areas of Choccolocco Creek with densely vegetated shorelines and/or canopy cover likely provide suitable habitat for mink. Areas without densely vegetated riparian zones provide less suitable habitat, as the HSI concluded that “shorelines devoid of vegetative or structural cover are assumed to have extremely low value as mink habitat”. Portions of Choccolocco Creek that have densely vegetated shorelines and an abundance of cover likely provide suitable habitat for mink. Portions of Choccolocco Creek that are highly impacted by both natural and man-made disturbances within the riparian corridor and floodplain (i.e., sections where the creek is bordered by agricultural fields or livestock pasture), likely do not provide suitable habitat for mink.

During the Phase 1 studies for OU-4, aquatic surveys were conducted to characterize the use of Choccolocco Creek by aquatic wildlife. During these surveys, no river otter observations were recorded at any location within Choccolocco Creek. Despite the lack of recorded observations, literature was reviewed regarding river otter habits and habitat needs to evaluate if areas of OU-4 could potentially provide otter habitat.

River otters are a large, aquatic, predatory mammal that preys primarily on fish, shellfish, and crayfish but will also take reptiles and amphibians, birds, and small mammals (Kaufman et al. 2004). River otters are highly adaptable and historically had one of the largest distributions of any North American mammal (Toweill and Tabor 1982). Ideal otter habitat consists of a permanent source of water with an adequate prey base and adjacent riparian areas with den sites (Melquist et al. 2003). Otters have shown some avoidance of areas with human disturbance, but habitat selection is driven primarily by suitable habitat and prey availability more so than human avoidance (Melquist and Hornocker 1983). In a study in Kansas, Jeffress et al. (2011) found that the probability of river otter occupancy along waterways increased with increasing adjacent woodland cover and decreasing agricultural cover.

Evidence of river otters has been observed within OU-4 and there are areas along Choccolocco Creek, especially in the forested floodplain that could provide suitable den sites for river otters. The sections of

Choccolocco Creek that are surrounded by agriculture or other human uses likely do not provide suitable habitat for otters.

6.1.7 Survival, Growth, and Reproduction of Amphibians or Reptiles

Risk to amphibians was evaluated based on two MEs (7a and 7b) as described below.

6.1.7.1 ME 7a: Concentration of COPCs in surface water, sediment, and soil in OU-4 compared to benchmarks and/or literature-derived toxicity threshold values.

Amphibians as part of aquatic life were evaluated based on surface water concentrations compared to ADEM WQS. For aquatic life exposed to surface water (Table 6-12), HQs based on chronic ADEM WQS are greater than 1 for PCBs, barium, lead, and mercury. HQs based on the acute ADEM WQS are less than or equal to 1 for all COPCs. The chronic benchmarks specific to aquatic invertebrates and fish are considered protective of amphibians. HQs based on chronic benchmarks for aquatic invertebrates are less than 1 except for cobalt, and HQs based on chronic benchmarks specific to fish are less than 1 except for lead.

Sediment, soil, and tissue-based TRVs could not be developed for amphibians and reptiles because suitable toxicity data for exposures to amphibians and reptiles are not available. Several sources of toxicity data were reviewed and results of the review are discussed further in the uncertainty analysis (Section 6.2).

6.1.7.2 ME 7b: Body burden of COPCs in selected reptile and amphibian receptor tissue in OU-4 as compared to those in the reference area(s).

PCBs were measured as total homologs for reptile/amphibian (i.e., snake and frog tissue) tissue samples. The locations of samples collected within or near the BSAs are presented on Figure 6-5b. For amphibian tissue, PCBs were detected in all OU-4 AAs, but not in the reference areas. For reptile tissue, PCBs were detected in all OU-4 AAs and in the reference areas. Mean reptile tissue concentrations in the reference areas are significantly lower (30 to 80 times) than in the OU-4 AAs. For amphibians, the MAA is significantly lower than the UAA, and for reptiles, there is no significant difference between the AAs. Overall, the tissue PCB data collected from the OU-4 Areas indicate concentrations that are relatively higher than the reference areas. It is consistent with soil and sediment PCB concentrations that are higher in the OU-4 Areas, but never detected in the reference areas.

Mean mercury concentrations in reptile/amphibian tissue samples collected within or near the BSAs are presented on Figure 6-8b. Mercury was detected in all OU-4 Areas and in the reference areas. Mean amphibian tissue concentrations in the reference areas are significantly lower than the UAA and MAA but not statistically different from the LAA. For reptiles, the LAA was different from reference but there we no statistical differences in the UAA and MAA and reference conditions. For both reptiles and amphibians, there is no significant difference in tissue concentrations between the AAs. Mercury concentrations are slightly higher in the OU-4 Areas than in the reference areas, which is consistent with sediment and soil mercury concentrations in the four AAs.

For non-mercury metals, the average concentrations in reptile/amphibian tissue samples for each OU-4 Area and the reference areas are presented on Figures 6-15 through 6-19. For these metals, concentrations in the LAA and MAA are generally similar to or lower than (often not detected) in the reference areas, suggesting that metals detected in reptile/amphibian tissue along the majority of Choccolocco Creek are not different from reference areas. Based on the two tissue samples collected in the UAA, non-mercury metal concentrations in reptile/amphibian tissue in the UAA appear to be higher than tissue concentrations in the LAA, MAA, and reference areas.

For PCDD/PCDF TEQ (Figure 6-20), reptile/amphibian tissue from the reference areas is not available for comparison to OU-4 Area tissue, which was collected in the UAA, LAA, and MAA. Mean tissue PCDD/PCDF TEQ concentrations are similar in each of the BSAs (approximately 0.005 to 0.007 mg/kg dw). The UAA is greater than MAA and LAA. The opposite trend is observed in soil and sediment mean PCDD/PCDF TEQ concentrations. Trends in the PCDD/PCDF TEQ data are difficult to discern due to the small sample size of the datasets, which consist of only one or two samples in each area.

6.2 UNCERTAINTY ANALYSIS

Section 6.2 Summary

There are a substantial number of uncertainties that affect risk characterization in complex ecological risk assessments such as this OU-4 BERA. These are summarized in this section.

In general, the OU-4 BERA methodology was selected to minimize the potential for underestimation of risk. Because of these approaches and other protective assumptions made throughout this OU-4 BERA, risks are expected to overestimate rather than underestimate the true risk associated with OU-4 in most cases. Many of the uncertainties are generic and are not summarized here. Some of the key uncertainties specific to this OU-4 BERA include:

- Environmental sampling and analysis. Key uncertainties include:
  - The representativeness of the samples collected spatially and temporally.
  - The uncertainty associated with analytical method.
  - Depth profile sampled.
- BAFs. Prey tissue concentrations measured in OU-4 were used to develop site-specific BAFs. Although a large amount of data were collected for PCBs and mercury to support BAF development, predictive relationships were generally not found between soil/sediment and prey tissue. The BAFs used in this OU-4 BERA were generally based on median BAFs. While the median BAFs provide a good estimate of the central tendancy of the data, the median BAFs are not predictive of tissue concentrations and they may over- or underestimate prey tissue concentrations in the modeled HQs. Use of measured tissue data in the dietary measured HQ estimates mitigates this uncertainty.
- Toxicity values. Several uncertainties include:
  - Use of literature-based benchmarks which do not reflect site-specific factors that modify toxicity of COPCs.
  - Methods used to derive and select site-specific sediment toxicity thresholds for benthic invertebrates, and their relative representativeness for the existing community.
  - Use of high-sensitivity and mid-sensitivity PCB TRVs and CTCs to evaluate birds.
- Ecological community evaluations. Key sources of uncertainty include:
  - Adequacy of sample size which affects statistical power to detect differences.
  - Similarity (location, habitat structure, etc.) of reference locations to OU-4 locations.
  - Seasonal or annual variability.
- Detectability (data were not always adjusted for detectability).

There are a substantial number of uncertainties that affect risk characterization in complex ecological risk assessments such as this OU-4 BERA. While it is not possible to quantify the impacts of all of these uncertainties on the risk predictions, it is important to catalog and describe their various types and possible influences, characterize their importance in the WOE risk conclusions, and consider them carefully in the risk management process.

Generally, risk assessments involve the use of assumptions, judgments, and incomplete data to varying degrees that may contribute to the uncertainty associated with the final risk estimates. Uncertainties may result from both the use of assumptions or models in lieu of actual data and from the error inherent in the estimation of exposure parameters. These uncertainties, generally associated with receptor exposure assumptions, BAFs, TRVs/CTCs, and benchmarks may result in the potential overestimation or underestimation of risks. The objective of this section is to discuss the major sources of uncertainty related to the key assumptions used in the analyses performed. The uncertainty discussions focus on providing an understanding of whether each assumption might underestimate or overestimate risk so that the conclusions reached in the risk characterization can be put into context. An analysis of specific uncertainties associated with this OU-4 BERA methodology is provided below.

The following steps were taken to minimize the potential for underestimation of risks:

- Estimates of COPC concentrations in OU-4 media were based on samples collected from known or suspected impacted locations within each study area and, thus, are likely to overestimate actual exposures to wildlife that might use OU-4.
- Wildlife representative species were intentionally selected based on attributes (e.g., small foraging areas) that provide conservative estimates of exposure for other members of the guild. Exposure parameters for the selected representative species from approved sources (e.g., USEPA's Wildlife Handbook) were preferred sources of wildlife exposure information to reduce the uncertainty for the species living at OU-4.
- Estimates of exposure assume that wildlife do not avoid contaminated areas or foods, and do not recognize differences in habitat quality based on land development.
- Reproductive or developmental effects, among the most sensitive of test endpoints, were the preferred endpoints when identifying toxicity studies used in the selection of TRVs.

Because of these approaches and other protective assumptions made throughout this OU-4 BERA, risks are expected to overestimate rather than underestimate the true risk associated with OU-4. Some of the key uncertainties are discussed below.

6.2.1 Exposure Assumptions

Several uncertainties are associated with estimating exposure in this OU-4 BERA. These include uncertainties related to sampling and analysis (sample design, collection of environmental samples, and analysis of environmental media), uncertainties in calculated exposure values (such as for TEQ), and uncertainties associated with actual receptor contact with environmental media in OU-4 or the specific exposure assumptions. Exposure assumptions with the greatest uncertainty are associated with receptor use of OU-4 (i.e., habitat quality, receptor site use, exposure concentrations, and exposure models). Each of these is discussed in the following sections.

6.2.1.1 Environmental Sampling and Analysis

Uncertainties associated with the environmental sampling depend on the degree to which samples collected and analyzed within OU-4 are representative of OU-4 chemical conditions. This uncertainty has three components:

1) The representativeness of the samples collected spatially and temporally,
2) The uncertainty associated with analytical methods, and
3) Depth profile sampled.

Spatial and Temporal Uncertainty

In this OU-4 BERA, the environmental sampling was primarily conducted to define the nature and extent of contamination in OU-4, refine the understanding of fate and transport of COPCs to the floodplain and downstream areas, and support the preliminary development of potential remedial alternatives for OU-4. Thus, sampling was, in many cases, focused on areas of known or suspected site-related impacts. Because wildlife would not selectively use a more contaminated area, and may even avoid such an area to some extent, the exposure estimates used in this OU-4 BERA based on these sampling data may overestimate exposure to wildlife. Additionally, recent and historical data included in the assessment span over several years. Changes in sediment deposition over time, such as increased sedimentation or erosion losses, may have occurred such that the surface soil/sediment dataset used in this OU-4 BERA is no longer representative of current conditions. Deposition of clean sediments or soils over historically contaminated materials may reduce exposure, or sediment removal in eroding areas may expose historically elevated concentrations of some COPCs. Therefore, some uncertainty due to the representativeness of samples collected over time is inherent in the risk estimates.

Data for non-mercury metals in sediment are not available for reaches C6 and C8. Assuming that the highest COPC concentrations are located upstream and migrate downstream, EPCs for the adjacent upstream reach were used to evaluate sediment exposure in reaches C6 and C8. However, as non-mercury metals are considered unlikely to be OU-4 related and do not demonstrate a clear upstream-to-downstream gradient, sediment concentrations in reaches C6 and C8 may be overestimated or underestimated. The uncertainty in the risk estimates based on sediment HQs for these reaches is considered to be relatively minor, as sediment concentrations are bounded by the surrounding reaches.

Data for mercury and other metals in soil are not available for the Snow Creek reach (C1). In this OU-4 BERA, exposure to metals in this area is uncertain. For non-mercury metal COPCs in OU-4, concentrations are generally similar to reference areas, there is no upstream to downstream trend, and the metals are not associated with historical Site use. Therefore, OU-4-related risk due to non-mercury metals is not anticipated in Snow Creek, and the lack of non-mercury metals data in Snow Creek is not considered to significantly affect risk conclusions for this OU-4 BERA. For mercury, the lack of soil data in reach C1 represents an uncertainty. In sediment however, sediment mercury concentrations in C1 are similar to those for the Choccolocco Creek AAs (Figure 6-7), and therefore it is reasonable to assume that soil mercury concentrations in the UAA (and associated ecological exposures and risk) would also be similar to those in reach C1.

Tissue data were collected only in a subset of the EUs. Specifically, the aquatic BSAs were located in three AAs (UAA reaches C2, C3, and C4; MAA reach C5; and LAA reach C7). No aquatic tissues were collected in Snow Creek (C1) or the remaining downstream reaches (C6, C8, C9, and C10). The

terrestrial BSAs were located in three AAs as well (UAA EUs C2 Central, C3 North, and C4 South; MAA EUs C5 North and C5 South; and LAA EUs C7 North and C7 South). No terrestrial tissues were collected in Snow Creek (C1 EUs) or the remaining downstream EUs. Thus, there is some uncertainty in assuming that the measured tissue concentrations are representative of unsampled areas. For the unsampled downstream reaches/EUs (C8 through C10 EUs), the use of the measured tissue data collected in C7 likely overestimates exposure to PCBs, since there is a clear upstream-to-downstream gradient and the lowest reaches EUs have among the lowest soil and sediment PCB concentrations. For the EUs in the UAA and MAA that do not have tissue data, tissue concentrations are expected to be relatively similar to those measured in the BSAs due to the generally similar abiotic media concentrations within each AA, and the mobility of some of the prey organisms that were sampled. There is no tissue data available for Snow Creek (C1). Due to the habitat and hydrological differences in this area relative to the AAs assessed within and along Choccolocco Creek, tissue concentrations are uncertain in this area. Use of the UAA measured tissue data to represent prey tissue concentrations in Snow Creek may overestimate or underestimate exposure in this area. Additionally, for all the EUs with and without measured tissue data, the risk estimates based on measured tissue are bounded by the risk estimated based on tissue concentrations modeled using abiotic media EPCs and BAFs.

There is also some level of uncertainty associated with the selection of reference areas. Specifically, one small mammal tissue sample collected within reference area 1 (upstream of the confluence with Snow Creek), contained concentrations of PCBs that were higher than some OU-4 concentrations indicating that the reference mammals may have had some level of OU-4 exposure. This particular sample was for a hispid cotton rat collected in successional field habitat at ERT-01. A second cotton rat was also sampled at this location and tissue PCB concentrations were not detected. In addition, PCBs in soil in this sample grid were not detected. This sampling grid is located approximately 1.75 miles from the OU-4 boundary, which is well beyond estimated home ranges for this species[13]. Thus, the likelihood of exposure of reference rats to OU-4 soils and biota is minimal. The estimated PCB concentration in tissue at this sample location is also uncertain because cotton rats are primarily herbivores and PCBs were not detected in plants within successional field habitat in the reference areas or within OU-4.

Analytical Methods

For PCBs, COPCs were measured as both Aroclors and homologs. Based on the ability of the Aroclor method to accurately characterize the quantity of PCBs, and the large amount of Aroclor data that are available for multiple media across OU-4 (and the Site), the data collection programs and this OU-4 BERA generally used total PCBs as the sum of Aroclor results. PCBs were analyzed as homologs in some cases to achieve adequate detection limits with the available sample volumes. Specifically, surface water, fish tissue, crayfish tissue, and mollusc tissue were analyzed as homologs. Approximately 10% of soil and sediment samples were also analyzed as both homologs and Aroclors. To evaluate the uncertainty associated with the different measurement methods, paired data were evaluated for 106 soil samples, 16 sediment samples, nine surface water samples, and 25 tissue samples (including fish, crayfish and molluscs). A strong correlation was found between the Aroclor and homolog results (Figure 6-21) with r^2 values ranging from 0.88 for soil to 0.99 for tissue. A regression was not run on the surface

[13] Available at: https://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx

water samples because all Aroclor results were ND. The slopes of the regression line ranged from 0.77 for tissue to 0.83 for both soils and sediment indicating that the Aroclor method overestimates PCB concentrations and that use of the Aroclor data may overestimate risk.

For metals, only total metals were analyzed. The toxicity of many metals, notably including mercury, depends strongly on the oxidation state, presence of methylation, and other site-specific factors (such as presence of iron sulfide, or co-occurring metals) that influence uptake and effects. Thus, measurement of total metal concentration may overestimate actual risk from some metals to specific receptors, because the form and toxicity of these metals in OU-4 is not accounted for. Additional information regarding the speciation of mercury and effects on risk estimates is presented in Section 6.2.3.9.

Depth Profile

For soil and sediment sampling, different depth profiles were sampled during different sampling events. The soil was generally sampled from 0 to 1 foot, which is considered a reasonable estimate of the potential exposure zone for ecological receptors. The sediment was sampled at both 0 to 2 inches bgs and 0 to 6 inches bgs. While the most likely ecological exposures are likely in the most surficial sediments, the 0- to 6-inch interval is considered more comprehensive of the potential exposure depth and is what is recommended in the USEPA document titled *Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic ERAs* (USEPA 2015b). Thus, there is uncertainty associated with the use of the data from the 0- to 2-inch depth. To evaluate the comparability of data collected from the 0- to 2-inch interval versus the 0- to 6-inch interval, sediment cores collected during the RFI phase of the project and segmented into the 0- to 2-inch and 2- to 6-inch intervals were evaluated to identify any differences or bias that may be introduced by using data from the 0- to 2-inch interval as representative of the 0- to 6-inch intervals. A statistically significant (P-value <0.001) regression line for the 0 to 5 mg/kg dataset (which excludes one value greater than 5 mg/kg) has a slope of 0.962 indicating an almost 1:1 relationship for data from the two intervals. This correlation and slope indicate that the 0- to 2-inch interval are a suitable representative for the 0- to 6-inch interval. Surface sediment data (0 to 2 inches bgs and 0 to 6 inches bgs) are shown by program on Figure 6-22.

6.2.1.2 Exposure Point Concentration Estimation

The primary uncertainty associated with any EPC is associated with how well it may actually represent the true exposure concentration. In all cases in this OU-4 BERA, an upper bound on the mean was selected as the EPC to mitigate this uncertainty. For sediment EPCs, specifically, the EPC is weighted based on the estimated spatial extent of the three texture classes (i.e., fine, coarse, gravel) identified in OU-4 sediments. An evaluation of the visual classification of sediment cores (using the Unified Soil Classification System) collected from more than 180 transect locations in OU-4 indicated that much of Choccolocco Creek is composed of coarse-grained materials consistent with a high-energy non-depositional environment. For the 413 acres of creek between Snow Creek and the Highway 77 Bridge, 174 acres can be characterized as consisting of gravel and having no recoverable material (42%) and 183 acres were classified as coarse-grained (44%). This leaves only 56 acres (14%) defined as fine-grained and likely depositional. Because the sampling for OU-4 was disproportionally focused on depositional areas, an approach to estimating EPCs based on the spatial area of each texture class was used. Thus, uncertainty associated with the class assignments may affect the estimated sediment EPCs.

The areas associated with the sediment EPC calculations were based on 769 attempted core locations from 187 transects in Choccolocco Creek. At each location where a core was collected, it was visually classified using the Unified Soil Classification System. The photographs and field descriptions of each core were reviewed in the office and the sediments were classified into fine, coarse, and gravel categories. Organics (OL, PT), clays (CH, CL), silts (MH, ML), and fine sands (SC, SM) were called "fine-grained" while coarse sands (SP, SW) were called "coarse-grained." Gravels included classifications GM, GP, and GW. Samples from 28 core locations were submitted for laboratory analysis of grain size, and for these 28 cores, the grain size results were used along with the visual descriptions to classify the sediments in the fine, coarse, and gravel categories. For the surficial data used for the PCB contribution to the sediment EPC calculations, 57 of the 266 samples used a combination of grain size results and visual criteria to classify the sediments. The remaining samples were based on visual criteria only. The use of both laboratory and visual classification mitigates some of the uncertainty associated with the texture class assignments, but for those samples where visual classification alone was employed, there is uncertainty. The primary way in which this would affect sediment EPCs is if fines were misclassified as coarse or gravel, thereby underestimating the area of fines (which contain relatively higher COPC concentrations). The degree to which this uncertainty over or under predicts the EPC is unknown.

6.2.1.3 TEQs Calculated for Sediments and Soils

There are three primary uncertainties associated with TEQ soil and sediment exposure estimates: 1) uncertainties regarding EPC calculation methodology; 2) uncertainty regarding the applicability of TEFs to abiotic media; and 3) uncertainty related to the small TEQ dataset

Because several congeners routinely were not detected in the sediment and soil samples, a potential area of uncertainty associated with the TEQ calculation is the way the samples with ND values are handled in calculating TEQ concentrations. For example, PCB-126 was detected in only 11 of 102 floodplain soil samples (10.8 %) and two of 12 sediment samples (16.7%). Two other non-ortho substituted congeners (PCB-81 and PCB-169) were not detected in floodplain soil or sediment samples.

How samples with ND concentrations are treated in the calculations can substantially affect the resulting TEQs. An appropriate approach to address this issue is to derive bounding estimates of the TEQ concentration. This method involves determining the lower and upper bounds based on the full range of possible values for NDs by: 1) assuming that all of the ND concentrations are zero; assuming that all NDs are represented by the full RL; and 3) assuming that the PCDD/PCDF ND analytes are present at the RL and the DL-PCB ND analytes are present at one-half the RL. This is the approach taken for soil and sediment EPC calculation in this OU-4 BERA; although, HQs were estimated assuming ND concentrations were equal to zero.

When ND congeners are evaluated at zero in the TEQ calculation, the TEQ contribution of individual congeners with elevated RLs may be underestimated. As reported by Rushneck et al. (2004), new analytical methods with lower detection limits have shown that some PCB congeners, such as PCB 126, are present in all Aroclor mixtures tested, whereas these congeners had been assumed to not be present in some Aroclor mixtures based on undetectable concentrations measured from older analytical methods.

When ND congeners are evaluated at one-half or the full RL, the TEQ contributions of individual congeners are unlikely to be underestimated but may be overestimated, especially for congeners with elevated RLs. As discussed in Appendix F, the range of TEQ concentrations calculated for the

PCDD/PCDF TEQs is relatively small, because the RLs are generally low. For DL-PCB TEQs, elevated RLs for some congeners result in a larger range of estimated TEQ concentrations. Inclusion of the DL-PCBs in the total TEQ concentrations also results in a relatively wide range of estimated total TEQ concentrations compared to the PCDD/PCDF TEQs.

Although there is uncertainty in the TEQ concentrations due to limitations of historical chemical analysis, this uncertainty is bounded through the calculation of TEQ concentrations using one-half or full detection limits as replacement values for the ND congeners.

Additionally, dioxin TEQs calculated for sediments/soils using mammalian TEFs are based on prey tissue ingestion (i.e., primarily from oral uptake studies through dietary exposure). Direct calculation of dioxin TEQ concentrations in soil and sediment does not account for reductions in bioavailability or uptake that occur differentially for the individual congeners during ingestion, and for differences in the environmental fate of these compounds in abiotic media (Van den Berg et al. 2006[14]). Similarly, the bird and fish TEFs are calculated based on egg injection studies or *in vitro* exposures where the exposure conditions are not likely to be representative (in terms of the suite of congeners and their relative concentrations) of the *in vivo* exposures that result from dietary uptake of dioxins and furans (Van den berg et al. 1998). Therefore, dioxin TEQs calculated using fish and bird TEFs are relevant only to tissue data in which dioxin/furan congeners were measured. There is significant uncertainty in the application of mammal, bird, and fish TEFs to soil and sediment data in the dietary models and dioxin TEQ HQs for these receptors may not be predictive of actual risk.

Finally, the TEQ dataset available for calculation of AA-specific EPCs and development of congener-specific BAFs is quite small. The BAFs developed using OU-4 data are uncertain because they are based on only one or two tissue samples in many cases. For sediment and modeled aquatic prey tissues, EPCs are based predominantly on maximum concentrations due to small dataset size. Available 95% UCL concentrations recommended by ProUCL can be sensitive to small changes in the underlying dataset as well. For example, the LAA soil dataset consists of 28 samples. The ProUCL-recommended avian DL-PCB TEQ EPC is 4,093 nanograms per kilogram (ng/kg), based on the 95% Chebyshev UCL. However, the ProUCL-recommended avian total TEQ EPC is 8,371 ng/kg, based on the 99% Chebyshev UCL, and the same number of samples. For reference, the avian total TEQ EPC based on the 95% Chebyshev UCL is 4,271 ng/kg. This sensitivity in the 95%UCL has a relatively large impact on both the soil and terrestrial tissue EPCs, as can be seen by the difference in HQs estimated by the toxicity unit method and direct calculation method. For example, the Carolina wren (1 and 2) would have estimated total TEQ HQs equal to 1 if the 95% Chebyshev UCL was selected as the EPC.

Based on the limited TEQ dataset available in OU-4, it is uncertain whether risks associated with TEQ exposure in OU-4 are underestimated or overestimated. However, as presented in more detail in Appendix F, PCDD/PCDF concentrations in soil and sediment appear to be largely within the range of background concentrations found in U.S. soils.

[14] Concern was expressed [by the WHO Committee] about direct application of the TEF/total TEQ approach to abiotic matrices, such as soil, sediment, etc., for direct application in human risk assessment. This is problematic as the present TEF scheme and TEQ methodology are primarily intended for estimating exposure and risks via oral ingestion (e.g., by dietary intake)

6.2.1.4 Habitat Quality/Food Availability

As discussed in Section 2.1, the quality of the habitat in this portion of Choccolocco Creek is largely agricultural or forested, with a limited number of residential properties and therefore, some areas are unlikely to meet optimal habitat requirements for some ecological receptors strictly due to the current land uses. However, as demonstrated above, wildlife communities and assemblages of invertebrates and plants are present and robust. The detailed discussion of receptor habitat use provided in Section 2 demonstrates that the evaluation of each of the receptors in this OU-4 BERA with the assumption of 100% site use likely overstates exposure, especially for wildlife with large home ranges. However, it is acknowledged that large areas of OU-4 represent relatively better quality habitat as compared to the mostly urbanized areas surrounding Snow Creek in OU-1/OU-2 where ecological habitat is generally lacking. Additionally, ecological habitat is found in nearby areas (such as upstream Choccolocco Creek and Cheaha Creek) outside the Anniston PCB Site. As such, the overall exposure to ecological receptors that may be from areas outside of OU-4 is unknown. It is anticipated that exposures to site-related COPCs outside the Anniston PCB Site are similar to background exposures and do not result in unacceptable risk to ecological receptors. In the other OUs, such as OU-1/OU-2, the lack of suitable habitat is expected to significantly reduce use of those areas. Thus, the risk estimates for this OU-4 BERA are not significantly underestimated, and may be overestimated based on consideration of the quality and usage of nearby ecological habitat.

6.2.1.5 Site Use

Some of the receptors that are assumed to be using OU-4 continuously (i.e., 100% site use) are likely transient and are not expected to spend 100% of their time in OU-4. For example, the Carolina wren and mink prefer dense, overgrown vegetation and may not be present in areas of OU-4 lacking shrubby or woody undergrowth. The red-tailed hawk, on the other hand, prefers open fields for foraging, and may not be present in areas with dense forest canopies. The tree swallow, osprey, and sandpiper are migratory in this area of the southeast U.S. and would be expected to use OU-4 only as a stop-over during winter months. However, other receptors, such as shrew, have relatively small home ranges and can utilize a variety of habitat types. For shrew, OU-4 is sufficiently large to support individuals and populations that reside primarily within OU-4. Therefore, the assumption that each receptor exclusively uses OU-4 may result in overestimation (for some receptors), but not underestimation of exposure and risk.

6.2.1.6 Receptor Exposure Parameters

For avian and mammalian receptors, exposure is estimated using a dietary exposure model. This model uses generic assumptions for food IR, body weight, and dietary composition that were derived from literature sources or estimated from allometric relationships and not actually measured using site-specific data. Variations from natural stresses may result in one or multiple parameter changes (e.g., mean value body weight or dietary consumption). It should also be noted that wildlife exposure factors for these representative species can vary by location, quality of habitat, and season. Conservative values, identified as the published values resulting in the highest exposure estimate, were often selected when conflicting information was presented.

The selected exposure parameters are likely to accurately represent or overestimate, but not underestimate potential exposure to actual wildlife present in OU-4, as the exposure parameters were

selected to be more protective (i.e., high IRs, low body weights, 100% site use/exposure to the upper bound of concentrations). For several of the selected representative receptors, significant uncertainty in the availability of preferred prey items in OU-4 was identified. Therefore, alternative diets were also considered. Specifically, alternative dose and risk estimates were calculated for the Carolina wren, spotted sandpiper, belted kingfisher, short-tailed shrew, raccoon, mink, and the red fox. While uncertainty in the estimated dietary compositions of ecological receptors may overestimate or underestimate exposure, this uncertainty is mitigated through selection of alternate diets, as noted.

For the mourning dove, 99% of its diet consists of seeds; however, site-specific seed samples were not collected and analyzed, and therefore, the dietary composition was categorized as plants. Although the moisture content in leafy plants is greater than in seeds (assumed to be negligible), the plant tissue concentrations were converted to dry weight for the dietary dose calculations and it was assumed that the concentrations are comparable to seed concentrations and therefore, risks are also comparable.

All other elements of the exposure model remained the same as those described in Sections 4.4 and 4.5. For this alternative analysis, detailed information on the derivation of the original and alternate diets is presented in Tables 4-1b for birds and 4-2b for mammals.

6.2.2 Bioaccumulation Factors

Prey tissue concentrations measured in OU-4 were used to develop site-specific BAFs. The BAFs are used to estimate prey tissue concentrations that may be consumed by the representative birds and mammals. Specifically, the BAF represents the relationship between abiotic media (in this case soil and sediment) and various prey tissues (e.g., plants, earthworms, benthic invertebrates, etc.), and represents one of the largest sources of uncertainty in the modeled HQ calculations.

For PCBs and mercury, the models were based on soil and sediment samples collected from the same general areas where aquatic or terrestrial biota samples were collected. These grouped biotic and abiotic datasets were sufficiently large to conduct regression analysis for development of linear uptake models to estimate bioaccumulation. While the use of regression equations to estimate uptake decreases some of the uncertainty with the use of BAFs, a good deal of uncertainty remains because predictive relationships were generally not found between sediment and soil and prey tissue for either PCBs or mercury. For non-mercury metals and dioxin TEQ (based on individual PCDD/PCDF and DL-PCB congeners), data were not sufficient to develop median AA BAFs or conduct regression analysis to develop an uptake model. Site-wide median BAFs were used in these cases, as discussed in Appendix B for metals and Appendix F for PCDD/PCDF and DL-PCB congeners. The uncertainties related to these approaches are discussed below.

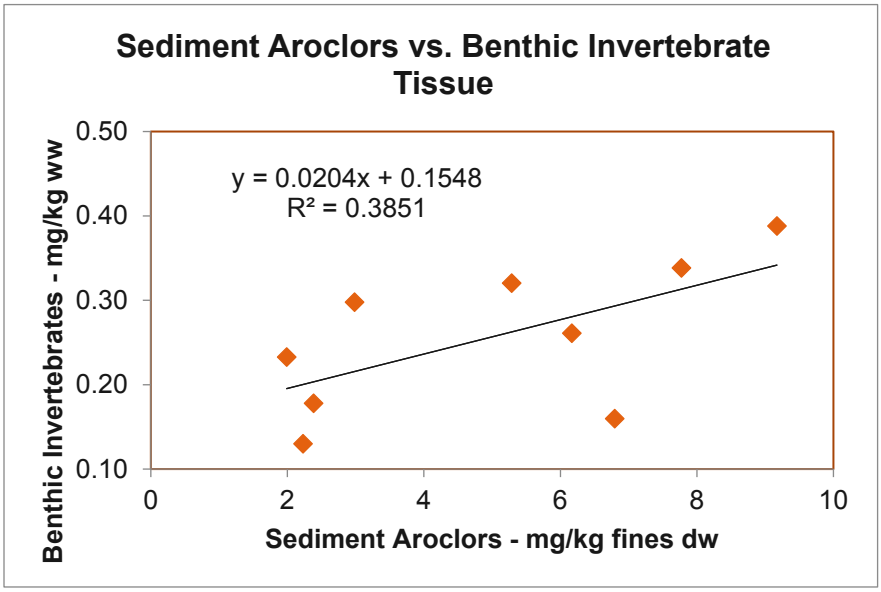
6.2.2.1 Sediment BAFs for PCBs and Mercury

Availability of uptake models based on fixed assumptions for OU-4 media

For sediment, regression analysis resulted in significant relationships between fines-normalized sediment and PCBs in benthic invertebrates and mercury in frogs on a wet weight basis. As discussed in Section 4.4, percent fines in sediment did not correlate well with PCB or mercury concentrations in sediment. Thus, it was not possible to estimate a concentration for any other tissue type based on fines-normalized sediment without introducing significant uncertainty related to having to assume a standard percent fines.

Because no other element of the diet is based on percent fines and because the calculation of HQs requires a static assumption about the percent of fines in sediment, it was not feasible to incorporate these fines-normalized relationships into the overall dose estimation for HQ calculations. To evaluate this uncertainty, an HQ was calculated using the benthic invertebrate PCB regression shown in Figure 6-23 below.

Figure 6-23. Regression Analysis of Fines Normalized PCB Concentrations in Sediment and Field Collected Benthic Invertebrate Tissue



To use this relationship in a dose model, it was necessary to convert the fines-normalized sediment concentration into a dry weight PCB concentration using the average percent fines for all BSA data of 36%. It was also necessary to convert the estimated tissue to a dry weight value to be consistent with the dry weight IR used in the dose model. The average percent solids of 19% (84% moisture) was used for this purpose. The resulting HQs based on this static assumption for fines would be increased by approximately 8% based on the sandpiper (scenario 1, i.e., the receptor with the highest proportion of benthic invertebrates in the diet).

Use of median AA BAF values

Based on the lack of a usable correlation for PCBs and mercury for several aquatic prey items, a ratio estimator that represents the central tendency of the dataset was selected to estimate tissue uptake. Because individual samples of the various prey tissues were not co-located with individual sediment locations, BAFs based on the mean sediment concentration (using Kaplan-Meier statistics to account for ND results) in a BSA and individual detected tissue concentrations were calculated to maintain some degree of co-occurrence. This method was selected following discussions with USEPA and after it was determined from review of field notes that specific tissue collection locations could not be estimated. While general collection areas were identified, specific tissue samples could not be associated with the individual collection locations, so additional analysis of spatial correlation was not conducted. BAFs based on individual tissue samples were calculated and, consistent with the approach used for BAF selection in the EcoSSL Guidance (USEPA 2005b), the median BAF was selected as the most appropriate estimate

of central tendency for the range of BAFs in each AA. BAFs based on AAs were selected to allow for potential differences in uptake across OU-4 to be incorporated into the food web models while maintaining a large enough sample size to have a reasonable estimated of central tendency and to estimate the variability in each median AA BAF value, as presented in Appendix B (Tables B-4 through B-7 for aquatic BAFs and B-15 and B-16 for terrestrial BAFs). For aquatic BAFs, 95% confidence limits on the median BAFs indicate that the selected median AA BAF values are generally close to the upper confidence limit for most tissues, indicating that uptake may be overestimated, whereas the site-wide median BAF values more often fall towards the center of these confidence limits. For terrestrial BAFs, the number of BAFs in the AAs was too small to calculate variability around the median AA BAF in most cases. The terrestrial site-wide median BAFs tend to fall in the center of the confidence limit range. In general, the variability around the selected median BAFs is relatively small, with upper and lower confidence limits differing by less than a factor of two from the selected median BAF. A notable exception is for emergent insects, for which the median AA BAFs for PCBs are 20.2, 0.53, 0.56, for the UAA, MAA, and LAA, respectively (Table 4-21). In the UAA, the 95% confidence limits on the median BAF range from 0.22 to 21.2. The median UAA BAF likely overestimates uptake to receptors consuming emergent insects, based on comparison to the other median AA and site-wide BAFs and literature values. Emergent insect BAFs are discussed in more detail below.

To further evaluate the predicted sediment median BAFs based on the OU-4 data, BAFs available for two other PCB sites were considered. For the Kalamazoo River (Kay et al. 2005) and the Housatonic River (USEPA 2003), dry weight BAFs were not readily available but lipid and OC-normalized biota-soil or biota-sediment accumulation factors (BSAFs) were available for several of the biotic tissues considered in this OU-4 BERA. Specifically, crayfish BSAFs were available from both sources and are used here for comparison. For the Kalamazoo River, calculated BSAFs were based on the geometric mean of lipid-normalized wet weight biota total PCBs to the geometric mean of OC-normalized dry weight sediment total PCBs. For the Housatonic River, BSAFs were based on averaged OC-normalized PCBs in river sediment by sediment mile and co-located lipid normalized crayfish tissue concentrations. The higher of the median or geometric mean of the individual BSAFs was used, and in the case of crayfish, the geometric mean of the individual BSAF was used. The Kalamazoo River data resulted in a crayfish BSAF of 0.43 kg OC/kg lipid (Kay et al. 2005) and the Housatonic River data resulted in a crayfish BSAF of 0.56 kg OC/kg lipid for Reach 5A/5B and a crayfish BSAF of 1.2 kg OC/kg lipid for Reach 5C/5D/6 (USEPA 2003). For comparison purposes, the crayfish BSAFs in this OU-4 BERA are calculated as 0.24, 0.40, and 0.18 kg OC/kg lipid based on the median AA BSAFs for the UAA, MAA, and LAA, respectively. Differences in the OU-4 BAFs/BSAFs relative to those estimated for the Kalamazoo River and Housatonic River may be due to a variety of factors, including differences in the composition of PCBs at the sites, site-specific factors affecting bioavailability, and the degree to which abiotic and biotic samples were co-located (for OU-4, data were not precisely co-located).

It is important to note that no predictive relationships were found between tissue and sediment for either the Housatonic River or the Kalamazoo River datasets and both values are based on selecting a predictor of central tendency. This comparison indicates that the site-specific values developed for this OU-4 BERA are similar to those observed for other sites and are preferred because they are based on site-specific data. The selected BAFs can be demonstrated to give a reasonable estimate of central tendency when averaged over the AAs, even if there is not predictive value (i.e., lack of significant regression

relationship). On a localized basis, there is the potential for the BAFs to overestimate or underestimate tissue concentrations.

Uptake models based on laboratory uptake data

As discussed in Section 4.4, bioaccumulation for benthic invertebrates was also measured in a laboratory study conducted with OU-4 and reference sediment and *Lumbriculus variegatus.* The resulting laboratory study predicts uptake of PCBs from sediment at approximately 26 times that of what was observed based on the field collected odonata larvae. The specific reasons for the differences in the laboratory and field estimates may result in part from differences in sediment composition, but the field data were evaluated based on OC- and fines-normalized sediment and neither of these factors substantially changed the general uptake estimates. Another factor that may influence differences is the fact that the field and laboratory data are based on different species. The worms used in the laboratory analysis are generally adult forms, are infauna, and live and feed primarily in the sediment matrix. The field collected invertebrates (odonates) are larval form and live on the surface of the sediment during this life stage and likely have lesser exposure than worms. Additionally, the odonate samples were not co-located with sediment samples. Rather, the tissue samples were collected within the same BSA as the sediment samples used to calculate BAFs. Therefore, the degree of exposure for the odonate larvae is uncertain due to spatial variability in sediment PCB concentrations. Regardless, a benthic feeding receptor likely eats some combination of a variety of invertebrates so the use of this lab-based uptake relationship may overestimate exposure as its use assumes all invertebrates consumed are worms.

Use of cranefly data for emergent insects

For emergent insects, tissue PCB concentrations in craneflies in EUA-02 and EUA-03 (in the UAA) were significantly higher than PCB concentrations in damselfly and mixed insect tissue for the remaining BSAs. As discussed in Appendix B, this disparity is unexpected because craneflies primarily feed at lower trophic levels than damselflies, which are predaceous. In addition, concentrations of PCBs in other aquatic tissues collected from these BSAs were not highly elevated compared to those collected in other BSAs as might be expected. Literature values specific to craneflies were not available for comparison. However, as discussed below, data for emergent insects from the Kalamazoo River would suggest that the cranefly-based BAFs are likely to be overestimating uptake. While there is uncertainty associated with these elevated concentrations, they are based on validated data and are used in this OU-4 BERA. The two cranefly samples affect exposure estimates for aquatic insectivorous birds and mammals within the UAA (including reaches C1 through C4) and may over predict exposure. The emergent insect BAFs employed for the MAA and LAA were based on samples primarily containing damselflies and dragonflies (odonate species). These BAFs were compared to BAFs estimated using an available dataset from the Kalamazoo River (Kay et al. 2005). For all aquatic insects, a BAF of 0.54 was calculated based on the mean tissue (0.74 mg/kg ww converted to 2.39 mg/kg dw assuming the average of OU-4 emergent insect samples of 31% solids) compared to the mean sediment concentration of 4.46 mg/kg dw. This BAF is very similar to the 0.56 and 0.53 BAFs calculated for OU-4 for the MAA and LAA respectively. A BAF value for odonates only (the species collected for the MAA and LAA), is estimated to be approximately 0.15. Thus, the selected BAF for the two downstream areas is considered adequately conservative.

Soil BAFs and use of literature BAF values

For soil, the regression analysis resulted in significant relationships between soil PCBs and mercury on a dry weight basis and small mammals (including and excluding shrews) and soil invertebrates on a dry weight basis. As these media concentrations are based on dry weight, the regression equations were easily incorporated into the HQs and relatively lower uncertainty is associated with the use of these uptake equations compared with the median BAFs for which no significant relationship between soil and tissue was found. In fact, for PCBs and mercury, the relationships between soil and tissue concentrations for small mammals and earthworms are highly significant, regardless of conversion to wet weight or OC- and/or lipid-normalization. For small mammals, there is some uncertainty regarding the range of PCB concentrations included in the dataset. To evaluate this uncertainty, the OU-4 model was compared to a model based on data from the Kalamazoo River. While a regression could not be developed for the Kalamazoo River dataset, the static BAF based on average soil concentration and average tissue concentrations was estimated for small mammals (Blankenship et al. 2005). The static BAF ratio based on the same assumptions used in this OU-4 BERA (i.e., combined shrews and small mammals using an assumption of 32% solids) is 0.314. This BAF predicts mammal tissue concentrations approximately 2 to 4 times lower than those predicted by the OU-4 regression. As such, the mammal regression employed is considered to be adequately protective and to have relatively lower uncertainty compared to ratio BAFs for which no relationship was found.

For terrestrial insects (i.e., grasshoppers), PCBs were never detected in grasshopper tissue; therefore, a BAF of 0.17 derived from non-worm terrestrial insects along the Kalamazoo River (Blankenship et al. 2005) was selected for use in the modeled dietary HQ calculations. This literature-based BAF likely overestimates uptake to terrestrial insects such as grasshoppers and crickets, in which PCBs were not detected in OU-4 samples. The literature-based BAF may overestimate or underestimate PCB concentrations in other terrestrial insect species more closely associated with the soil, as well as in upper trophic levels that consume a variety of terrestrial insects. Similarly, PCB and mercury data for terrestrial plants were not sufficient for regression analysis or calculation of median BAFs. Literature-based values were selected to model uptake to plants in this OU-4 BERA. For PCBs, a soil-to-terrestrial plant uptake relationship was derived from data presented by Ficko et al. (2013). For mercury, a terrestrial plant BAF of 0.05 from Pant et al. (2011) was selected. These literature uptake factors may overestimate or underestimate uptake of PCBs and mercury in OU-4.

For the remaining terrestrial tissues including mercury in grasshoppers and small mammals, median AA BAFs were used, similar to those calculated for sediments. Many of the same uncertainties related to use of a BAF based on a central tendency estimate exist for soil as discussed above for sediment.

6.2.2.2 Soil and Sediment BAFs for Non-Mercury Metals

Aside from PCBs and mercury, the remaining COPCs in OU-4 are metals for which a sufficient tissue and sediment/soil dataset is not available to test statistical uptake relationships. For these non-mercury metals, site-wide median BAFs were calculated using the approach described above for median AA BAFs. A site-wide median BAF was selected for these non-mercury metals because the median AA BAF values were considered too uncertain due to small sample sizes. Additionally, in some cases, data were not sufficient for calculation of a site-wide median BAF. Because some BSAs did not have data for both abiotic and biotic samples, it was not possible to calculate site-wide median BAFs for several COPCs and tissues. In these cases, the site-wide average ratio BAF was selected. Use of this alternate BAF

approach is considered more uncertain than use of site-wide median BAFs, because the data used to calculate the ratio can be located in any area of OU-4 and may not reflect local uptake conditions for the sampled tissue. The BAFs based on this alternate method may overestimate or underestimate uptake of COPCs into prey tissue.

Some non-mercury metals were never detected in tissue. In these cases, a tissue concentration equal to half the maximum RL was selected. When a RL-based value for the tissue EPC was assumed, prey tissue concentrations for these compounds and tissues are considered to be overestimated for upper trophic levels because these metals were never detected in tissue.

Although some of the non-mercury metals BAFs may be underestimated or overestimated in this OU-4 BERA, the impact on the risk characterization is expected to be minimal, as these compounds are not considered the primary risk drivers in OU-4.

6.2.2.3 Soil and Sediment BAFs for TEQ

Several uncertainties are inherent in calculation of BAFs for DL-PCBs and PCDD/PCDFs. For this OU-4 BERA, site-wide median BAFs were calculated for individual congeners based on the approach used for other COPCs. However, due to the small dataset size and low frequency of detection for many of the congeners, the site-wide median BAFs were often based on only a few paired samples or could not be calculated at all. Site-wide average ratio BAFs were calculated, as done for non-mercury metals, when congener-specific data were insufficient to calculate a site-wide median BAF. Uncertainties due to the use of a site-wide average ratio BAF are the same as described above for non-mercury metals. When congeners were never detected in tissue, no BAF was selected for use in the TEQ calculations. As a result, congeners that were never detected in tissue were excluded from the TEQ calculations for those prey tissues; although, it is unknown whether they were not detected due to the small dataset size, or whether actual differences in congener uptake and elimination result in the tissue NDs. Excluding congeners that were never detected from calculation of tissue TEQ concentrations may overestimate or underestimate tissue TEQ EPCs and exposure estimates for upper-trophic level receptors.

No PCDD/PCDF or DL-PCB data were collected for earthworms or terrestrial insects in OU-4. Literature-based BAFs based on earthworm uptake data from Fagervold et al. (2010) were selected for the individual PCDD/PCDF congeners. Uncertainties due to use of literature-based BAFs are similar to those described above for PCBs and terrestrial insects. No literature-based BAFs were located for the DL-PCBs; therefore, the median of the PCDD/PCDF congener BAFs was selected to model uptake of all DL-PCB congeners. While this assumption does not take into account the differences in uptake assumed for the various DL-PCB congeners based on chemical structure and level of chlorination, the various homolog groups for the PCDD/PCDFs span a range of uptake potentials that is assumed to be similar to the range for the DL-PCB homologs, and the median PCDD/PCDF BAF is considered a reasonable estimate for DL-PCB BAFs. Because the DL-PCBs have relatively low TEF values, use of the overall PCDD/PCDF median BAF to represent DL-PCBs in the combined TEQ concentrations is expected to be minimal.

Additionally, uptake for all terrestrial invertebrates (soil invertebrates and terrestrial insects) was assumed to be based on the earthworm uptake factors from Fagervold et al. (2010). Based on the exposure assumptions for grasshoppers, it is likely that using a BAF value based on uptake in worms overestimates exposure to terrestrial insects that are not in close contact with soil media. For other COPCs, the

terrestrial insect BAFs are significantly lower than for worms, and this trend is also expected for PCDD/PCDF and DL-PCB congeners. Therefore, HQs for receptors consuming terrestrial insects can be considered to be conservative.

6.2.3 Toxicity Benchmarks and Toxicity Reference Values

The toxicity benchmarks and TRVs used to identify risk to each AE represent a significant source of uncertainty in this OU-4 BERA. Most of the toxicity data evaluated were derived from laboratory studies conducted in settings that do not mimic true field conditions. Laboratory studies typically control various factors to isolate one parameter in particular. Although such controlled experiments result in a more valid interpretation of the isolated parameters or relationship, uncertainty is associated with assuming that laboratory exposure conditions are equivalent to in-field exposure conditions. Exposure duration and toxicity characterization are two parameters that exemplify the difficulty in translating literature-derived data to data representing the exposure conditions for receptors. The use of chronic data is preferred in development of TRVs. Available toxicological data were not always associated with chronic exposure durations. Therefore, uncertainties were introduced in extrapolating non-chronic test results to chronic receptor toxicity benchmarks or TRVs. These uncertainties were partially handled through the application of uncertainty factors in the derivation of low TRVs.

In all cases, the benchmarks and TRVs are selected to be conservative estimators of a toxicity threshold so that the possibility of underestimating risk is minimized. The specific uncertainties for these values are discussed below.

6.2.3.1 PCB Sediment Thresholds and Benchmarks for Benthic Invertebrate Communities

Uncertainty in the sediment-toxicity thresholds (EC0, EC0*, EC10*, and EC20*) has five components: (1) whether the reference sediments collected in areas that are located upstream of OU-4 reflect background chemical constituents that are not associated with P/S (i.e., urban runoff from the Snow Creek watershed); (2) whether the lowest measured reference-sediment response for a given toxicity endpoint adequately represents the lowest response that would be caused by a reference sediment; (3) variability in the calculated toxicity thresholds (EC0, EC0*, EC10*, and EC20* values); (4) inherent variability in results of toxicity tests; and (5) potential variability between batches of toxicity tests conducted at different times and in different laboratories a considerable length of time after the sediments were collected from OU-4. These five potential sources of uncertainty are discussed below.

Regarding the first uncertainty, the six reference sediments collected from Choccolocco Creek approximately 3 km upstream of its confluence with Snow Creek came from an agricultural area that does not receive urban inputs. Therefore, the reference sediments do not have physical-chemical characteristics of an urban-influenced stream (Snow and Choccolocco Creeks) and might underestimate or overestimate the toxicity caused by chemicals that originated from non-site sources, thus, under- or overestimating the toxicity caused by inputs originating from OU-4.

Regarding the second uncertainty, six reference sediments might not adequately represent the entire range of potential reference-sediment responses, even if the reference sediments contained appropriate background chemicals and toxicity from non-site sources. Therefore, the lowest reference-sediment

response for a given toxicity endpoint might not be representative of the "true" lower limit of the reference values, contributing to a potential underestimate or overestimate of the toxicity caused by inputs originating from OU-4. In addition, confidence intervals around the EC0* value were estimated for two of the most sensitive endpoints to better understand how well the EC0* captures the full range of reference responses. The 95% UCLs for the EC0* values for the two most sensitive *Hyalella azteca* endpoints from the OU-4 sediment toxicity tests are:

- 42-day survival-normalized young/female: 72 mg/kg
- 42-day young/female: 14 mg/kg

The 95% lower confidence limit for these two endpoints could not be defined because the 95%UCL on the control-normalized response (which is associated with the lower confidence limit on the whole sediment concentration) in that reference sediment was greater than the maximum response in the regression of control-normalized response versus PCB concentration for the OU-4 sediments. These wide confidence intervals are a result of large variability in reproduction among the eight replicate beakers per sediment. For example, the coefficient of variation (the standard deviation of the eight replicate beakers divided by the mean value) was 0.86 for survival-normalized young/female and 0.45 for young/female. Similar variability occurred even if all six reference sediments were pooled to calculate an overall standard deviation (instead of the individual-sediment variability). These UCLs on the PCB concentrations reflect the high among-replicate variability in these sediment toxicity tests and indicate that the EC0* (1.4 and 1.5 mg/kg for the two endpoints, respectively) are conservative estimates of the potential reference conditions.

Regarding the third uncertainty, as described above, there is variability in the responses from the OU-4 sediments around the central-tendency concentration-response curves for each endpoint (see Figures C-2a through C-2c and C-3a through C-3c in Appendix C). Furthermore, there is variability in the toxicity responses for repeated testing of a given sediment (see Appendix C and below). Although the toxicity tests are conducted using strictly specified exposure criteria, inherent variability in the biological responses is normal and expected. Therefore, there is statistical uncertainty in the EC* values listed in Table C-1 of Appendix C. Laboratory control response was particularly variable for endpoints found to be the most sensitive. Control response for *Hyalella azteca* reproduction endpoints, in particular had very high control variability, varying as much as 4-fold among batches (Appendix C, Table C-2). Reference response (percent of control) ranged widely for these endpoints (64 to 192%) and confidence intervals for concentration response models were much wider for these endpoints than for the endpoints with more stable control response such as survival (Appendix C, Figure C-3c). In addition, a sample collected very far downgradient from the site and in which PCBs (and most other chemicals) were not detected performed very poorly with respect to these endpoints (Figure C-3c). Conversely, many of the OU-4 sediments performed better than the laboratory controls. Therefore, there is large uncertainty surrounding the predictability of these reproductive endpoints. To evaluate the sensitivity of the control response to threshold estimates the *Hyalella azteca* endpoint was re-modeled using non-adjusted data. The EC0* for the non-adjusted model is 6.97 mg/kg PCB, five times greater than the EC0* based on adjusted data (i.e. 1.38 mg/kg PCB). In contrast, when 42d survival is modeled with non-adjusted data the EC0* is very similar (35.8 vs. 31.1 mg/kg PCB for adjusted data). This variability in the response results in uncertainty for risk characterization of sediments based on the EC* values derived from *Hyalella azteca* reproduction. Regarding the fourth uncertainty, results of sediment toxicity tests can be highly variable for some

endpoints, even when conducted in the highly-skilled laboratories that conducted the tests with OU-4 sediments (Appendix C). For example, the OU-4 tests were conducted in three batches, each with its own control sediment (but the same sediment was used as a control in all three batches). The variation among the three control responses for the 23 endpoints ranged from 1.3% to 137% of the mean of the three results (Appendix C). In general, survival and hatch-percentage endpoints varied by relatively small percentages (1.3% to 4.4%), growth endpoints varied by intermediate percentages (18% to 80%), and reproduction endpoints varied by intermediate to large percentages (25% to 137%). Given this sometimes large variability in control responses for a toxicity endpoint, large variability can also be expected in responses of organisms exposed to OU-4 sediments, and careful consideration needs to be given to interpretation of the growth and reproduction endpoints where such variability was substantial. For example, for the one OU-4 sediment that was repeat-tested two months apart in the same laboratory, the difference in control-normalized response for the 12 endpoints ranged from 0.2% to 74% of the mean of the two results. Six (50%) of those endpoints had differences that were less than 20% of the mean control-normalized response, and five (42%) had differences between 20% and 50% of the mean control-normalized response. The median difference was 22.4%. Therefore, when comparing any one response percentage to a specified threshold for significant effects (e.g., an EC0*, EC10*, or EC20*), it should be recognized that the "true" toxicity of that sediment might not be accurately estimated by the result from a single toxicity test (i.e., the toxicity might be considerably underestimated or considerably overestimated). In contrast, the regression-based predictions of PCB concentrations that cause a specified percentage response are central-tendency estimates that tend to "average-out" that variability, making the regression-based predictions of effect percentages less uncertain than the results from any single sediment toxicity test.

Regarding the fifth uncertainty, the OU-4 sediments used in the toxicity tests were collected in August 2010 but were not tested until November 2010 (the first cycle of testing) or January 2011 (the second cycle of testing). Those intervening periods exceeded the maximum eight-week hold time recommended by the USEPA (2000) before sediment toxicity tests should be started. During storage, the chemical characteristics of the sediments might have changed, thus altering the concentrations and/or bioavailability of the PCBs and other potential contributors to toxicity. However, those delays were decided to be necessary: (1) to provide time for chemical analyses of the sediments so informed decisions could be made about which sediments to test in which batch, and (2) because the two contracted laboratories did not have enough capacity to conduct all the toxicity tests in one batch (i.e., a minimum two-month interval was needed between batches to allow the *Chironomus dilutus* tests in the first batch to be completed before starting the second batch of tests). The extended hold times were deemed acceptable because the primary goal of the testing was to develop generic concentration-response relationships of toxicity *versus* PCB concentration (for extrapolation to all OU-4 sediments, not only those sediments that were tested) and was not to specifically characterize the "true" toxicity of any given OU-4 sediment. Therefore, although changes in the chemistry of sediments that are stored beyond the eight-week hold time can contribute to interpretation uncertainties, the uncertainty is less when the results of the toxicity tests are used to develop concentration-response relationships (as in this application) than when they are used to decide whether a specific sediment is toxic when tested after its hold time has been exceeded (which was not the purpose of these toxicity tests).

6.2.3.2 PCB Sediment Toxicity Threshold Interpretation

Although a range of PCB toxicity thresholds are evaluated herein, it is important to understand the uncertainty associated with the specific interpretation of the threshold exceedances. In CERCLA risk assessments, site-specific data and information are weighted higher for risk management decision-making than non-site-specific or literature data/information. The site-specific benthic invertebrate toxicity thresholds for OU-4 were developed from two standard test organisms (i.e., an amphipod and a midge) and a variety of toxicity test endpoints. Many of the test results were highly variable for the sediments analyzed from OU-4 and the reference areas, with little obvious relationship to sediment PCB concentrations. Nevertheless, statistical analyses were conducted to provide a means to develop thresholds for risk characterization and bounding, and to evaluate potential response relationships relative to reference (Section 5.1.1 and Appendix C). The inclusion of a variety of endpoints and toxicity thresholds provides a robust set of information for the WOE assessment of risk to benthic communities.

The EC-based toxicity thresholds are based on a range from 0% to 20% effect levels beyond the reference response for growth, reproduction, and survival endpoints. While all endpoints provide useful information, a 10% effect on a growth endpoint cannot be interpreted the same as a 10% effect on a survival endpoint. Growth of individuals has an uncertain potential overall impact on communities, whereas survival has a clearer potential impact. Likewise, it is uncertain whether a 10% or 20% decrease of reproduction (i.e., in young per female) of a given test species would actually result in population or community level impacts. This, coupled with the fact that the variability in the laboratory-control responses was often high for the growth and reproduction endpoints, makes the survival endpoints a more certain measure of likely effects from PCBs on populations/communities of infaunal benthic invertebrates for OU-4.

Finally, consideration needs to be given to the two standard laboratory test organisms used to conduct the laboratory toxicity tests, and their representation of the benthic communities that occur at the site (including reference areas). An evaluation of the benthic community data suggests that amphipods, like *Hyalella azteca*, do not occur in the OU-4 area waterways. Chironomids (i.e., midges), on the other hand, are abundant in the site-specific benthic invertebrate community samples (see Table 2-2) and likely make up a substantial portion of the benthic communities in area waterways. This is not surprising given the warm water conditions in northeast Alabama, and the fact that these organisms are typically predominant in waterways of the southeastern U.S. In addition, USFWS (2015) recently reported that bivalves tested using the same sediments from the site-specific toxicity program are less sensitive to the OU-4 sediments than either the midge or amphipods. This suggests that the midge and amphipod data represent a conservative assessment of potential toxicity test conditions at OU-4.

6.2.3.3 TECs and PECs for Sediment

Consensus-based sediment guidelines were evaluated by MacDonald et al. (2000a, 2000b) to determine if they would be effective tools for predicting sediment quality benchmarks in freshwater ecosystems. The TEC is defined as the concentration below which adverse effects are not expected to occur, and the PEC is the concentration above which adverse effects are expected to occur. These levels were derived using an averaging approach based on similar thresholds from the following published sources:

- Effects-Level SQGs (threshold effects levels [TELs] and probable effects levels [PELs]; Smith et al. 1996)
- *Hyalella azteca* Effects-Level SQGs (TEL-HA28 and PEL-HA28; Ingersoll et al. 1996 and USEPA 1996)
- Effects-Range SQGs (effects range low and effect range median; Long and Morgan 1991)
- Screening-Level Concentration SQGs (lowest effect levels and severe effect levels; Persaud et al. 1993)
- Sediment Quality Advisory Level SQGs (minimum effect thresholds, toxic effect thresholds, effects concentration and EC, MENVIQ; Environment Canada and Ministere de l'Envionnement du Quebec 1992)

Based on the evaluation criteria, TECs and PECs for most of the individual chemicals and mixtures were considered by the authors to be reliable as predictive tools (i.e., predictive ability was greater than 75%). This reliability was associated with the narrative intent of TECs and PECs (i.e., sediment samples were predicted not to be toxic if the measured concentration of a chemical was less than its corresponding TEC and, similarly, sediment samples were predicted to be toxic if the measured concentration of a chemical was greater than its corresponding PEC). However, MacDonald et al. (2000b) acknowledged that sediment samples with concentrations of a chemical that lie between its corresponding TEC and PEC values could not be predicted as being not toxic or toxic. Thus, the true toxicity threshold (i.e., no effect) theoretically lies between the TEC and PEC.

There is significant uncertainty inherent in all of the approaches developed based on empirical data relationships and, consequently, compound-specific values can vary by several orders of magnitude depending on the intent of their use and the derivation procedure (MacDonald et al. 2000b; Smith et al. 1996). Empirical approaches may not reflect contaminant-specific response thresholds (due to un-addressed co-contaminant and chemical mixture issues), and they do not incorporate site-specific factors that influence bioavailability, such as the presence of OC, iron sulfides, and grain size effects, as well as biotic factors that alter exposure and uptake patterns (MacDonald et al. 2000a, 2000b; Di Toro et al. 1991). For these reasons, these screening values are likely to overestimate toxicity, as demonstrated specifically with OU-4 sediments in Appendix C. One exception to this is the TEC and PEC values for lead relative to the site-specific toxicity thresholds developed by Ingersoll et al. (2014) based on the OU-4 toxicity testing program. Lead site-specific threshold values, which ranged from approximately 10 to 14 mg/kg, were lower than the TEC and PEC values of 35.8 and 128 respectively. Because lead and total PCB concentrations were closely correlated in the sediments tested, it is impossible to discern whether these values reflect actual lead toxicity. However, the results of the AVS-SEM analyses conducted as part of the site-specific toxicity test program (Appendix C), lead, and other divalent metals are not likely bioavailable or toxic in OU-4 sediments.

Sediment toxicity benchmarks are not available for barium, cobalt, and vanadium. Therefore, HQs for these COPCs could not be estimated for sediment invertebrates. However, lack of these benchmarks is considered to have a minimal effect on the overall conclusions reached in this OU-4 BERA as the primary risk driver is PCBs. Specifically, the results of the site-specific sediment toxicity testing indicated that "PCBs, rather than metals, PAHs, or organochlorine pesticides, are the principal contaminants causing toxicity in the sediments that were evaluated in this study". Furthermore, the authors evaluated

correlations between whole sediment concentrations of these metals and the survival, growth and reproduction responses and did not find statistically significant correlations. Thus, concentrations of these three metals are unlikely to be of concern for benthic invertebrates within OU-4 (Ingersoll et al. 2014).

6.2.3.4 Soil Screening Levels

Soil-based benchmarks are available from the literature (USEPA EcoSSLs, Efroymson et al. 1997a, 1997b; USEPA 1999, 2015a; Beyer 1990) for soil invertebrates and terrestrial plants. While the specific applicability of these benchmarks to OU-4 invertebrate or plant communities is somewhat uncertain due to differences in the plant and invertebrate communities present in OU-4 and those tested for development of screening benchmarks, these toxicity benchmarks were derived to provide a conservative, screening level assessment of risk. Therefore, uncertainties are biased conservatively, and these values are appropriate for screening soil for potential adverse effects.

The plant benchmarks for the COPCs were obtained from Efroymson et al. (1997a) and the authors report low confidence for most of them because they are based on limited studies. Additionally, most of the studies are laboratory tests using mostly agricultural/produce type of plants which are not representative of the plants within OU-4. The PCB benchmark for plants (40 mg/kg) is based on laboratory tests using pigweed (*Amaranthis retroflexus L.*) grown in sandy soil, which indicated 22% reduction in fresh foliage weight at 40 mg/kg. The PCB benchmark is considered to overestimate toxicity for non-sandy soils and sediments, such as are present at OU-4, in which bioavailability would be reduced due to binding with organic matter. The mercury benchmark (0.30 mg/kg) is obtained from a secondary reference source reporting unspecified toxic effects on plants. The only other study reported by the authors reported reduction in barley germination by 20% at 34.9 mg/kg (115 times higher than the selected benchmark). The chromium benchmark of 1 mg/kg is low and it is not clear how the benchmark was derived by the authors as all the effects concentrations were reported as higher than 1 mg/kg. For vanadium, only two studies were obtained, one obtained from a secondary reference source reporting unspecified toxic effects on plants at 50 mg/kg and the other reporting toxic effects at 2.5 mg/kg; it is not clear how the benchmark (2 mg/kg) was derived by the authors. The authors reported moderate confidence in the plant benchmark for lead (50 mg/kg), which is the lowest reported effect concentration (30% reduction in leaf weight) from 17 studies.

The soil invertebrate benchmarks for the COPCs were obtained using USEPA Region 4 methodology (USEPA 2015a) to derive a benchmark value for PCBs and from Efroymson et al. (1997b) for remaining COPCs, for which low confidence in the benchmarks is reported by the authors. For PCBs, the NOAEL-equivalent and LOAEL-equivalent benchmarks (3.6 and 36 mg/kg, respectively) are based on the equilibrium partitioning approach recommended by USEPA Region 4 (2015a). An alternate water quality benchmark for aquatic invertebrates was selected, since the water quality benchmark used by USEPA Region 4 is based on an ECOSAR model that is not valid for most PCBs and because the selected ECOSAR endpoint was for a saltwater species not present in OU-4. The LOAEL-equivalent water quality benchmark selected in this OU-4 BERA is the FCV calculated by Fuchsman et al. (2006) using NAWQC methodology (Stephen et al. 1985) but derived specifically for aquatic invertebrates. The Final Acute Value/FCV from Fuchsman et al. (2006) are designed to be protective of 95% of aquatic species. The level of protection for the resulting soil benchmark is less certain because differences in toxicity between aquatic and terrestrial invertebrates are unknown, and because input parameters such as Koc and

Henry's Law constant require assumptions for the PCB mixtures. Additionally, the NOAEL-equivalent value was estimated from the LOAEL-equivalent value using an uncertainty factor of 10. Thus, the soil benchmarks used in this OU-4 BERA may overestimate or underestimate risk to terrestrial invertebrate communities. While the calculated soil benchmarks have uncertainties, as noted above, empirical data for PCBs and soil invertebrates suggest that effects occur at higher concentrations than predicted using equilibrium partitioning (EqP). Survival was not reduced in crickets exposed to PCBs at soil concentrations of 500 mg/kg (Paine et al. 1993). Abundance of soil microorganisms (nematodes and microarthropods) was not effected by exposure to 385 mg/kg Aroclor 1254 (Parmalee et al. 1997). And in a review of available soil toxicity data for PCBs, Jensen et al. (2012) cite several unpublished studies that indicate that earthworms are tolerant pf PCB concentrations up to 100 mg/kg or greater. The empirical data available for soil invertebrates suggest that use of the EqP-based soil benchmark likely overestimates PCB risk to soil invertebrates in this OU-4 BERA.

The soil invertebrate benchmark for chromium is based on a study where earthworms were exposed to hexavalent chromium added to soil and animal dung for 60 days and survival was reduced by 75% at 2 mg/kg but the number of cocoons produced were not reduced until 20 mg/kg and there was no impact to the number of juveniles produced. An uncertainty factor of 5 was applied to effect concentration of 2 mg/kg to derive a benchmark of 0.4 mg/kg. The authors report low confidence in this benchmark as it is based on limited studies. The use of a hexavalent chromium benchmark likely overestimates chromium toxicity associated with exposure to trivalent chromium, the species assumed to be present at OU-4, because trivalent chromium is generally considered to be less toxic than the hexavalent form due to its lower solubility and subsequent bioavailability (Eisler 1986). Additionally, the test conditions may not be applicable for OU-4, as the solubility and subsequent bioavailability of hexavalent chromium is greater than for trivalent chromium (Eisler 1986, Pawlisz 1997).

Similarly, the confidence in the NOAEL-equivalent benchmark for mercury of 0.1 mg/kg from Efroymson et al. (1997a) is also low, as it was derived by applying a safety factor of 5 to the lowest effects concentration of 0.5 mg/kg based on an earthworm study. Data from Son et al. (2007) were selected to derive a mercury LOAEL-equivalent benchmark for soil invertebrates. In that study, springtail reproduction was reduced at 0.23 mg/kg. While the LOAEL and EC50 values were similar in this study, this hexapod species is not closely related to insects and is common in Korean rice paddies. It is unknown whether invertebrate species present in OU-4 would have similar mercury sensitivity as springtail. Son et al. (2007) also report that 2 mg/kg mercury is associated with a population growth rate of zero. This population-based benchmark may be more relevant for assessing risk to invertebrate communities in soil.

A soil invertebrate benchmark is not available for vanadium and therefore, the HQ could not be estimated. However, lack of this benchmark is considered to have a minimal effect on the overall conclusions reached in this OU-4 BERA as the primary risk driver is PCBs and it is assumed that any measures to mitigate risk from PCBs would also address risk from vanadium.

6.2.3.5 Surface Water Screening Levels

Surface water effects benchmarks were selected from the literature for aquatic life, aquatic plants, aquatic invertebrates, and fish. The ADEM WQS (ADEM 2015) and NAWQC (USEPA 2016e) were used in this OU-4 BERA, which are derived to be protective of aquatic life, including plants, invertebrates, and fish. The ADEM WQS and NAWQC are derived from the geometric mean of published effect thresholds, and

are designed to be protective of at least 95% of taxa (USEPA 1985). Thus, the aquatic life benchmark values may not be protective of some highly sensitive species or individuals that inhabit the water column. However, the criteria attempt to provide a "reasonable and adequate amount of protection with only a small possibility of considerable overprotection or underprotection". Criteria are only developed if the appropriate amount and quality of toxicological data are available, and are therefore considered to represent the best science available for evaluation of aquatic life. Additionally, surface water benchmarks specific to each receptor group were developed from literature data from ORNL (Suter and Tsao 1996). Thus, receptor specific risks are also calculated in this OU-4 BERA. Use of the lowest toxic effect thresholds, especially when not based on population level effects (e.g., the aquatic plant benchmark for PCBs is based on a 24-hour test showing reduced carbon fixation in algae [*Scenedesmus quadricaudata*]) or based on biological effects but not on statistical significance (e.g., benchmarks for fish and aquatic invertebrates) may result in overestimation of risk for aquatic receptors. However, using the ADEM WQS/NAWQC for surface water effects benchmarks instead of the lowest available toxicological effects thresholds are not expected to significantly underestimate risks in this OU-4 BERA. In fact, as ADEM WQS/NAWQC are developed using salmonid toxicity data (one of the requirements for criteria development), toxicity to fish may be significantly overestimated, as these relatively sensitive cold-water species are not present in OU-4 and were excluded from the development of toxicity benchmarks for this OU-4 BERA. Additionally, the ADEM WQS for mercury is based on toxicity of methylmercury. Use of the ADEM WQS mercury aquatic life benchmark assumes that 100% of total mercury in surface water is present as methylmercury. This assumption likely overestimates mercury risk to aquatic life.

ADEM WQS/NAWQC for some metals are estimated based on hardness assumptions. For this OU-4 BERA, 200 mg/L hardness was assumed. Because hardness data are not available for OU-4, site-specific adjustments could not be made. This assumption could overestimate or underestimate the toxicity benchmarks. If hardness is lower, the toxicity benchmarks employed would underestimate possible risk and if hardness is higher, they would overestimate possible risk.

Additionally, the ADEM WQS, NAWQC, and receptor-specific benchmarks from Suter and Tsao (1996) were used to assess benthic invertebrate exposure to surface water. Since these surface water benchmarks are not based on toxicity data for benthic species, there is uncertainty in resulting HQs being applied to benthic invertebrates. While the HQs based on surface water benchmarks may overestimate or underestimate risk to benthic invertebrates, the overall risk conclusions for benthic species are based on site-specific thresholds developed for sediment. Thus, risk to benthic invertebrates in this OU-4 BERA is not considered to be highly uncertain.

Although some receptor specific benchmarks are not available including barium, cobalt, and vanadium for aquatic plants; barium, chromium, and lead for aquatic invertebrates; and barium for fish, generic aquatic life surface water benchmarks are available for these COPCs that apply to all receptor groups and were used to assess risk for COPCs missing receptor-specific benchmarks.

6.2.3.6 Avian Dietary TRVs

As discussed in Section 5, one of the primary uncertainties associated with avian PCB TRVs is determining if identified receptors might be highly sensitive to PCBs (i.e., chicken-like). For avian receptors, a large number of the available toxicity studies have been conducted using the domestic chicken as the test species. Based on review of the data, the chicken appears to be substantially more

sensitive to PCBs than most of the other avian species tested. As such, TRVs based on domestic chicken studies were developed to represent the high end of the range of sensitivity for all potential species. Given that domestic chickens are not representative of most of the birds that occur at OU-4, these TRVs likely overstate risks to many bird species present in OU-4. A second set of TRVs were developed to represent the mid-range of sensitivity. Recent research conducted by Dr. Kennedy at the University of Ottawa indicates that the vast majority of wild species are not expected to be chicken-like in their sensitivity to PCBs (Farmahin et al. 2012). Specifically, more than 85 wild species have been genetically sequenced to date (Appendix D; Table D-5), including seven of the eight receptor species for OU-4, all of which have either moderate or low sensitivity. The Carolina wren has not been tested, but the house wren has been tested and had moderate sensitivity. Other wild birds potentially present in OU-4 are assumed to mostly have moderate to low sensitivity to the AHR; European starling is the only wild species tested by Farmahin et al. (2012) and subsequently by Eng et al. (2014) that is identified as high sensitivity and is potentially present in OU-4. Additional detail regarding Dr. Kennedy's research and species sensitivity to PCBs is provided in Appendix D. Thus, the mid-range sensitivity TRVs are expected to be more representative of most wild birds found along OU-4. In cases where wild birds have low sensitivity, such as for receptors including the great blue heron, kingfisher, and red-tailed hawk, use of the mid-range TRVs is expected to overestimate toxicity of PCBs.

For development of the high-sensitivity (i.e., chicken) PCB TRVs, a total of eight studies were evaluated. Based on the available data, the lowest LOAEL of 0.13 milligrams per kilogram per day (mg/kg-d) for reduced hatchability in chickens, reported by Lillie et al. (1974) was selected. While the relevance of this endpoint to population level effects is uncertain, the LOAEL was selected to be protective. No NOAEL was measured in this study, thus the NOAEL was extrapolated by dividing the selected LOAEL by a factor of three. The extrapolated NOAEL of 0.043 mg/kg-d is lower than the observed NOAEL from Scott et al. (1975) of 0.065 mg/kg-d and indicates that an extrapolation factor of three is conservative. These values are the lowest values from the available literature and are, therefore, likely to be conservative TRV values.

A total of 13 studies were evaluated to develop mid-range sensitivity (i.e., non-chicken) PCB TRVs. Based on the available data, the lowest LOAEL of 1.4 mg/kg-d for reduced egg production in mourning doves (Koval et al. 1987) was selected for a representative low-effect threshold for the mid-range of sensitivity. This study was not designed to measure this endpoint and authors did not provide statistical evaluation of egg production. Due to the substantial effect on the reproductive endpoint of egg production, this exposure concentration was selected as a LOAEL for this OU-4 BERA. The next lowest LOAEL available is from Dahlgren et al. (1972), where a LOAEL of 1.8 mg/kg BW-d was derived based on reduced hatching success in a chronic study conducted with ring-necked pheasants. The LOAEL of 1.4 mg/kg BW-d from Koval et al. (1987) was selected as the dietary avian LOAEL TRV for PCBs for mid-range sensitivity. To derive the NOAEL for mid-range sensitivity species, the chronic LOAEL from the Koval et al. (1987) study was divided by an uncertainty factor of 3, resulting in the chronic NOAEL of 0.47 mg/kg BW-d. A factor of 10 is considered excessive (would result in 0.14 mg/kg BW-d) based on the range of the NOAEL data reviewed in which the lowest measured NOAEL was 0.41 mg/kg BW-d. These values are similar to TRVs for ring doves that can be calculated from Peakall and Peakall (1973) using the dry matter IR from Nagy (2001), as the study diet was noted to contain only 10% moisture. These TRVs are the low values from the available literature and are, therefore, likely to be TRV values that overstate risk to most mid-sensitivity and low-sensitivity receptors.

Unlike with PCBs, chickens do not appear to be more sensitive to mercury than other wild avian species (Heinz et al. 2009). As such, one set of TRVs are developed herein and are considered applicable to all avian species evaluated for OU-4. The studies considered in the USEPA (2005b) criteria document focus on endpoints that could result in population-level impacts such as survival, reproduction, development, and growth. Because the TRVs provided in the criteria document (USEPA 1995) are based on a literature search conducted in or prior to 1995, other more recent toxicity studies for mercury, which may have evaluated more sensitive endpoints (e.g., nest productivity, fledging) and a wider range of species (e.g. ibis, kestrel, egret), for mercury in avian species were reviewed. Specifically, three studies were identified that provided dose-response data for dietary mercury. These included Albers et al. (2007), Spalding et al. (2000), and Frederick and Jayasena (2011). The selected LOAEL TRV is based on a study conducted by Spalding et al. (2000). The study determined that dietary methylmercury resulted in adverse effects on growth of great egret nestlings at the low dose of 0.068 mg/kg BW-d. The selected LOAEL of 0.068 mg/kg BW-d from the Spalding et al. (2000) study was divided by an uncertainty factor of 3, resulting in the chronic NOAEL of 0.023 mg/kg BW-d (Table D-2). A factor of 10 is considered excessive (would result in 0.0068 mg/kg BW-d) based on the range of the data considered and the selection of a LOAEL TRV that is based on the lowest value in this range. These values are the low values from the available literature and are, therefore, likely to be conservative TRV values.

For mercury, the primary uncertainty associated with the selected TRVs is the fact that the selected values are based on studies in which exposure was solely to methylmercury (more toxic form of mercury). This likely over estimates potential toxicity to identified receptors as the complete dose would not be expected to consist of methylmercury. In animal tissues, the proportion of mercury in the methylated form varies by species, ranging from nearly 100% for most fish species (Bloom 1992) to as low as 6% in some sediment-dwelling bivalves (Boening 2000). In wildlife, mercury uptake is primarily via the diet as methylmercury; however demthylation in the liver is reported in both birds and mammals. In birds, the proportion of methylmercury in some bird tissues can be relatively high (75 to 86% in muscle, Campbell et al. 2005), but the fraction of organic mercury present in liver (and a significant proportion of the total mercury mass) will vary by species, age, sex, season, and tissue (Fimreite 1979). In mammals, a similar pattern was found where methylmercury in muscle and skin was typically greater than 90% of the total mercury present, but in liver it ranged from 3 to 12% of total mercury (Wagemann et al. 1998). Additionally, mercury present in abiotic media at OU-4 is unlikely to be present entirely as methylmercury. Uncertainties associated with the use of methylmercury TRVs to represent mercury toxicity to wildlife in this OU-4 BERA are discussed further in Section 6.2.3.9.

Dietary avian TRVs for the remaining five metals (barium, chromium, cobalt, lead, and vanadium) were selected primarily from the datasets compiled for development of USEPA EcoSSLs (USEPA 2005b and 2007), discussed in more detail in Section 5.5 and Appendix D. The EcoSSL guidance (USEPA 2005b) defines the endpoints considered for NOAEL TRV development as growth, reproduction, and mortality, and a wide range of endpoints are included within each of these categories. While the NOAEL value may be appropriate for use as a screening level, it does not represent a risk threshold. The LOAEL TRVs were generally selected as the lowest LOAELs for a biologically relevant endpoint that was above the selected NOAEL. Because these values were selected at the low end of observed LOAELs from the larger datasets, they are also conservative and may not represent true risk thresholds. Developing TRVs requires conversion of dietary doses using body weight and food IRs. For studies where body weight and food IRs were not provided, general values for birds and mammals were used. Reviewing the data used

to develop these TRV values, uncertainties including the biological relevance of the endpoint selected or conversion of dietary dose using body weight and food IR may result in uncertainty in the TRV.

For example, the chromium LOAEL TRV is based on general reproductive success of duckling survival in black ducks (*Anas rubripes*) of an unspecified age exposed to chrome alum dodecahydrate for 180 to 190 days in feed in an artificial field study. The lowest bounded LOAEL from the growth, reproduction, and mortality datasets is 2.78 mg/kg BW-d (Haseltine et al. unpublished). The primary uncertainty with the selected TRV is the food IR was not reported and a general food IR for birds was used. Using duck-specific information including a body weight of 1.3 kg based on the mean of female and male body weights (Dunning 1984) and a food IR of 125 grams (g) food per day based on mallard ducks in Heinz et al. (1989), Sample et al. (1996) calculated an exposure dose of 5.0 mg/kg BW-d.

The vanadium LOAEL TRV value also includes some uncertainty. This TRV is based on a five week feeding study of sodium metavanadate in one day old chicks (Hill 1979). This study did not provide the body weight or food IR, so general body weight and food IRs for birds were used. Additionally, the lowest bounded LOAEL of 0.69 mg/kg BW-d resulted in the growth endpoint of reduced body weight, which is a general growth endpoint and the biological significance of reduced body weight is uncertain.

6.2.3.7 Mammalian Dietary TRVs

For PCBs, a total of 11 studies were evaluated to develop the TRV values for small mammals. Based on the available data, the lowest LOAEL of 0.68 mg/kg-d based on reduced mouse birth and weaning weight and reduced number weaned per month (McCoy et al. 1995) was selected as the representative LOAEL TRV. For selection of the NOAEL TRV, only one study was available which provided both a bounded NOAEL and LOAEL value. However, the NOAEL from this study was higher than the value selected for the LOAEL TRV and this NOAEL was not selected to derive the NOAEL TRV. Therefore, a NOAEL TRV threshold was extrapolated by dividing the lowest LOAEL (LOAEL TRV) by a factor of 3. While this may create some uncertainty surrounding the exact no-effect threshold level, this is not anticipated to underestimate risk to small mammalian species, as this value is well below the other NOAEL values in the small mammal toxicity dataset considered.

In addition, for non-mink mammals, dietary TRVs were developed for total PCBs based on datasets comprised mostly of mouse and rat toxicity results. However, these TRVs are applied to risk estimates for the shrew and other mammals. Because it is unknown how well mice and rats represent these receptors, uncertainty may exist in the extrapolation of laboratory toxicity results to wild mammalian species. The selected TRVs could overestimate or underestimate toxicity to shrews. To evaluate this, a shrew field study conducted for the Housatonic River (Boonstra and Bowman 2003) was considered. This study indicated that PCB concentrations in soil generally higher than those found within the floodplain EUs in OU-4 resulted in no adverse effects on shrew populations. While this study did not measure dietary inputs or tissue burdens, an exposure estimate comparable to the NOAEL TRV used in this OU-4 BERA can be calculated from the soil NOAEL to provide insight into the relative sensitivity of shrews as compared to other small mammals as well as the differences in laboratory versus actual site data. Using the NOAEL soil concentration of 21.1 mg/kg from the Housatonic River shrew study as a protective soil concentration (functionally similar to an RGO), a dose that would be protective of shrews can be calculated using the same input parameters used for the forward risk analysis for shrews (see Equation 8 below).

Equation 8: $$\text{NOAEL Dose} = \sum_{k=1}^{n}(C_k * DF_k * NIR_{dw}) + (NIR_{dw} * NOAEL_{soil} * DF_{soil})$$

Where:

NOAEL	Dose Estimated dose based on Soil NOAEL from Housatonic River Shrew Study and exposure parameters in Tables 4-2a and 4-2b.
C_k	EPC for the kth food type – calculated as the BAF_k x $NOAEL_{soil}$ (mg/kg dw)
DF_k	Dietary fraction of intake of the kth food type (range 0 to 1.0)
DF_{soil}	Dietary fraction of soil intake
NIR_{dw}	Normalized dry weight IR (kg/kg BW-d)
$NOAEL_{soil}$	Soil NOAEL EPC from Housatonic River Shrew Study (mg/kg)
n	Number of contaminated food types

This calculation results in a NOAEL dose of 4.7 mg/kg-d. This dose is effectively a NOAEL dose (i.e., a dose at which no adverse effects were observed) that is then comparable to the NOAEL TRV used in this OU-4 BERA of 0.23 mg/kg-d (approximately 20 times higher than the selected NOAEL developed from mouse and rat toxicity studies). While there is some uncertainty in this direct comparison because of possible limitations in the Housatonic River field study, different study design and differences in endpoints that were measured, this comparison does provide context for interpretation of modeled HQs primarily based on laboratory studies, relative to actual field observations of the robustness of a local community or population.

Because shrews are intended to represent a range of mammalian species, an additional HQ calculation was conducted for mice to determine if the shrew HQs may also be overestimating potential for adverse effects for other species. Using exposure parameters from available sources which are listed below, site-specific BAFs (Table 4-20), and an assumed soil EPC of 11.4 (the EPC for EU C1 East), and Equation 8 above, a daily dose of 0.75 mg/kg-day is calculated. Comparing this value to the NOAEL TRV of 0.23 mg/kg-day, results in an HQ of 3 for mice in OU-4. The comparable HQ for shrew in this EU was 19. This, in combination with the shrew calculation described above suggests that the shrew risk model likely overestimates risk to small mammals.

Exposure parameters used for the deer mouse:

- Body weight (g): 17.8, selected from Nagy (2001), which was the paired body weight from the measured food IR presented below.
- Food IR normalized to body weight (kg, dw/kg BW-d): 0.214, calculated using the measured dry weight food intake from Nagy (2001).
- Dietary composition: Deer mouse diet consists of 40% vegetation and 58% terrestrial insects. The remaining 2% of the diet presented in Wolff et al. (1985); cited by the USEPA (1993) was unknown and divided equally between the two dietary categories to result in 41% vegetation and 59% insects.

A number of uncertainties affect this analysis, including those generally associated with using a dietary dose model. These are discussed in Section 6.2.1. An additional source of uncertainty associated with using the Housatonic River NOAEL is the difference in PCB composition and biota uptake between sites. Because of the limited congener-specific data available for the Housatonic River, this uncertainty has not been quantified. It is recognized that the uptake and possible total PCB toxicity thresholds could vary between the two sites. However, given the large magnitude in the difference between the estimated NOAEL dose and the TRV used in this OU-4 BERA (based on laboratory mouse and rat studies), this evaluation would still indicate that shrews may be less sensitive to PCBs than some other small mammals.

Dietary TRVs were also developed for mink to evaluate this species and the river otter, another semi-aquatic mustelid species that may have higher sensitivity to PCBs similar to mink. Fifteen studies were identified that were appropriate for development of the mink TRV. The Restum et al. (1998) study was selected as the basis for the mink TRV and alternate mink TRV; however, the PCB-containing fish diet was from Saginaw Bay, and therefore likely also co-contaminated with dioxins and furans. Thus, the selected NOAEL (0.050 mg/kg BW-d) and LOAEL (0.10 mg/kg BW-d) based on the reproduction endpoint and LOAEL (0.05 mg/kg BW-d) based on the growth endpoint may be artificially low, since these compounds act via the same mechanism as co-planar PCBs. While fish containing dioxins and furans may have influenced toxicity in the Restum et al. (1998) study, mink data available from a recent study by Bursian et al. (2013) support the use of the reproduction-based TRVs. Similar NOAEL and LOAEL TRVs of 0.1 and 0.2 mg/kg BW-d based on reduced growth at 6 weeks of age and reduced kit survival at 31 weeks of age can be calculated based on data for mink exposed to weathered PCB mixtures in the diet (Bursian et al. 2013). And an EC20 of 0.06 mg/kg BW-d for kit survival in mink was calculated by Fuchsman et al. (2008). As several studies report similar effects level for mink, uncertainty in the risk estimates for mink based on the reproduction endpoint from Restum et al. (1998) is low. However, growth effects are not clearly tied to population-level impacts in mink, and therefore the mink TRV based on the growth endpoint from Restum et al. (1998) is more uncertain.

For mammalian species, the mink appears to be more sensitive to mercury (CalEPA 2000). Because of the limited toxicity dataset for mercury in mammals, separate TRVs for mink and non-mink small mammals were not developed and dietary studies of mercury in mink were used to develop the mammalian dietary TRV for mercury. The study by Dansereau et al. (1999), a two-generation study in which mink were fed a range of doses of total mercury in their contaminated fish-based diet was used to develop mammalian TRVs for mercury. The primary uncertainty associated with the selected mammalian TRVs for mercury is the fact that the selected values are based on studies in which exposure was solely to methylmercury. Additionally, since the Dansereau et al. (1999) study does not provide body weight and food IRs, generic values were used to convert the dietary concentration to the dose used for the TRVs, which may under or overestimate the TRV values.

Similar to the avian dietary TRVs for other metals, review of the studies used to develop the TRV values in the EcoSSL documents indicates there is some uncertainty in the selected EcoSSL values. For example, for chromium, the lowest LOAEL that is above the NOAEL is 2.8 mg/kg BW-d (Mercado and Bibby 1973). This LOAEL is based on a mortality endpoint in a 50-day study in adult rats, based on water ingestion. The daily dose is estimated based on generic assumptions for water ingestion and body weight, which results in some uncertainty for this TRV. The next lowest LOAEL based on a 35-day study in adult mice measuring reduced sperm cell count in testes, is 9.6 mg/kg BW-d (Zahid et al. 1990). The

LOAEL TRV of 9.6 mg/kg BW-d may be a more appropriate TRV value because it is based on a dietary study in which the dose was reported in mg/kg BW and measured a reproductive endpoint.

The TRV selected for dioxin TEQs for mammals (Moore et al. 2012) has some level of associated uncertainty because the authors indicated that they observed no effects on mink reproduction at the highest dose tested and that this result was unexpected based on the results of other studies where mink had been exposed to a mixture of PCBs and dioxins. While the cause of the differences observed in their study relative to other studies is unclear, based on the concept of employing TEQ methodology, it would not be expected to be a result of differential congener toxicity. The underlying premise of the TEQ methodology is that a class of chemicals, in this case DL compounds, cause adverse effects via a common mechanism of action. To be included in the TEQ calculation, a compound must show a structural relationship to 2,3,7,8-TCDD, bind to the AHR, elicit AHR-mediated biochemical and toxic responses, and be persistent and accumulate in the food chain. Because DL-PCBs are purported to satisfy these criteria, they are included in the calculation of the TEQ along with PCDDs and PCDFs. The TEQ approach is intended convert all DL-PCB congeners, including DL-PCBs, into the concentration of a single compound - 2,3,7,8-TCDD. As such, the Moore et al. (2012) study is considered applicable for both PCDD/PCDF and DL-PCB toxicity. There are also uncertainties associated with the TEFs employed to convert PCDD/PCDF and DL-PCB congener concentrations into TEQs. These values have been developed for birds, mammals and fish using a range of *in vivo* and *in vitro* methods to estimate the relative potency of each congener. However, the TEFs may overestimate or underestimate the actual potency of a particular congener for a given receptor. This uncertainty is mitigated because PCB effects (DL and non-DL) on mammals are fully evaluated in this OU-4 BERA PCB assessment.

6.2.3.8 Amphibian and Reptile Benchmarks and TRVs

Suitable toxicity values for COPC exposures to amphibians are not available. Several sources of toxicity data were reviewed including the U.S. Army Center for Health Promotion and Preventive Medicine Terrestrial Toxicity Database, the Port Hueneme Amphibian Risk Assessment Guidance Manual (ENSR International 2004), and the Naval Facilities Engineering Service Center (NFESC) Amphibian Ecological Risk Assessment Guidance (ENSR International 2004). A sediment screening value is available for lead in the NFESC Manual, but it was not selected for this OU-4 BERA because the NFESC Manual explicitly recommends that generic published screening levels for benthic invertebrates should be used preferentially over values developed in the NFESC study. The values developed in the NFESC study were, in some cases, three orders of magnitude higher than current sediment screening values.

In addition, several individual studies reporting effects on survival, reproduction, and growth endpoints from the peer reviewed literature were considered. Savage et al. (2002) reported that significant mortality was observed in their study, where wood frog (*Rana sylvatica*) tadpoles were exposed to PCB contaminated sediment (collected from a riverine marsh located within Mohawk Nation of Akwesasne in New York). They did not observe a dose-dependent relationship and mortality varied significantly between the different dose groups. Other sublethal effects observed were effects on behavior (i.e., not population level effects). Concentration of PCBs in the study's field collected sediment samples was 325 mg/kg. In comparison, the highest EPC (16.0 mg/kg at C1) and the maximum detected concentration (95 mg/kg at C2) of PCBs in sediment within OU-4 are significantly less than the sediment LOAEL of 325 mg/kg based on the study by Savage et al. (2002). Similarly, in the study by Jofre and Karasov (2008)

reporting sex ratio effects in leopard frogs, the exposure of leopard frog embryos and tadpoles to PCB 70 and 101 in water did not significantly affect hatchability, survival, deformities, or growth. In comparison, the site-wide surface water EPC (0.16 µg/L) for OU-4 is less than the surface water LOAEL of 0.50 µg/L based on sex ratio effects in the study by Jofre and Karasov (2008). The site-wide surface water EPC (0.16 µg/L) for OU-4 is also less than the surface water LOAEL for survival and growth of African clawed frog (*Xenopus laevis*) larvae and tadpoles exposed to 10,000 µg/L Aroclor 1254 reported by Fisher et al. (2003), and a LOAEL of 50 µg/L for larval survival of two ranid species exposed to PCB 126 until metamorphosis (Rosenshield et al.1999). Note that exposures to one or two PCB congeners, such as in the studies by Rosenshield et al. (1999) and Jofre and Karasov (2008), are not representative of weathered PCB mixtures present in OU-4. In each case, the benthic invertebrates and aquatic life toxicity benchmarks selected for OU-4 are lower and therefore, it is assumed that toxicity benchmarks protective of benthic invertebrates and other receptors are protective of amphibians. Use of the generic aquatic life surface water benchmarks for evaluation of risk to amphibians may result in overestimation of risk.

Several mercury studies were also reviewed. Studies that were not based on population level effects endpoints (growth, reproduction, mortality) were not considered appropriate for this OU-4 BERA. Chang et al. (1974) reported a LOAEL for metamorphosis failure in frogs exposed to 1 µg/L methylmercury. Birge et al. (1979) conducted static bioassays from fertilization through four days post hatch with 14 amphibians species and inorganic mercury in water. The resulting LC50 values ranged from 1.3 to greater than 8 µg/L The maximum mercury surface water concentrations in OU-4 is 0.43 µg/L, however. Additional aqueous exposure data for amphibians were limited to acute exposures at high concentrations that were not considered relevant for the OU-4 BERA. One study by Birge et al. (1977) reported mortality and tertaogenesis for sediment exposures to amphibians at a sediment LOAEL of 0.15 mg/kg; however, concentration-dependent responses were not observed in this study and similar mortality was reported at mercury concentrations ranging from 0.15 to 122 mg/kg. For comparison, the sediment EPCs in OU-4 range from 0.70 mg/kg in the MAA to 27.4 mg/kg in reach C2. The LOAEL value of 0.15 mg/kg from Birge et al. (1977) is similar to the toxicity benchmarks for benthic invertebrates (TEC = 0.18 mg/kg and PEC = 1.1 mg/kg; Table 5-2b) and therefore, it is assumed that toxicity benchmarks protective of benthic invertebrates are protective of amphibians. These findings are further supported by the evaluation of risk to amphibians using tissue-based exposure and tissue-based toxicity data provided in Section 6.2.3.12.

There are no generally accepted TRVs available for reptiles; therefore, risks were not quantitatively evaluated for these receptors in this OU-4 BERA and risks to reptiles are uncertain. However, as a range of risks were evaluated for other ecological receptors, from NOAEL-based to LOAEL-based, it was assumed that conservative assumptions used in the evaluation of risks for other species will be protective of these receptors. This assumption could over or under estimate risk for reptiles.

6.2.3.9 Use of Methylmercury-based TRVs for Evaluation of Total Mercury

In this OU-4 BERA, mercury was evaluated using methylmercury dietary TRVs. This conservatively assumes that 100% of the mercury present in abiotic and biotic media is present as methylmercury. However, as shown in Table 6-22, the proportion of methylmercury in prey tissues ranges from very low (3% for terrestrial plants) to very high ((90% for fish). Since methylmercury is more toxic than inorganic forms of mercury, assuming that 100% of mercury is present as methylmercury overestimates risk to many wildlife receptors. The magnitude of this effect is dependent on the relative toxicity of

methylmercury and inorganic mercury, as well as the proportion of methylmercury present in each pretty tissue consumed by wildlife receptors.

The relative toxicity of methylmercury and inorganic forms of mercury can be assessed by comparing literature-based TRVs for these forms of mercury. In this OU-4 BERA, dietary mercury TRVs were based on methylmercury for birds and mammals. For birds, the methylmercury-based NOAEL and LOAEL TRVs used in this OU-4 BERA are 0.023 and 0.068 mg/kg BW-d, respectively, from Spalding et al. (2000). Inorganic mercury NOAEL and LOAEL TRVs of 0.45 and 0.9 mg/kg BW-d are available from Hill and Scaffner (1976), as cited in Sample et al. (1996). Thus, inorganic mercury appears to be more than 10 times less toxic than methylmercury to birds. For mammals, the methylmercury based TRVs used in this OU-4 BERA are 0.075 and 0.15 mg/kg BW-d, respectively, based on data from Dansereau et al. (1999). Inorganic mercury NOAEL TRV of 1.0 mg/kg BW-d, as reported by Aulerich et al. (1974), and a LOAEL of 0.37 mg/kg BW-d, as reported by Atkinson et al. (2001). Based on the Atkinson et al. (2001) LOAEL value, inorganic mercury is roughly 3 times less toxic than methylmercury, although the Aulerich et al. (1974) data suggest even lower relative toxicity.

When the dietary proportions of methylmercury in prey and the relative toxicity of methyl and inorganic mercury are combined, the overall effect of assuming methylmercury is present as 100% of total mercury can be evaluated. For example, HQs were calculated for the Carolina wren (scenario 1; terrestrial) in the C2 North EU using the BERA assumptions (100% methylmercury scenario) and assuming both methylmercury and inorganic forms are present (speciated scenario; Table 6-23). For the speciated scenario, the dose associated with methylmercury was calculated using measured tissue EPCs for mercury multiplied by the proportion of methylmercury in the prey tissue (Table 6-22), and a methylmercury HQs were calculated using the methylmercury TRVs. The proportion of methylmercury in soil was conservatively assumed to be equal to 50%. Similarly, the inorganic mercury dose was estimated using measured tissue EPCs for mercury multiplied by the proportion of inorganic mercury in the prey tissue (assumed to be equal to 1 – proportion of methylmercury). Inorganic mercury HQs were calculated using the inorganic mercury TRVs, and total mercury HQs were calculated by summing the HQs for methylmercury and inorganic mercury.

As shown in the methylmercury scenario HQs and speciated scenario HQs presented in Table 6-23, the overall effect of evaluating mercury species instead of assuming 100% methylmercury is to lower the estimated HQs. For the Carolina wren, the total mercury HQs based on the speciated scenario are roughly one-half the value of the total mercury HQs based on 100% methylmercury scenario. The magnitude of the effect will vary for different wildlife receptors based on the proportion of methylmercury in their diets. All speciated scenario HQs will be lower than assuming 100% methylmercury, but the effect will be smallest for receptors with a high proportion of methylmercury in their diets (e.g., piscivorous receptors) and the greatest reductions in the HQs will be for receptors with very low methylmercury in their diets, such as herbivorous receptors. As the mercury HQs estimated in this OU-4 BERA are based on 100% methylmercury, they overestimate actual risk from mercury to these receptors in OU-4.

6.2.3.10 Avian Egg Tissue CTCs

Tissue-based CTCs were developed for birds based on egg PCB concentrations in high sensitivity species (chickens) and mid-range sensitivity species (non-chicken species).

For development of the high-sensitivity PCB egg CTC, five chicken studies were identified for evaluation, including one egg injection study and four dietary exposure studies. All contain bounded reproductive effect NOAELs. The lowest LOAEL and highest NOAEL that was below the lowest LOAEL were both from a study conducted by Britton and Huston (1973) in which white leghorn chickens (*Gallus gallus*) were exposed to five doses of Aroclor 1242 in their diet for up to 42 days. Egg hatchability was reduced after six weeks with a corresponding egg yolk concentration of 3.7 mg/kg. Whole egg concentrations were estimated, assuming generic yolk weight fractions reported in the literature. Chicken egg weights were available from eight studies and were relatively similar, ranging from 51 g to 67 g. Percent yolk weights ranged from 29.5% to 31.2% of the total egg weight. Thus, little uncertainty is expected in the whole egg CTC due to estimation from egg yolk concentrations. Additionally, the five studies identified for chickens had LOAELs in a relatively narrow range, four of the studies ranged from 1.1 to 4.6 mg/kg whole egg, and the final study had a somewhat higher (16 mg/kg) threshold for reduced hatchability. In addition, the NOAEL and LOAEL values span a narrow range of concentrations (NOAEL is less than a factor of 3 of the LOAEL), which results in a higher level of confidence surrounding the true effect threshold. The literature data indicate that adverse reproductive effects associated with whole egg concentrations of around 1.0 mg/kg ww are likely, and therefore significant overestimation or underestimation of risk to high sensitivity bird species, if present in OU-4, is unlikely.

For development of the mid-range sensitivity PCB egg CTC, five appropriate studies were identified, based on mallard, American kestrel, screech owl, and ring dove. Mallard, American kestrel, and screech owl have been tested for AHR sensitivity and contain the lowest sensitivity (type 3) to PCBs and other DL compounds. Because none of the selected studies contained a paired NOAEL and LOAEL, the selected values are from two different studies. The selected whole egg tissue LOAEL CTC is based on a study from Peakall et al. (1972) in which adult ring doves failed to successfully incubate eggs. Egg concentrations associated with adult tissue concentrations at which parental attentiveness decreased were 16.5 mg/kg ww. Because exposure duration spanned a critical lifestage (i.e., reproductive cycle) and this study reported measured egg concentrations, thus reducing uncertainty associated with a dosage conversion, this LOAEL represents a toxicity result of sufficient quality. Although the exposure produced a high level of embryonic mortality, a lower LOAEL is not available for mid-sensitivity birds and several studies report NOAELs at similar concentrations. For example, the selected NOAEL of 7.1 mg/kg ww for screech owls from McLane and Hughes (1980) is based on dietary exposure to Aroclor 1248 over two breeding seasons. This value is similar to those reported in two independent field studies (Bishop et al. 1999; Jayaraman et al. 2009) with tree swallows (type 2 species), in which no effect on clutch size, hatching success, or nesting attempts were found at egg concentrations of 11.2 µg/kg egg ww. Thus, while the selected LOAEL is uncertain due to a relatively high effect level (83% reduction in hatching success), the Peakall et al. exposures were conducted in the laboratory under high bioavailability conditions. Several NOAEL values from laboratory and field studies in two different type 2 species indicate that the no adverse effects would be expected at concentrations very close to the selected LOAEL. Given that the mid-sensitivity egg NOAEL bounds the uncertainty in the egg LOAEL, risk to mid-sensitivity bird evaluated using these CTCs are not considered to be significantly overestimated or underestimated.

The range of toxicological effect levels varied substantially across chicken and non-chicken avian species. The lowest chicken LOAEL was about 30-fold less than the lowest available non-chicken LOAEL. For further comparison, the geometric mean of all chicken LOAELs equals 3.3 mg/kg egg ww,

which is an order of magnitude less than the lowest non-chicken LOAEL. In addition, a study conducted by Haseltine and Prouty (1980) indicates no adverse effects on mallard reproduction endpoints when egg-based concentrations exceeded 100 mg PCB/ kg egg ww. Although the non-chicken dataset is limited by a lack of bounded effect concentrations, it is concluded that the identified NOAELs and LOAELs provide suitable CTC thresholds for the mid-range of sensitivity because the lowest range of potential adverse effects is bounded by the chicken dataset.

For mercury, 35 effects endpoints from 27 studies were identified for development of the whole egg CTC. The selected NOAEL and LOAEL for CTC development are from a study by Jackson et al. (2011) based on modeled nest survival from female Carolina wren blood mercury concentrations, and represent a 10% and 20% reduction in nest success. Uncertainties in the egg CTCs are related to effects based on modeling as opposed to measured effects, significance of the 20% effects level being selected as a LOAEL, as well as the small number of eggs (n = 7) used to develop the model. However, as the selected egg CTCs are at the low end of the range of many studies in which tissue-based effects due to mercury are observed from 0.20 to 40 mg/kg whole egg ww, these uncertainties could likely overestimate risk.

6.2.3.11 Mammalian Tissue CTCs

Mammalian tissue CTCs were developed for PCBs as discussed in Appendix D. The small mammal CTC is based on data from McCoy et al. (1995) in which mice were exposed to Aroclor 1254 spiked into rodent feed, which may overestimate or underestimate toxicity to other Aroclor mixtures. As presented in Appendix D, tissue residue data available for small mammals is limited primarily to Aroclor 1254 data. Two studies (French et al. 2001 and Segre et al. 2002) were conducted with PCB mixtures containing Aroclors 1254 and 1242, and one study (Masuda et al. 1979) was conducted with a mixture of seven PCB congeners. The Aroclor mixtures tested by French et al. (2001) and Segre et al. (2002) resulted in tissue CTCs greater than those from the McCoy et al. (1995) study, although it is uncertain whether these differences are due to differences in toxicity of the Aroclor mixtures or differences in study design, such as species and test duration. Note also that the Segre et al. (2002) study reported biochemical endpoints and changes in organ weight, and did not contain data relevant to survival, growth, or reproduction. The Masuda et al. (1979) study contains only unbounded NOAEL data, which are not useful for comparisons to the McCoy et al. (1995) CTCs. Regardless, it is likely that the Aroclor 1254-dosed feed used in the McCoy et al. (1995) study represents a high bioavailability source of PCBs compared to PCBs present in OU-4 media that consist of a weathered mixture of Aroclors. Therefore, differences in toxicity of the various Aroclor mixtures are likely compensated for at least partially by the use of CTCs based on high bioavailability dietary data. Estimated risk to small mammals based on the selected tissue CTCs are not anticipated to underestimate toxicity to Aroclor mixtures present in OU-4.

Due to lack of appropriate studies, mammalian tissue CTCs could not be developed for mercury or other metal COPCs. Therefore, mammalian tissue HQs could not be estimated due to lack of mammalian tissue CTCs for metals; however, it is assumed that risk to mammals from metals in OU-4 is sufficiently and conservatively evaluated through dietary exposure.

6.2.3.12 Fish Tissue CTCs

Eight PCB studies were identified from the literature that met the data quality criteria for this OU-4 BERA. Additional studies were omitted due to uncertainties related to potential non-PCB non-contaminant

exposure in field sediments, or measurement of specific tissue residues instead of whole body tissue residues. The selectivity of the data reduction steps is considered to improve the quality of the tissue CTCs developed for fish. Therefore, exclusion of the additional studies is not anticipated to result in significant overestimate or underestimate of risk to fish.

Of the eight selected studies for development of the fish tissue PCB CTC, the study by Hansen et al. (1974) was selected as the primary study for CTC development in this OU-4 BERA at the request of the USEPA (2012b). In the Hansen et al. (1974) study, sheepshead minnow were exposed to Aroclor 1254 for four weeks. The tissue LOAEL CTC based on a 26% decrease in fry survival were selected for use in this OU-4 BERA. Although Orn et al. (1998) reported lower effects thresholds (NOAEL = NA, LOAEL = 1.1 mg/kg ww) for an unspecified PCB mixture, these values were not selected because the study specifies that the analysis of PCBs does not represent a whole-body analysis as the livers and ovaries were dissected prior to the analysis. Another study (Bengtsson 1980) also reported lower effects thresholds (NOAEL = 1.6 mg/kg ww, LOAEL = 15 mg/kg ww); however, because this study used a mixture of 20 different PCBs or because the PCB mixture (Clophen A50) is notably more toxic than Aroclor mixtures due to a high proportion of TEQ, it was not selected for developing fish CTCs. The Hansen et al. (1974) study tested Aroclor 1254 in water exposures to sheepshead minnow, and reported effects thresholds for fry survival (NOAEL = 1.9 mg/kg ww; LOAEL = 9.3 mg/kg ww) similar to Orn et al. (1988) and Bengtsson (1980). The range of effects thresholds are similar in all three studies, and therefore the use of the Hansen et al. (1974) tissue-based CTCs are not likely to underestimate toxicity to fish in OU-4. It should be noted that the remaining endpoint studies identified as appropriate for use reported LOAELs ranging from 15 to 1,018 mg/kg ww and include data for Clophen A50, Aroclors 1242, 1248, and 1254. Thus, risk to fish exposed to difference Aroclor mixtures in OU-4 is not expected to be underestimated and may be significantly overestimated due to use of the selected conservative tissue-based PCB CTC for fish based on Aroclor 1254.

For mercury, the tissue CTCs are based on analysis by Beckvar et al. (2005), a review study that provides a review of tissue residue studies for mercury and considers all of the studies considered for CTC development. The recommended NOAEL and LOAEL are based on sub-lethal endpoints including growth, reproduction, and development. Note that the Friedmann et al. (1996) reproductive effect level selected by Beckvar et al. (2005) as the basis for the tissue CTC was a small (approximately 15%) decrease in gonadosomatic index, which is not clearly tied to reproductive success. However, a wide range of effects values are reported in the literature, suggesting that mercury effects depend on a variety of factors (including site-specific factors that influence speciation/methylation, bioavailability, and exposure) that influence mercury uptake and toxicity. Uncertainty exists in the mercury fish CTC that may overestimate or underestimate risks to fish in OU-4; however, because Beckvar et al. (2005) focused on data for sublethal endpoints (including growth, reproduction, and development), these values are considered to be protective and appropriate for application in a risk assessment context.

Due to the limited availability of whole body tissue effect data for non-mercury metals in fish, of the remaining metal COPCs, fish CTCs were only developed for lead and vanadium. The study used to develop fish CTCs for lead was considered appropriate as lethal and sublethal effects were evaluated in this study, and no effect and effect levels are reported as whole body tissue concentrations. For vanadium, although the fish CTC was based on a study reporting appropriate endpoints, the species used was rainbow trout, which is a cold-water species and do not occur naturally within OU-4. Moreover, the dataset used as the basis for this CTC consisted of only two studies with the second study reporting a

LOAEL an approximate order of magnitude higher. Therefore, risk from vanadium to fish is likely overestimated. Additionally, risk from other metals is considered to be adequately addressed through the use of surface water benchmarks protective of aquatic life and fish.

For TEQ, the CTC is based on the 95%UCL effects residue (2.2 nanograms per gram [ng/g] lipid) for 2,3,7,8-TCDD, calculated from the geometric mean of no observed effect residue and lowest observed effect residue values from Steevens et al. (2005). The mean CTC value from the dataset is 0.70 ng/g lipid. The species sensitivity distribution from Steevens et al. (2005) incorporates residue effect data for lake trout and other salmonids that are substantially lower than residues associated with effects in the other fish species (Steevens et al. 2005). As the mean CTC is highly influenced by toxicity data for salmonid species which are not present in OU-4, the 95%UCL on the mean CTC was selected to minimize overestimation of risk that would occur if HQs were calculated based on the mean CTC. Use of the 95%UCL CTC Is not considered to underestimate toxicity to OU-4 fish species, because it is based on a species distribution that includes a large number of salmonids.

6.2.3.13 Amphibians and Reptiles Tissue CTCs

For amphibians and reptiles, appropriate tissue residue data are insufficient to support development of tissue-based CTCs. Seven individual studies--five were considered for PCBs and two for mercury--were identified and reviewed. Most of these studies were not based on population level effects endpoints (growth, reproduction, mortality), and were not considered appropriate for CTC development. Savage et al. (2002) reported significant mortality in their study for tadpoles exposed to PCB contaminated sediment. Frog PCB body burdens in the sediment-exposed group averaged 22.4 mg/kg ww. However, a clear dose-dependent relationship was not observed and mean mortality varied between dose groups. Sublethal effects were observed (behavior), but are not considered appropriate for CTC development as the potential adverse effects on the individual or populations is not clear. Additionally, Gillardin et al. (2009) report no effects on survival and growth of African clawed frog tadpoles at tissue concentrations of 51.4 mg/kg ww. Fisher et al. (2003) and Jelaso et al. (2002) report decreased growth or mortality, respectively, in African clawed frog at tissue PCB concentrations greater than 100 mg/kg ww. In comparison, the OU-4 amphibian tissue concentrations range from 0.50 to 7.5 mg/kg ww, with all samples below tissue concentrations associated with mortality and only one sample containing a greater concentration than the behavior (e.g., decreased activity and swimming speed) LOAEL of 6.0 mg/kg ww reported by Savage et al. (2002). In the second study (Jofre and Karasov 2008), accumulation of PCBs was reported in tadpoles, and survival or growth were not affected at concentrations up to 8.0 mg/kg ww for PCB 101 and 6.1 mg/kg for PCB 70. These single congener values are similar to the total PCB concentrations in frogs collected from OU-4.

For mercury, tissue concentrations associated with no effects on survival were reported by Todd et al. (2011). Specifically, the authors found no overall difference in survival after a year and no evidence of emergent latent effects in the terrestrial toads that could be attributed to earlier exposure. The mean tissue concentrations of total mercury reported were 4.1 mg/kg dw in recently metamorphosed American toads (*Bufo americanus*) and 0.33 mg/kg dw in juvenile toads after one year. In comparison, the OU-4 concentrations range from 0.12 to 1.76 mg/kg dw (Table 4-15), which are within the range of concentrations reported by Todd et al. (2011). A second mercury study was reviewed (Unrine and Jagoe

2004), but was a bioaccumulation study performed with leopard frogs and did not evaluate toxicity endpoints.

6.2.3.14 Invertebrate Tissue CTCs

For aquatic and terrestrial invertebrates, the scientific literature supporting development of CTCs is limited. CTCs were developed from available information for the various invertebrate tissue types; however, due to the small number of available studies, confidence is low in most of the invertebrate CTCs. Additionally, acute exposure data were selected in some cases when no chronic data were available. For the purposes of evaluating invertebrates, exposures of one week or less were considered to be acute in duration and uncertainty factors were applied (as described in Appendix D) to estimate chronic CTCs. For these CTCs based on acute effects data (PCBs for earthworm, and mercury NOAEL for mollusc), the use of an uncertainty factor may overestimate or underestimate toxicity to the invertebrate receptors. Individual tissue CTCs with additional specific uncertainties are discussed below.

6.2.3.14.1 Invertebrate PCB CTCs

For PCBs, CTCs were developed for aquatic tissues (worms, emergent insects, odonate larvae, molluscs, and crayfish) and terrestrial tissues (earthworms and terrestrial insects) collected in OU-4. Some of these tissue CTCs have specific uncertainties, as discussed below.

The CTC for aquatic worms is based on data from Fisher et al. (1999) that demonstrate a relatively constant sublethal effect (approximately 30% reduction in biomass/reproduction) associated with exposure to molar concentrations of about 0.34 mmol/kg ww for four PCB congeners with varying degrees of chlorination. The CTC was calculated by converting the LOAEL effect concentration (mmol/kg) to mg/kg using the molecular weight of Aroclor 1254. While there are uncertainties related to the use of individual congener data for calculation of the CTC and the assumption that Aroclor 1254 is representative of weathered PCB mixtures at OU-4, the selected LOAEL CTC is lower than other available effects data for oligochaetes from Fowler et al. (1978). The selected study (Fisher et al. 1999) was conducted with good experimental design, using the same species (*Lumbriculus variegatus*) evaluated in the OU-4 food web models, showed a consistent response across the PCB congeners, and exposures were chronic in duration. Therefore, use of the selected LOAEL CTC is unlikely to underestimate toxicity to aquatic worms in OU-4.

For odonate larvae, no toxicity data were identified for the Class Odonata. Data for other epibenthic arthropod species were considered for CTC development, including three amphipod species. Amphipods (crustaceans) are not closely related to Odonata (insects), but both are arthropod species present in similar habitats. Additional aquatic insect data also potentially relevant to odonatan larvae include data evaluated separately for emergent insects (for mayfly, midge, stonefly, and mosquito). As the emergent insect data include only unbounded NOAELs, it is unclear whether the selected odonatan CTC overestimates or underestimates risk to aquatic insects, including odonates and emergent species. Similarly, the odonatan larvae CTC could also be used to evaluate emergent insects. In this case, use of the selected unbounded NOAELs as the basis for the emergent insect CTC likely overestimates toxicity to these receptors when additional data for aquatic invertebrates suggests higher effect levels would also be observed in emergent insects.

For crayfish and molluscs, the toxicity studies employed for CTC development were based on Aroclor 1254 exposure and tissue concentrations. Because Aroclor 1254 was the highest and most frequently detected Aroclor in these tissues, this CTC is likely a reasonable representation of toxicity. While, there is uncertainty associated with potential toxicity associated with other detected Aroclors, Aroclor 1254 is generally considered to be one of the more toxic Aroclors and thus the CTCs selected are not likely to underestimate toxicity for crayfish or molluscs.

6.2.3.14.2 Invertebrate Mercury CTCs

For mercury, CTCs were developed for aquatic tissues (emergent insects, odonate larvae, molluscs, and crayfish) and terrestrial tissues (earthworms) collected in OU-4. Data were insufficient to develop CTCs for aquatic worms and terrestrial insects. Some of these tissue CTCs have specific uncertainties, as discussed below.

The CTC for emergent insects is based on data for burrowing mayfly from Saouter et al. (1993). Only one other study (Rossaro et al. 1986) was identified with relevant tissue data, for the midge. Only unbounded NOAELs were available. The selected CTC is based on the lower NAOEL for mayfly, as midge can be relatively tolerant to contaminants. However, mercury had no effect on survival in midge larvae at tissue concentrations more than ten times greater than the mayfly survival NOAEL selected as the CTC for emergent insects. Based on the available information, the selected NOAEL-based CTC for emergent insects is likely to overestimate risk to most aquatic insects present in Choccolocco Creek.

For odonata, the uncertainties in the mercury CTC are based on the species included in the dataset, similar to the uncertainties described in Section 6.2.3.14.1 for odonatan larvae and PCBs.

Similarly, for crayfish, the selected CTC is based on toxicity data for the cladoceran *Daphnia magna* due to a lack of effect data for other decapods. Cladocerans were grouped with crayfish based on their exposure primarily to the water column. However, the amphipod toxicity data evaluated for odonates could also be considered relevant for crayfish, because crayfish and amphipods are both different Orders in the Class Malacostraca, whereas cladocerans are most distantly related crustaceans (Class Branchiopoda). The NOAEL and LOAEL CTCs selected for odonates (based on amphipod data) are 10 and 16 mg/kg ww, and are about 10-fold greater than the values available for cladocerans (NOAEL and LOAEL of 0.92 and 1.6 mg/kg ww, respectively). The *Daphnia magna* data were selected to evaluate crayfish due to the extremely limited dataset. However, as *Daphnia magna* are less closely related to crayfish than amphipods, and *Daphnia magna* are often among the most sensitive species to contaminants, the selected CTCs based on cladoceran data likely overestimate toxicity to crayfish.

6.2.4 Ecological Community Evaluations

Biological community analyses are always accompanied by some level of uncertainty. Key sources of uncertainty include (1) adequacy of sample size per habitat type which affects statistical power to detect differences, (2) similarity of reference locations to OU-4 locations, (3) seasonal or annual variability, and (4) detectability.

The experimental design of the community studies creates some uncertainty in the results because sample sizes generally were not always large for every biological community. The experimental design was based upon the Phase 1 study objectives of an initial survey of biological communities in the

floodplain and creek ecosystems for at most two years to support selection and parameterization of appropriate exposure factors for ecological risk assessment. The parameters included habitat conditions, receptors, food web structure, and spatial and temporal relationships among biota and habitat types. Specifically, relationships between habitats and organisms over a two-year period were to be identified to assist in separating exposure effects from habitat and temporal effects to improve decision-making. Locations selected for transect placement were developed in cooperation with the USEPA and spanned different habitats and a potential concentration gradient within each of the former EDRs to represent community changes expected across habitats and possible effects across PCB gradients. Transects were established 100 meters away from edges to avoid edge effects and were not co-located with transect-specific chemical analyses because characterizing PCB effects across larger areas was the Phase 1 goal. Therefore, habitat differences were incorporated into all analyses, except for aquatic mammals and birds which could not be assigned one aquatic habitat because of their mobility.

Except for the benthic invertebrate community study, the sample sizes for this Phase 1 study design were not selected for rigorous analysis, but as an assessment to corroborate other LOEs. Notably, except for small mammals and invertebrates, results from individual transects or sampled areas were composited or averaged by habitat within locations to ensure independence of experimental units, match the PCB gradient being evaluated, and to reduce data variability (e.g., by three habitat types within each REF1, REF2, REF3 for reference, UAA, MAA, LAA for OU-4) before conducting the statistical analyses (the location, not transect was the experimental unit replicated within a season and habitat).

Sample size for statistical comparison to reference for communities other than benthic invertebrates ranged from 21 to 42 for abundance and richness, resulting in low power to detect differences. Results are most reliable when differences are detected. However, despite these small sample sizes for a two- or three-way ANOVA, the mean values for community measures averaged across habitats that should decrease if there were an adverse effect (e.g., diversity, richness, and abundance) were higher (or the same) in OU-4 than reference areas, which might suggest no overall effect on these communities from PCBs (or other COPCs) with the exception of the small mammals. Similarly, for measures that should increase with an adverse effect (e.g., dominance and tolerance), mean values were lower (or the same) in OU-4 than in reference areas. Improving confidence and precision in the mean values (and thereby ability to detect differences) by increasing sample size is unlikely to change that result except in cases where sample sizes are very unbalanced among habitats or areas, true of the terrestrial vertebrate data but not the fish, terrestrial invertebrate, or plant data.

For small mammals, abundance and richness had lower, rather than higher means in OU-4 locations, but had inadequate sample sizes and thus limited confidence in the finding of no significant differences; only six reference locations were sampled and compared to 36 locations in OU-4. In contrast, for the benthic invertebrates, sample size is high and adequate with 70% power to detect 20% or larger reductions in means (n = 158). While the sample size was adequate for statistical analysis, the benthic invertebrate sampling locations within each AA were limited in spatial extent which adds uncertainty to the interpretation. However, given that there is little variation in PCB concentrations throughout the AAs, it is unlikely that benthic communities are impacted elsewhere in the AAs outside of the sampled areas. In addition, different sampling methods were used in each benthic habitat type due to the nature of the invertebrates expected to be found within each habitat. The sampling methods were selected to be specific to the habitat types and were consistent between the AAs to minimize uncertainties associated

with sample collection activities. The potential for these uncertainties were accounted for in the data evaluation process by adding habitat as a dependent variable.

For PCB (and other COPC) gradient comparisons for aquatic animals and terrestrial vegetation, performed because no reference data were available, the most impacted reach (UAA) has the highest mean value (indicative of less adverse impacts) of the three AAs of Choccolocco Creek. Changes in sample size likely will not change that result suggesting no adverse effects. The exception was the aquatic bird endpoint, which has the highest and lowest mean values for diversity and dominance, respectively, in the least impacted AA. Although, abundance and richness were highest in the MAA with intermediate impacts. Because the sample size for aquatic birds was small (n = 12), the finding of no significant adverse impacts to diversity and dominance is uncertain.

The second issue is similarity of reference locations to OU-4 locations. Use of reference areas in the field creates some uncertainty because ideally the two areas should be identical but for the COPCs. Often other physical or chemical features such as habitat, site history, land management practices, and presence of other stressors can differ between site and reference locations. Efforts were made to select ecologically similar reference locations for comparison with OU-4; however, some differences likely exist. Three instream reference locations and their adjacent reference floodplain areas were sampled. Reference Area 1 (Choccolocco Creek upstream of the Snow Creek Confluence) and Reference Area 3 (Talladega Creek) were similar in size and habitat to Choccolocco Creek in the study area. Reference Area 2 (Cheaha Creek) was a slightly smaller creek but overall the three reference creek areas were believed to be structurally similar enough to serve as reference locations for instream habitats.

The floodplain habitats were similar except Reference Areas 2 and 3 were closer to a highway and Reference Area 3 had more edge habitat (forest-to-field transitional areas) than the OU-4 locations. If COPCs are causing large impacts, the community differences should become apparent among locations, though small subtle impacts may be masked by differences in microhabitat along and in the creeks and in edge and disturbance effects. Locations were stratified by aquatic and terrestrial macrohabitats (forested, maintained field, successional or riffle, run, pool, vegetation) to minimize community differences when comparing within macrohabitats using the two- or three-way ANOVA. The ANOVA was designed to essentially hold habitat effects constant while evaluating OU-4 versus reference effects (notably, the means do not reflect this adjustment but the significance results do). For some AEs, data for reference areas were unavailable and a gradient of high to low-impacted sites were evaluated instead. Uncertainties in the risk conclusions are inherent using both the gradient approach and site-to-reference area comparisons, and one approach is not necessarily more reliable than the other. Theoretically, an unimpacted reference location could provide greater separation among locations than between a less impacted and more impacted location. Thus power to detect differences may be less, creating more uncertainty in the results that show no significance with the gradient approach for those endpoints where means differ in a way that could suggest adverse effects (e.g., for aquatic birds). On the other hand, gradient locations from the same system would be very similar in nature, differing mainly in PCB/COPC concentrations. In this case, the gradient locations theoretically would have fewer confounding variables that may affect community structure, and thus the power to detect differences due to PCB (or other COPC) exposure could be greater than when comparing OU-4 data to reference areas. It is also important to note that when evaluating the OU-4 versus reference areas, impacted reaches are averaged as “site” for all analyses that include a reference area, except for benthic invertebrate analyses. This approach ignores the gradient of COPC concentrations on Choccolocco Creek, creating uncertainty as to

effects at smaller scales within the OU-4 for these communities. Comparisons between the reference areas and each of the three AAs were not possible due to low sample sizes with low power, and conclusions are restricted to comparing the entire OU-4 to the entire reference area.

It also assumes that COPCs present in the reference areas are from the same sources and have the same bioavailability as COPCs in the site areas, when in fact background-related PCBs and metals may have different uptake characteristics.

The third issue is seasonal or annual variability. Community measures can vary substantially from one season to the next or one year to the next, especially if climatic conditions change. For this reason, sampling was stratified by season and year in most cases. Time of year effects were held constant in the two- or three-way ANOVA when evaluating OU-4 versus reference or gradient effects to ensure comparisons were assessed within the same season of the year. Interaction terms were included in the ANOVA if possible (given sample size) in case differences between OU-4 and reference locations changed by season. However, sampling was not repeated in the same season for more than one year (all were sampled between fall 2006 and summer 2007), which creates uncertainty because the sampled season might not be representative of a "typical" year. Also, due to lack of a reference area in some seasons (e.g., winter 2006), terrestrial birds and mammals (not small mammals) were stratified into two time periods rather than each season: (1) fall 2006 and (2) three seasons combined in 2007 (winter, spring, summer). When the four seasons are split into two periods, seasonal/annual effects become significant, but the results related to location effects from COPCs are not statistically significant. Additionally, more years of sampling of communities are needed to fully understand temporal variability. Using only two years of data may obscure effects.

The fourth and last issue is that data were not always adjusted for detectability. The ability to detect mammal signs or hear or see birds varies among terrestrial habitats and decreases with distance away from the observer (Mills 2012, Farnsworth et al. 2002). Some adjustment for detectability was made by increasing the transect width for more open habitats where visibility is high, which might be an acceptable approximation of a detectability adjustment for birds. However, mammal signs were observed only in a narrow band around the transect, yet visual observations of actual mammals were included across the entire width of the transect, and these differences were not taken into account. Similar issues arise with sampling fish or invertebrates – the habitat type or sampling method affects detectability (Thurow et al. 2006). Nevertheless, relative but not absolute differences in density can be compared between OU-4 and reference locations if the sampling methodology was consistent within a habitat type and a season and a habitat was relatively homogeneous. This was not always the case because successional fields often were quite variable in visibility from one field to the other, which creates some small amount of uncertainty.

As mentioned when discussing the results, the areas searched or methods of sampling an AE varied by habitat type for benthic invertebrates, fish, terrestrial birds, and terrestrial mammals. Thus, results cannot be compared across habitat types, even if standardized per unit area because number of taxa increases as area sampled or searched increases (Gotelli and Colwell 2001).

Results obtained from the community analyses only address overall community structure of the major taxa found in the study area. The results would not necessarily apply to smaller groups of individual sensitive species.

6.3 Risk Findings

Section 6.3 Summary

The overall risk findings are summarized in this section. PCBs are considered the primary driver of potential site-related risk within OU-4.

The WOE considers the potential for risk, level of conservatism, and uncertainties associated with risk estimation inputs to identify an over all level of confidence for each LOE. Each factor was ranked as high, moderate, or low. Predicted risk based on HQs was categorized as negligible (NOAEL-based HQ $\leq$1), low (NOAEL HQ >1 and LOAEL HQ $\leq$ 1), moderate (LOAEL HQ $\leq$10) and high (LOAEL HQ > 10). The final WOE conclusion for each receptor was based on the LOE with the highest confidence rank, but with consideration of all LOEs.

The LOE weightings are summarized as follows:

- Terrestrial plants: media-based HQs were given highest weight. This LOE indicates neglegible risk in all EUs except C1 West.
- Soil invertebrates: tissue-based HQs were given highest weight. This LOE indicates negligible risk in all EUs.
- Aquatic plants and invertebrates: HQs based on the receptor-specific chronic surface water benchmarks were given highest weight. This LOE indicates moderate risk in C1 (plants only), and negligible risk in the UAA, MAA, and LAA.
- Benthic invertebrates: comparisons of OU-4 surface sediment data (n = 266) to the EC0* and EC10* thresholds derived from the site-specific sediment toxicity studies were given the highest weight. This LOE indicates negligible risk in the majority of samples within OU-4 (i.e., 77%) with some localized moderate to high risk predicted primarily in reaches C1 and C2.
- Fish and small mammals: HQs based on measured tissue concentrations and CTCs were given highest weight.
  - Low risk predicted for forage fish throughout OU-4 and bottom fish in the MAA. Moderate risk predicted for bottom fish in the UAA and LAA and predator fish throughout OU-4.
  - Negligible risk predicted for shrew throughout OU-4.
- Birds, mink and other large mammals: HQs based on dietary doses estimated using measured tissue concentrations were given higher weight than those based on modeled tissue concentrations (except for carnivorous birds and mammals). HQs were weighted higher than community metrics.
  - Birds: dietary HQs based on mid-sensitivity TRVs given highest weight.
    - For piscivorous birds (based on great blue heron), risk is considered moderate throughout OU-4.
    - For other (non-piscivorous) aquatic birds (based on tree swallow), risk is considered negligible in the MAA and LAA (reaches C5 through C10) and moderate in reach C1, and the UAA (reaches C2 through C4).
    - For terrestrial birds (based on Carolina wren), risk is negligible in the MAA and LAA (reaches C5 through C10), and moderate in reaches C1, and the UAA reaches. For hawk based on modeled HQs, risk was negligible or low in C3, and C5 through C9, moderate in C1 East, C2, and C4 EUs, and high in C1 West.
  - Non-carnivorous mammals dietary HQs based on TRVs for reproductive endpoints were given highest weight.
    - Piscivorous mammals (based on mink and otter): High risk predicted throughout OU-4.
    - Insectivorous aquatic mammals (based on bat), neglibible risk predcite in the MAA and LAA (reaches C5 through C10) and moderate risk predicted in C1, and the UAA reaches.
    - Omnivorous and herbivorous terrestrial mammals: negligible risk predicted throughout OU-4.
  - Carnivorous mammals (weasel and fox consuming primarily small mammals): modeled HQs based on the small mammal regression were given the highest weight.
    - Negligile risk predicted in reach C2 and C5 thorugh C9, low risk predicted in reaches C1 East , C3 and C4, and moderate risk predicted in C1 West.
- Amphibians and Reptiles: Limited analysis possible due to lack of toxicity data. Risk considered unlikely based on a comparison of site media data to generic aquatic life HQs based on surface water criteria.

This section describes the risk findings which provide an integrated interpretation of the MEs and their associated uncertainty for each AE. As described in Section 6.1, PCBs and mercury are the only COPCs that appear to be elevated within OU-4 compared to reference concentrations and to also have an apparent upstream to downstream trend. Although HQs for other COPCs are greater than 1 in some of the EUs, no apparent upstream to downstream trend was observed in media concentrations and concentrations in OU-4 media do not appear to be different from reference in most cases. Thus, PCBs are considered the primary driver of site-related risk within OU-4. One exception to this is for mercury in EU C2 sediment, where mercury is somewhat elevated and exceeds the site-specific toxicity thresholds at a higher frequency than PCBs.

Thus, this discussion of risk findings focuses on PCBs as the primary risk driver for OU-4. A WOE approach is used to interpret the results of the MEs for each AE for PCBs.

6.3.1 Weight of Evidence Approach

The WOE process is summarized in Figure 6-24 and the WOE results for PCBs are summarized in Table 6-24 for lower trophic receptors (i.e., plants, invertebrates, and fish), Table 6-25 for birds, and Table 6-26 for mammals. Each LOE was evaluated relative to its risk estimate and the ranking criteria. These are described below.

6.3.1.1 Lines of Evidence

A range of HQs provides the primary LOE used in this OU-4 BERA. The range of HQs includes:

1. HQs based on estimated EPCs in abiotic media compared to literature-derived benchmarks and/or site-specific toxicity thresholds for lower trophic level organisms;
2. HQs based on dietary doses in wildlife food web models estimated using modeled prey tissue concentrations compared to literature-derived dietary TRVs;
3. HQs based on dietary doses in wildlife food web models estimated using measured prey tissue concentrations compared to literature-derived dietary TRVs; and
4. HQs based on measured biota tissue concentrations compared to literature-derived tissue-based CTCs.

Additionally, secondary LOEs included in this OU-4 BERA to support the risk characterization include:

1. Site-specific sediment toxicity data/thresholds (for benthic invertebrates only);
2. Site-specific field survey data statistically evaluating potential differences in community metrics between the OU-4 AAs and/or to reference habitat areas;
3. Comparisons between site-specific COPC concentrations in soil, sediment, or biological tissue to concentrations in reference areas; and
4. Observations and qualitative survey results for wildlife present in OU-4.

The interpretation and the risk ranking criteria employed in the WOE are discussed below and the findings for each AE are discussed in Sections 6.3.2 through 6.3.8.

Hazard Quotient Results

The WOE rank assignment for risks estimated from HQs is as follows:

- If the NOAEL HQ for PCBs is less than or equal to 1, then risk to a receptor (individual or population) is considered negligible.
- If the NOAEL HQ for PCBs is greater than 1 but the LOAEL HQ is less than or equal to 1, then risk to a receptor population is considered low.
- If the LOAEL HQ for PCBs is greater than 1 but less than or equal to 10, then risk to a receptor population is considered moderate.
- If the LOAEL HQ for PCBs is greater than 10, then risk to a receptor population is considered high.

Ecological Community Data Results

For ecological community evaluations, statistical analyses (described in detail in Section 5.6) were conducted on site-specific observations of the various receptor groups. These data were primarily collected during the Phase 1 and 2 ecological surveys within OU-4 and reference areas. When no difference was observed between OU-4 and reference conditions or when OU-4 conditions were found to be higher quality than reference conditions, this LOE indicates that no adverse effect from PCBs or other COPCs on ecological communities are occurring and risk is considered negligible. When the community analysis is based on comparison among OU-4 AAs, the findings are based on whether the results indicate an upstream to downstream gradient of community conditions that would be expected if effects were associated with PCB concentrations. When no differences were observed, site-related risk is considered negligible. When differences from reference or when a possible gradient was observed, risk is considered low, moderate, or high, depending on the magnitude of differences.

Reference Comparisons

For the reference comparisons, the OU-4 soil, sediment, and prey tissue concentrations were compared visually and statistically to reference conditions. In all cases, OU-4 concentrations of PCBs are elevated compared to reference conditions (Figures 6-4 through 6-6 and Tables 6-13 through 6-15). While this does indicate exposure to PCBs within OU-4 is likely higher than in reference areas, this comparison does not indicate that risk is present. The reference comparisons are considered a supplemental LOE and are not given specific rankings in the WOE.

6.3.1.2 Weight of Evidence Rankings

For each receptor community or population, the LOEs evaluated are assigned a rank based on the results of the MEs. The rank considers the level of conservatism and the uncertainties associated with the inputs to the risk estimate to determine the overall confidence that can be ascribed to the LOE (and related MEs). Specific uncertainties and the level of conservatism (i.e., the likelihood of over or under-estimating risk) are characterized in detail in Section 6.2.

Conservatism

For level of conservatism, a low, moderate, or high rank was assigned based on an understanding of the uncertainties associated with the key inputs for the risk estimates. In many cases, the more site-specific inputs (e.g., use of measured site media and tissue data, site-specific toxicity thresholds, measured ecological community data) were considered to result in risk predictions that were less conservative and consequently less likely to overestimate risk. In the absence of site-specific inputs, highly conservative

assumptions are made in most cases, often resulting in the likelihood of overstated risks. Supporting information along with best professional judgment was used in assigning the ranks for the level of conservatism.

Confidence

For confidence in the risk assessment, a rank was assigned low, moderate, or high based on the level of conservatism and the uncertainties associated with each input to the analysis.

The potential for risk, level of conservatism, and confidence in the risk finding was combined to produce an individual WOE risk finding for each receptor and LOE. The final WOE conclusion for each receptor was based largely on the LOE with the highest confidence, but with consideration for all LOEs evaluated.

The WOE results for each AE are described in Sections 6.3.2 through 6.3.8.

6.3.2 AE 1: Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities

For aquatic plants, two HQ approaches were evaluated. Results are summarized in Table 6-24 and discussed below:

- HQs were estimated by comparing the surface water EPCs to WQS. For PCBs, predicted risk is high in reach C1 and in the LAA and moderate in the UAA and MAA. HQs for PCBs based on the chronic criterion (an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect) are greater than 1 but are all less than or equal to 1 based on the acute criterion (an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect). This evaluation is considered to be moderately conservative as the ADEM WQS are based on toxicity data for a variety of aquatic life, including many organisms with higher sensitivity to PCBs than plants. Confidence in the risk estimates based on this LOE is moderate/low.
- HQs were estimated by comparing the surface water EPCs to aquatic plant-specific benchmarks. For PCBs, risk is considered negligible in UAA, MAA, and LAA, and moderate in Snow Creek (C1). This evaluation is considered to be moderately conservative as receptor-specific benchmarks were used; however, as discussed in Section 6.2.3.4, the benchmarks are literature-based and not derived based on population-level endpoints (based on a 24-hour test showing reduced carbon fixation in algae). As a result, confidence in the risk estimates based on this LOE is moderate/low.

The two LOE for aquatic plants have a similar associated level of confidence and disparate findings. Based on the conservative nature of the WQS (a finding of high risk) and the uncertainties associated with the plant-specific benchmark (a finding of negligible risk), the overall WOE finding for plants is negligible risk, but confidence in this finding is low because neither LOE has high associated confidence and the two LOE do not agree.

For terrestrial plants, HQs and community metrics were evaluated. Results are summarized in Table 6-24 and discussed below:

- HQs were estimated by comparing the soil EPCs from each floodplain soil EU and AA to the selected plant benchmarks. For PCBs, risk is considered negligible for all the EUs and AAs except C1 West, for which risk is moderate. This evaluation is considered to be moderately conservative because, as discussed in Section 6.2.3.4, the benchmark is not site- or receptor-specific and based on laboratory tests using pigweed grown in sandy soil. The authors report low confidence in the benchmark as it was selected based on limited studies. In addition, the EPC for soil in reach C1 West is based on the maximum detected concentration. Thus, plant communities are not likely exposed to this worst case exposure estimate. As a result, confidence in the risk prediction based on this LOE is low.
- Terrestrial plant communities were evaluated and results indicate that there is significantly lower species richness in the MAA (reaches C5 and C6) when compared to the UAA (reaches C1 through C4). Similarly, plant cover is significantly reduced in the MAA compared with the UAA and LAA (C7). These results suggest that the differences in species richness and plant cover were not due to PCB or other COPC concentrations alone. In addition, comparison of tissue concentrations of COPCs from upstream to downstream areas indicate no upstream to downstream trend. Overall, results suggest no adverse effect of PCBs or other COPCs on terrestrial vegetation communities. There is a low level of confidence in this LOE because, although it is based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Based on the WOE, there is low confidence in the risk estimates for terrestrial plants by both the HQ and community analysis methods. The final WOE risk finding of negligible risk throughout OU-4, except for possible risk in reach C1 West is based on the benchmark comparison. This is supported by the community assessment as well as the fact that PCBs were found to accumulate at very low concentrations in terrestrial plants (i.e., maximum detected concentration was 0.26 mg/kg).

6.3.3 AE 2: Survival, Growth, and Reproduction of Benthic Invertebrate Communities

LOEs for the benthic community include comparisons between sediment toxicity thresholds or benchmarks and individual OU-4 sediment samples, HQs based on measured OU-4 tissue concentrations to CTCs, and an evaluation of the benthic community. Surface water EPCs were also compared to WQS for aquatic life and aquatic invertebrates, although this LOE is considered highly uncertain. Results are summarized in Table 6-24 and discussed below.

Comparisons of OU-4 sediment to toxicity thresholds were based on a range of site-specific toxicity thresholds and on literature-derived benchmarks.

- The benthic community was evaluated by comparing sediment sample concentrations to site-specific sediment toxicity thresholds for PCBs. A range of site-specific values were developed including EC0*, EC10*, and EC20* values calculated relative to the lowest measured response for each benthic endpoint in the reference envelope. The EC0* values represent a bound on the reference population. The EC0* is a concentration at or below which any effects observed would not be considered site-related. Thus, sediments with concentrations less than or equal to the EC0* are not considered indicative of site-related risk. Similarly, the EC10* and EC20* values represent a concentration at which 10% or 20%, respectively, of organisms might experience a site-related effect. Exceedances of the

EC10* are considered to represent moderate risk. Concentrations exceeding the EC20* value are considered to indicate high risk.

Sediments were compared to the EC0*, EC10*, and EC20* of the most sensitive endpoint (i.e. *Hyalella azteca* 42-day young/female [normalized to survival]) as well as to the most sensitive survival endpoint for each species. For PCBs (mg/kg dw), based on the most sensitive reproduction endpoint, risk is considered negligible in 77% of samples, low in 12% of samples, moderate in 8% of samples, and high in 4% of sediment samples, primarily in reaches C1 and C2. While there were a small number of individual point exceedances in lower reaches, the numbers were small (i.e., less than 10 samples with moderate risk predicted and one or two with predicted high risk for this endpoint). There is a moderate to high level of uncertainty associated with the 42-day young/female thresholds due to high variability in the controls for that test. For the survival endpoints, 6% of samples in reach C1, 10% in reach C2, and 3% in reach C4 exceeded the lowest survival EC0* and no samples exceeded the EC10* (Figure 6-1). Thus, risk for a small portion of reaches C1, C2, and C4 is considered low for this endpoint and risk for all other reaches is considered negligible. Conservatism for the survival endpoint is low and uncertainty is considered low to moderate.

This evaluation is based on site-specific toxicity observations and therefore, is adequately and sufficiently protective (i.e., level of conservatism is moderate for reproductive endpoints and low for survival endpoints). As a result, confidence in the risk prediction based on this LOE is moderate/high for the reproduction and survival endpoints.

- The benthic community was also evaluated by comparing the sediment sample concentrations to literature-based benchmarks (i.e., TECs and PECs) as shown in Figure 6-3. For PCBs, risk is considered high (i.e., sediment exceeds PECs) for some percentage of samples in all reaches with the largest exceedances in reaches C1 and C3. This evaluation is considered to be highly conservative. As discussed in Section 6.2.3.3, the TECs and PECs do not reflect contaminant-specific response thresholds (due to un-addressed co-contaminant and chemical mixture issues), and they do not incorporate site-specific factors that influence bioavailability. As a result, confidence in the risk prediction based on this LOE is low.
- HQs were estimated by comparison of surface water EPCs to WQS and literature-based screening levels for aquatic invertebrates (Suter and Tsao 1996). The ADEM WQS/NAWQC benchmark was exceeded by a factor of about 5 to 36 for PCBs in the various AAs, whereas the receptor-specific benchmarks were not exceeded. For PCBs, risk is considered low. This evaluation is considered to be moderately conservative as the ADEM WQS/NAWQC are considered to be conservatively protective of all aquatic life in waters of the State, but were derived using fish and water-column macroinvertebrates and not using benthic species. Additionally, the water PCB EPC exceeds the chronic criterion but does not exceed the acute criterion. The receptor-specific criteria (Suter and Tsao 1996) are based on toxicity to water-column macroinvertebrates for which exposure to COPCs in surface water is expected to be greater than for sediment-dwelling species. As a result, confidence in the risk prediction based on this LOE is low.
- HQs were estimated by comparing measured benthic invertebrate tissue (including odonate larvae, crayfish, and molluscs) on an AA basis to literature-derived CTC values for each group. Risk in all AAs is considered negligible. Uncertainty associated with this LOE is considered moderate as the

CTCs are based on relatively small toxicity datasets and results in some cases had high variability. However, the values are species-specific and were selected to be on the low end when more than one study was available, thus are conservative. Overall confidence in this LOE is considered moderate.

- Benthic invertebrate communities were evaluated and results indicate that mean invertebrate abundance is similar or greater in OU-4 compared with reference areas. Mean taxa richness and diversity were lower in the fall in UAA compared to reference but not in the spring. Mean taxa and richness were equal or greater in all AAs compared to reference in the spring. Tolerance was greater in UAA compared to reference in some habitats (EAV in fall and riffle in spring). The EPT index and percent EPT were very low in backwater and depositional locations in both OU-4 and reference areas. For other habitats, the EPT index was lower in UAA compared to reference in the fall and spring (riffle only); however, the abundance of EPT taxa as a percent of total abundance was equal or greater in all AAs compared to reference. Based on this analysis, although there is variability in the benthic community for the two years evaluated, overall results suggest no adverse effect of PCBs or other COPCs on the benthic invertebrate community and overall health within OU-4 can be considered comparable to reference areas. While sediment chemistry is not specifically co-located with the community assessment locations, the fact that the sediment PCB concentrations are higher in OU-4 than in reference locations suggests that PCBs are not impacting the community. There is moderate level of confidence in this LOE because although it was based on 158 site-specific observations, the survey was spatially limited in scope.

Based on the WOE, the comparison to site-specific toxicity thresholds is considered to have the highest relative confidence in predicting risks to benthic invertebrate communities from PCBs in OU-4 sediment. Based on the most sensitive reproduction endpoint, risk is considered negligible across the majority of samples, with a few samples indicating localized low, moderate, or high risk, primarily in reaches C1 and C2. Based on the survival endpoints negligible risk is predicted for the majority of samples and possible low risk for a small number of samples in reaches C1, C2, and C4. The benthic community analysis indicated that there is no difference between the structure, diversity, or abundance of benthic invertebrates in sediments of Choccolocco Creek as compared to reference areas; therefore, there is no apparent relationship between the relatively low range of PCBs in OU-4 sediments and potential risks to these communities. These findings of no impact to the community are consistent with the fact that the site-specific toxicity thresholds for survival are rarely exceeded in OU-4.

6.3.4 AE3: Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities

Two HQ methods and ecological community evaluation were evaluated for terrestrial invertebrates along with comparison to reference conditions. Results are summarized in Table 6-24 and discussed below:

- HQs were estimated by comparing the soil EPCs from each floodplain soil EU and AA to the soil invertebrate benchmark. For PCBs, risk is considered low to negligible for all the EUs and AAs except C1 West. This evaluation is considered to have moderate to high uncertainty because the benchmark, which is based on EqP theory and a water quality benchmark for aquatic invertebrates (Fuchsman et al. 2006) is non site-specific and contains a number of input variables that introduce uncertainty. Conservatism for this benchmark is considered high to moderate because the underlying

toxicity data upon which it is based is conservative and as described in Section 6.2.3.4, empirical data for PCBs and soil invertebrates suggest that effects occur at higher concentrations than predicted using EqP. Moreover, the soil samples employed to estimate the exposure may or may not be suitable for the worm species and may not be applicable. As a result, confidence in the risk prediction based on this LOE is low.

- HQs were estimated based on earthworm tissue EPCs for each AA compared to literature-derived CTCs. Risk is considered negligible in all AAs based on this LOE. This LOE is considered moderately conservative because the CTC employed was selected as the lowest value identified. There is also a moderate level of uncertainty associated with the use of this benchmark. The measured tissue exposure estimate is considered less uncertain than estimating exposure based on abiotic media. Thus there is a moderate level of confidence for this LOE.
- Terrestrial invertebrate communities were evaluated and results indicated that mean abundance, taxa diversity, and taxa dominance did not significantly differ by location ($P>0.05$). However, taxa richness was significantly higher in OU-4 than in the reference area. There is low level of confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Based on the WOE, the tissue-based HQs are considered to have relatively higher relative confidence than the other LOE and risk to soil invertebrate communities is considered negligible in OU-4.

6.3.5 AE 4: Survival, Growth, and Reproduction of Fish Communities

LOEs for the fish evaluation include a range of HQs, ecological community evaluation, and evaluation of DELT anomalies and results are summarized in Table 6-24 and discussed below.

Three HQ approaches were employed, two based on surface water and one based on measured fish tissue concentrations as described below.

- HQs were estimated by comparing the surface water AA-based EPCs to WQS. For PCBs, risk is similar across C1 and all three AAs and is considered high based on the chronic WQS. The water PCB EPC exceeds the chronic criterion, but does not exceed the acute criterion. This evaluation is considered moderately conservative as the ADEM WQS/NAWQC are developed be conservatively protective of all aquatic life (including fish) in waters of the State. As a result, confidence in the risk prediction based on this LOE is moderate.
    - HQs were estimated by comparing the surface water AA-based EPCs to water-based fish benchmarks. For PCBs, risk is considered negligible in all AAs. This evaluation is considered moderately conservative as receptor-specific benchmarks were used. However, as discussed in Section 6.2.3.5, the benchmarks are literature-derived based on biological effects but not on statistical significance. As a result, confidence in the risk prediction based on this LOE is moderate.
    - HQs were estimated by comparing AA-based fish tissue EPCs to whole body fish tissue CTCs. Concentrations of PCBs in fish tissue are relatively similar across the three AAs, thus risk predictions for this LOE are similar. Risk to predator fish is moderate in all three AAs. Risk to bottom fish is moderate for the UAA and LAA but low for the MAA (differences in HQs were small

– HQs of 2 in UAA and LAA and 1 in the MAA). Risk to forage fish is low in all AAs. The primary uncertainty for this LOE is associated with the fish tissue CTC. The selected value is selected as one of the lowest values from a range of toxicity studies and LOAELs reported from other studies range up to three orders of magnitude higher than the selected LOAEL CTC (Section 6.2.3.11). However, the CTC is based on toxic effects to sheepshead minnows, which are a biologically relevant species and considered to be adequately representative of fish in OU-4. Based on the uncertainties and conservatism associated with the key inputs, confidence in the risk prediction based on this LOE is moderate.

- Fish communities were evaluated and results indicated that mean fish abundance and species richness did not significantly differ by location when both years were combined, but were higher in OU-4 than reference in 2007 and lower in OU-4 in 2006 (significant interaction of year and location), cancelling out an effect of location. Based on these results, the health of the fish community within OU-4 appears to be similar to those found in the reference areas, despite the higher tissue PCB concentrations in OU-4 fish and estimated dietary HQs greater than 1 for some areas (as noted above). Overall, the community results suggest no adverse effect of PCBs or other COPCs on the fish community. There is low level of confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Based on the WOE, the LOE are not in agreement with the surface water comparison to WQS indicating high risk, the surface water comparison to fish-specific water benchmarks indicating negligible risk, the comparison of fish tissue to CTCs indicating low to moderate risk, and the community analysis indicating negligible risk. The comparison of measured fish tissue concentrations to fish tissue CTCs is considered to have the highest relative confidence in predicting risk to fish communities from PCBs in sediment. Predicted risk based on the tissue-based LOE is moderate to low and the confidence is this finding is moderate.

6.3.6 AE 5: Survival, Growth, and Reproduction of Birds

LOEs evaluated for birds include a range of HQs (based on dietary and egg-based exposure) and community metrics. A wide range of HQs were calculated, including results for nine avian receptors, 12 exposure scenarios, and seven COPCS. Each of these scenarios and results are summarized in Section 6.1. The WOE approach is used to interpret the risk to aquatic and terrestrial birds, focusing on PCBs for the quantitative LOEs as summarized in Table 6-25 and discussed below. HQs were calculated using 1) measured prey tissue to model dietary exposure and literature-derived dietary TRVs, 2) using modeled prey tissue to estimate dietary exposure and literature-derived dietary TRVs, and 3) using estimated egg tissue concentrations and literature-derived tissue-based CTCs. There are uncertainties with both the exposure models and the effects criteria (i.e., the TRVs and CTCs) employed. The largest uncertainty associated with the measured prey tissue-based HQs (1) is the representativeness of the tissue EPC estimate across a relatively large spatial area. The modeled dietary approach (2) has relatively high uncertainty associated with the BAFs used to estimate prey tissue concentrations for the exposure models. This is particularly true for prey items for which no relationship was found between soil or sediment and tissue (e.g., for fish). The largest uncertainty associated with the egg-based approach (3) is that eggs were not measured and egg concentrations were modeled using non-site-specific model from the literature. The dietary-based TRVs are considered to have a similar level of uncertainty as the egg-

based CTCs (i.e., all were derived from a body of literature and are not site-specific). As described in Section 5.2, two sets of TRVs were selected for birds, one representing the high end of sensitivity and the other representing moderate sensitivity. The high sensitivity TRVs are based on studies with domestic chickens which appear to be more sensitive to PCBs than most other avian species tested. Moreover, recent research indicates that the vast majority of wild species are not expected to be chicken-like in their sensitivity to PCBs. Based on this research, no aquatic feeding bird has been found to exhibit high sensitivity (see discussion of species sensitivity in Section 5.5 and a list of species tested in Table D-5 in Appendix D). It is recognized that there is uncertainty associated with assessing avian sensitivity and that the receptors evaluated herein are representative of a wider range of species. In addition, specifically for the dietary high sensitivity TRVs employed, the selected TRVs are based on an approximate 10% reduction in growth of chicks. This low level of effect on an endpoint that may or may not affect individual viability or community health may over predict risk. The mid-sensitivity TRV is based on an approximate 35% reduction in number of females laying eggs. Because the study was not designed to evaluate this endpoint, no statistical comparisons were made between control and test groups. In addition, there is uncertainty about the actual dose received by birds because feeding was *ad libitum* and specific consumption was not monitored.

Considering these factors, the dietary HQs based on the measured prey tissue concentrations and mid-sensitivity TRVs are in most cases given the highest weight of the various HQ methods in the WOE. Exceptions are noted for specific receptors below.

6.3.6.1 Aquatic Birds

Three feeding guilds representative of aquatic birds potentially present onsite were evaluated in this OU-4 BERA: piscivores, ground feeding insectivores/invertivores, and aerial insectivores. A range of HQs as well as community metrics were evaluated.

For all aquatic birds, the community metrics indicate that mean bird abundance, richness, diversity, and dominance did not differ significantly among reaches. Overall, the results suggest no effect of PCBs or other COPCs on the aquatic/semi-aquatic bird community and no upstream to downstream trend is apparent. There is low confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

The risk findings for aquatic birds are summarized in Table 6-25 and discussed below.

Piscivorous Birds

For piscivorous birds (kingfisher, heron, and osprey) exposed to PCBs in sediment, HQs are included based on three different exposure models, two dietary (one based on measured prey tissue and one based on modeled prey tissue) and one based on modeled egg concentrations. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on BAFs for which no significant relationship was identified between site sediment and fish tissue. Likewise, this model is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary measured tissue exposure model are summarized for the most sensitive receptor (great blue heron).

- Dietary HQs based on high sensitivity avian TRVs for PCBs and the exposure model using measured prey tissue concentrations indicate that risk to the most sensitive species (great blue heron) is high in all reaches and in all three AAs. This evaluation is considered to be highly conservative because the high sensitivity PCB TRVs are based on toxicity studies conducted with domestic chickens and as discussed above, the chicken appears to be more sensitive to PCBs than most other avian species tested. The HQs are also contradicted by the fact that the great blue heron was the most commonly observed species sited during the aquatic wildlife surveys in 2006 and 2007. Because the HQ results are based on site-specific measured tissue and receptor specific parameters but there is uncertainty associated with the application of the high sensitivity TRVs, confidence in the risk prediction for piscivorous birds based on this LOE is low to moderate.
- Dietary HQs based on mid-sensitivity avian TRVs indicate that risk to the most sensitive species (great blue heron) is moderate in all reaches and AAs. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are based on a mourning dove study which is an ecologically relevant species and is adequately representative of birds present onsite. Because the heron and other piscivorous birds (kingfisher) have been observed onsite and because the HQ results are based on site-specific measured fish tissue, receptor specific parameters, and appropriate TRVs, confidence in the risk prediction for piscivorous birds based on this LOE is moderate to high.

Based on the WOE, the comparison of the measured dietary dose to mid-sensitivity TRVs is considered to have the highest relative confidence in predicting risks to piscivorous birds from PCBs in sediment. The findings from this LOE are not consistent in most reaches with the modeled findings (egg-based and dietary). This is not surprising as measured fish tissue (prey for the heron) is relatively consistent in concentration across OU-4, whereas, the model will predict lower concentrations in the lower reaches based on the lower PCBs in sediment in those areas. The great blue heron showed the highest risk estimates among the piscivorous birds and these results are considered protective of all other piscivorous birds. Risk from PCBs is considered moderate in all reaches and AAs.

Aquatic Ground Feeding Invertivores

For the aquatic ground-feeding insectivorous/invertivorous birds (sandpiper-2) exposed to PCBs in sediment, in addition to the community metrics discussed above, a range of HQs were calculated and results are summarized for the identified representative receptor (sandpiper-2). The primary uncertainty associated with the dietary HQs for exposure based on modeled prey tissue are associated with the modeled tissue estimates. For the sandpiper, 50% of the diet is based on a BAF for which no significant relationship was identified between site sediment and measured invertebrate tissue. The remaining 50% of the modeled estimate is based on an uptake model developed based on laboratory exposure to *Lumbriculus variegatus*. While a significant relationship was found between sediment and tissue, the extrapolation of laboratory results to the field added uncertainty. The primary uncertainty with the dietary exposure model based on measured tissue is that the measured invertebrate tissue is not for odonate larvae and cannot be compared directly to the laboratory worm tissue. The specific composition of the sandpiper diet is uncertain and is likely based on the relative availability of prey items seasonally. Based on these considerations, both dietary HQs are considered to have a similar level of uncertainty and overall confidence.

As described above, the dietary model is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results

based on the dietary exposure models are summarized for the identified representative receptor (spotted sandpiper)

- Dietary HQs using measured prey tissue and based on high sensitivity avian TRVs for PCBs indicate that risk to the sandpiper is moderate in all reaches with a slight decreasing trend from upstream to downstream. The HQs based on modeled prey tissue indicate extremely high risk in all reaches (i.e., HQs > 100) This evaluation is considered to be highly conservative because of the high sensitivity PCB TRVs (see discussion above). Based on the uncertainty of the applicability of the high sensitivity TRV to aquatic feeding invertivores, confidence in the risk prediction for insectivorous/invertivorous aquatic birds based on this LOE is moderate.
- Dietary HQs using measured prey tissue and based on mid sensitivity avian TRVs for PCBs indicate that risk to the sandpiper is negligible in reaches C3 through C10 and all AAs, and low in reaches C1 and C2. The modeled estimates are over an order of magnitude higher and indicate high risk in reaches C1 through C4, C8, and the UAA and LAAs. Moderate risk is predicted in reaches C5 through C7, C9 and C10 as well as the MAA. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are ecologically relevant and adequately representative of birds present onsite. Although the sandpiper has not been observed onsite, other insectivorous/invertivorous aquatic birds (killdeer [*Charadrius vociferous*] and yellowlegs [*Tringa melanoleuca*]) have been observed. Based on the uncertainty associated with the TRVs and the different uncertainties associated with the two different exposure model approaches, confidence in the risk prediction for insectivorous/invertivorous aquatic birds based on both modeled and measured prey tissue is moderate to high.

Based on the WOE, the dietary HQs based on comparison of estimated dietary dose using both measured and modeled prey tissue concentrations to mid-sensitivity TRVs are considered to have similar confidence in predicting risks to insectivorous/invertivorous aquatic birds from PCBs in sediment. While the dietary HQs have the highest confidence compared to other LOE, because the two dietary HQ approaches have similar confidence, but very disparate risk findings, the overall WOE finding for the sandpiper requires consideration of the secondary LOE. The egg-based HQs, while lower in confidence, are consistent with the measured dietary HQs. Likewise, the community data are considered as a supporting LOE and is more consistent with the dietary HQs based on measured prey tissue. As such, the overall WOE for invertivorous birds is based on the dietary HQs using measured prey tissue and the mid-sensitivity TRVs. In summary, risk from PCBs is considered negligible in reaches C3 through C10 and low in reaches C1 and C2.

Aerial Insectivorous Birds

For the aerial insectivorous birds (tree swallow) exposed to PCBs in sediment, HQs are included based on three different exposure models, two dietary (one based on measured prey tissue and one based on modeled prey tissue) and one egg-based. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on BAFs for which no significant relationship was identified between OU-4 sediment and prey tissue (i.e., emergent insects). Likewise, this model is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary measured tissue exposure model are summarized for the representative receptor (tree swallow).

- Dietary HQs based on high sensitivity avian TRVs for PCBs indicated that risk is considered high in reaches C1 through C4 and the UAA, moderate in reaches C7 through C10 and the LAA and low in reaches C5 and C6 and the MAA. This evaluation is considered to be highly conservative because of the high sensitivity PCB TRVs (see discussion above). In addition, there is uncertainty associated with the measured prey tissue. The emergent insects consisted primarily of a mixture of mayflies, damselflies, and crane files, with the exception of two samples in the UAA which were exclusively cranefly tissue. The PCB concentrations reported by the laboratory were over an order of magnitude greater than the other samples found within OU-4. As discussed in Section 6.2, there is some uncertainty associated with these results. However, because the dietary HQ results are based on site-specific measured prey tissue and receptor specific parameters but highly conservative TRVs, confidence in the risk prediction for insectivorous/invertivorous aquatic birds based on this LOE is low to moderate.
- Dietary HQs based measured prey tissue and mid-sensitivity avian TRVs indicated that risk is negligible in reaches C5 through C10 and the MAA and LAA, and moderate in reaches C1 through C4 and the UAA. This moderate risk finding for the UAA is related to the elevated crane fly tissue samples discussed above for which there is some uncertainty. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are based on mourning dove studies which are ecologically relevant and adequately representative of birds present onsite. The tree swallow and other aerial aquatic birds (phoebe [*Sayornis phoebe*] and rough-winged swallow [*Stelgidopteryx serripennis*]) have been observed onsite. The HQ risk predictions for aerial aquatic birds considering the uncertainty associated with the site-specific tissue, receptor specific exposure parameters, and appropriate TRVs have moderate confidence.

Based on the WOE, the comparison of modeled dietary dose to mid-sensitivity TRVs is considered to have the highest relative confidence in predicting risks to aerial insectivorous aquatic birds from PCBs in sediment. While the findings for the UAA have some associated added uncertainty, the findings from this LOE are consistent with the findings from the other two HQ approaches. Risk from PCBs is considered negligible in reaches C5 and C10 and moderate in reaches C1 through C4.

6.3.6.2 Terrestrial Birds

Four feeding guilds representative of terrestrial birds potentially present onsite were evaluated in this OU-4 BERA: herbivores, insectivore/invertivores, omnivores, and carnivores. The risk findings for aquatic birds are summarized in Table 6-25 and discussed below.

For all terrestrial birds, the community metrics indicate that mean abundance and species richness were significantly higher in OU-4 than reference area. Diversity and dominance did not significantly differ by location ($P>0.05$). Based on these results, the health of the terrestrial bird community within OU-4 appears to be similar or more robust within OU-4 compared to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial bird community. There is a low level of confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Herbivorous Birds

For the herbivorous birds (mourning dove) exposed to PCBs in floodplain soil EUs, HQs are included based on three different exposure models, two dietary (one based on measured prey tissue and one based on modeled prey tissue), and one egg-based. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on a literature-derived BAF (because no significant relationship was identified between site soil and plant tissue). Likewise, the dietary HQ model based on measured tissue is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary measured tissue exposure model are summarized for the mourning dove below.

- Dietary HQs based on high sensitivity avian TRVs for PCBs indicated that risk is negligible for C2 South and Central EUs, C5 North and South EU, C6 North EU, C7 through C10 (all EUs), and the MAA and LAA. Risk is considered low in C2 North EU, C4 South EU, and C6 South EU, moderate in C1 East EU, C3 (North and South EUs), and C4 (North EUs). High risk is predicted in C1 West EU. This evaluation is considered to be highly conservative because of the use of high sensitivity PCB TRVs (see discussion of high sensitivity TRV above). Because the HQ results are based on site-specific measured plant tissue and receptor specific parameters but highly conservative TRVs, confidence in the risk prediction for herbivorous birds based on this LOE is low to moderate for all EUs and AAs.
- Dietary HQs based on mid-sensitivity avian TRVs indicated that risk is negligible in all reaches and AAs except C1 West EU where risk is considered moderate. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are ecologically relevant and adequately representative of birds present onsite. The mourning dove and other herbivorous birds (goldfinch [*Spinus tristis*], housefinch [*Carpodacus mexicanus*], and cardinals [*Cardinalis cardinalis*]) have been observed onsite. Because the HQ results are based on site-specific tissue, receptor specific parameters, and appropriate TRVs, and because receptors are present onsite, confidence in the risk prediction for herbivorous birds based on this LOE is moderate to high.

Based on the WOE, the HQ based on estimated dietary dose using measured prey tissue to mid-sensitivity TRVs is considered to have the highest relative confidence in predicting risks to herbivorous birds from PCBs in floodplain soil. Risk from PCBs is considered negligible in all EUs except C1 West EU where predicted risk is moderate.

Insectivorous Birds

For the insectivorous/invertivorous birds (Carolina wren) exposed to PCBs in floodplain soil EUs in addition to the community metrics discussed above, a range of HQs were calculated and results are summarized for the identified representative receptor (Carolina wren-1). The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue has a higher level of uncertainty. Specifically, it is based approximately 55% on BAFs for which no significant relationship was identified between site soil and measured plant and grasshopper tissue and another 31% on an uptake model used for worms as a surrogate for spiders in the diet of the Carolina wren. The remaining 15% of the modeled estimate is

based on an uptake model in which a significant relationship was found between field collected earthworms and OU-4 soil.

In addition, as described above, the dietary model is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary exposure model using measured tissue concentrations are summarized for the most sensitive receptor (Carolina wren).

- Dietary HQs based on high sensitivity avian TRVs for PCBs indicated that risk is high in all EUs within the UAA and moderate in all other EUs. This evaluation is considered to be highly conservative because of the high sensitivity PCB TRVs (see discussion above for high-sensitivity TRVs). While species similar to the Carolina wren have been found to have moderate sensitivity to PCBs, this specific species has not been tested so there is uncertainty associated with the interpretation of the high sensitivity TRVs. This species and other insectivorous/invertivorous birds (robin [*Turdus migratorius*], warbler [*Dendroica petechia*]) have been observed onsite. Because the HQ results are based on site-specific measured tissue concentrations and receptor-specific parameters but highly conservative TRVs and because this species was observed onsite, confidence in the risk prediction for insectivorous/invertivorous birds based on this LOE is low to moderate for all EUs and AAs.
- Dietary HQs based on mid-sensitivity avian TRVs indicated that risk is moderate in all EUs within the UAA (C1 through C4) and negligible in all other EUs and AAs. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are ecologically relevant and adequately representative of birds present onsite. Because the HQ results are based on site-specific measured data, but earthworm tissue was used as a surrogate for the spider portion of the diet, confidence in the risk prediction for insectivorous/invertivorous birds based on this LOE is moderate for all EUs and AAs.

Based on the WOE, the comparison of the estimated dietary dose based on measured tissue concentrations to mid-sensitivity TRVs is considered to have the highest relative confidence in predicting risks to insectivorous/invertivorous birds from PCBs in floodplain soil. Risk from PCBs is considered moderate in all EUs within the UAA and negligible all other EUs.

Omnivorous Birds

For the terrestrial omnivorous birds (blue jay) exposed to PCBs in floodplain soil EUs, in addition to the community metrics discussed above, HQs are included based on three different exposure models, two dietary (one based on measured prey tissue and one based on modeled prey tissue) and one egg-based. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based primarily on a literature-derived BAF (because no significant relationship was identified between site soil and plant tissue which comprise 78% of the bluejay diet). Likewise, the dietary HQ model based on measured tissue is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary measured tissue exposure model are summarized for the selected representative receptor (blue jay).

- Dietary HQs based on high sensitivity avian TRVs for PCBs indicated that risk is high in C1 West and C3 South EUs, and moderate in the remaining EUs within the UAA. Downstream of the UAA all EUs have low predicted risk. This evaluation is considered to be highly conservative because of the high

sensitivity PCB TRVs (see discussion above for high-sensitivity TRVs). The blue jay and other terrestrial omnivorous birds (thrasher [*Toxostoma rufum*], chickadee [*Poecile atricapillus*], and grackle [*Quiscalus quiscula*]) have been observed onsite. Because the HQ results are based on estimated dose using site-specific measured tissue and receptor specific parameters but highly conservative TRVs, confidence in the risk prediction for terrestrial omnivorous birds based on this LOE is low to moderate.

- Dietary HQs based on mid-sensitivity avian TRVs indicated that risk is moderate in C1 West EU, C1 East EU and all EUs in the UAA, and negligible in all EUs downstream. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are based on mourning dove studies which are ecologically relevant and adequately representative of birds present onsite. Because the HQ results are based on an estimated dose using site-specific measured tissue, receptor specific parameters, and appropriate TRVs, and also because blue jay and other terrestrial omnivorous birds have been observed onsite, confidence in the risk prediction for terrestrial omnivorous birds based on this LOE is moderate to high.

Based on the WOE, the comparison of the estimated dose using site-specific measured tissue to mid-sensitivity TRVs is considered to have the relatively highest confidence in predicting risks to terrestrial omnivorous birds from PCBs in floodplain soil. There was good agreement between all three HQ approaches in most reaches with the exception of C1 West where the modeled predictions are more elevated due to the maximum detected soil PCB EPC. Based on this evaluation, risk from PCBs is moderate in C1 West EU, low in C1 East EU and all EUs in the UAA, and negligible in all EUs downstream.

Carnivorous Birds

For the carnivorous birds (red-tailed hawk) exposed to PCBs in floodplain soil EUs, in addition to the community metrics discussed above a range of HQs was calculated and results are summarized for the identified representative receptor (red-tailed hawk). The primary uncertainty associated with the dietary HQs for exposure based on modeled prey tissue are associated with the modeled tissue estimates. For the hawk the primary dietary component is small mammals and a significant relationship was found between OU-4 soil and small mammal tissue. The remaining portion of the diet is comprised of snakes for which no relationship was found with sediment (snakes collected were water snakes so uptake was evaluated based on sediment exposure). The primary uncertainty with the dietary exposure model based on measured tissue is associated with the representativeness of the measured tissue across areas that were not sampled. Based on these considerations, the dietary HQs based on modeled tissue are considered to have a slightly lower level of uncertainty.

In addition, as described above, the dietary model is considered to have higher weight than the egg-based model due to the uncertainty associated with the use of modeled egg tissue as the exposure term. HQ results based on the dietary exposure model using modeled tissue concentrations are summarized for the red-tailed hawk.

- Dietary HQs based on high sensitivity avian TRVs for PCBs indicated that risk is high for EUs in C1 and in all EUs within the UAA, moderate for all EUs within C5 through C8 and C9 North, and low in C9 South. This evaluation is considered to be highly conservative because of the high sensitivity PCB TRVs (see discussion above for high-sensitivity TRVs). The red-tailed hawk and other carnivorous

birds (barred owl [*Strix varia*], Cooper's hawk [*Accipiter cooperii*], and red-shouldered hawk [*Buteo lineatus*]) have been observed onsite. Because the HQ results are based on doses estimated using predictive models for prey tissue across the full range of PCBs measured in OU-4 soils and receptor specific parameters but highly conservative TRVs, confidence in the risk prediction for carnivorous birds based on this LOE is low to moderate for most floodplain soil EUs.

- Dietary HQs based on mid-sensitivity avian TRVs indicated that risk is negligible in all EUs within the LAA as well as C5 North. Predicted risk is low in C3 and C5 South, and moderate in all remaining EUs except C1 West where predicted risk is high. This evaluation is considered to be moderately conservative because the mid-sensitivity PCB TRVs are based on mourning dove studies, which are ecologically relevant and adequately representative of birds present onsite. Because the HQ results are based on doses estimated using predictive models for prey tissue across the full range of PCBs measured in OU-4 soils, receptor specific parameters, and appropriate TRVs, and also because the red-tailed hawk and other carnivorous birds have been observed onsite, confidence in the risk prediction for terrestrial carnivorous birds based on this LOE is moderate to high.

Based on the WOE, the comparison of modeled dietary dose to mid-sensitivity TRVs is considered to have relatively the highest confidence in predicting risks to carnivorous birds from PCBs in floodplain soil. Risk from PCBs is considered to be moderate in all EUs in the UAA and MAA (EUs C1 through C6) and low in all EUs within the LAA. In EUs C1 and C2 the HQs based on modeled prey tissue were high compared with those calculated based on measured tissue whereas downstream, the measured tissue estimates were slightly higher than the modeled estimates but all values were close in range.

Mixed Diet Birds

For the mixed diet invertivorous birds (Carolina wren-2 is most sensitive) exposed to PCBs in floodplain soil, riparian soil, and sediment, dietary HQs based on both measured and modeled prey tissue and high and mid-range sensitivity TRVs were estimated. As for most of the other avian receptors, the HQs based on measured tissue and mid-range sensitivity had the relative highest confidence (moderate/high) in the WOE and are discussed below.

Dietary HQs indicated that risk to the Carolina wren-2 is moderate in all reaches in the UAA (C1 through C4), and negligible downstream. As discussed above for other terrestrial mammals, this evaluation is considered to be moderately conservative because the avian TRVs for PCBs used in this evaluation are conservative and based on a study conducted with a relevant species. The primary uncertainty associated with this evaluation is the assumption that Carolina wrens eat a significant amount of spiders and that these spiders obtain exposure from sediment. In addition, earthworm tissue was used as a surrogate for spider tissue. Based on these uncertainties, confidence in the risk prediction for mixed diet invertivorous birds based on this LOE is low to moderate.

6.3.7 AE 6: Survival, Growth, and Reproduction of Mammals

LOEs evaluated for mammals include a range of HQs (based on dietary and tissue-based exposure) and community metrics. A wide range of HQs were calculated, including results for eight mammal receptors, 12 exposure scenarios, and seven COPCs. Each of these scenarios and results are summarized in Section 6.1. The WOE approach is used to interpret the risk to aquatic and terrestrial mammals, focusing on PCBs for the quantitative LOEs as summarized in Table 6-26 and discussed below. HQs were

calculated using 1) measured prey tissue to estimate dietary exposure and literature-derived dietary TRVs, 2) modeled prey tissue to estimate dietary exposure and literature-derived dietary TRVs, and 3) measured whole body mammal tissue concentrations and literature-derived tissue-based CTCs. There are uncertainties with both the exposure models and the effects criteria (i.e., the TRVs and CTCs) employed. The largest uncertainty associated with the measured prey tissue-based HQs (1) and the measured small mammals tissue (3) is the representativeness of the tissue EPC estimate across a relatively large spatial area. The modeled dietary approach (2) has relatively high uncertainty associated with the BAFs used to estimate prey tissue concentrations for the exposure models. This is particularly true for prey items for which no relationship was found between soil or sediment and tissue (e.g., for fish). The effects criteria employed (i.e., the TRVs and CTCs) for all three analyses are considered to have a similar level of uncertainty (i.e., all were derived from a body of literature and are not site-specific). Considering these factors, the tissue-based HQs based on measured tissue are given the highest weight when available. When whole body tissue was not available, dietary HQs based on the measured prey tissue concentrations are in most cases given the higher weight than the HQs based on modeled tissue. Exceptions are noted for specific receptors in Section 6.3.7.2 below.

6.3.7.1 Aquatic Mammals

Two feeding guilds representative of aquatic mammals, potentially present onsite, were evaluated in this OU-4 BERA: piscivores and aerial invertivores. The risk findings for aquatic mammals are summarized in Table 6-26 and discussed below.

For all aquatic mammals, the community metrics indicate that mammal abundance was significantly lower in the MAA than in the UAA and LAA. Other community measures (richness, diversity, dominance) did not significantly differ among reaches. Overall, the results suggest no effect of PCBs or other COPCs on the aquatic mammal community with no apparent trend going from upstream to downstream. There is low level of confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Piscivorous Mammals

For piscivorous mammals (mink and river otter) exposed to PCBs in sediment EUs, HQs were calculated for dietary exposure based on both modeled and measured prey tissue and for two TRVs, one based on a growth endpoint and one based on a reproductive endpoint. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on BAFs that for which no significant relationship was identified between site sediment and fish tissue. In addition, the selected reproduction-based LOAEL TRV is based on an approximate 85% reduction in kit survival and the growth-based LOAEL TRV is based on an approximate 15 to 25% reduction in kit growth. As discussed in Section 6.2.3.7, the PCB-containing fish diet used in the study was co-contaminated with PCDD/PCDFs. Thus, the selected TRVs may be artificially low, because these compounds act via the same mechanism as co-planar PCBs. However, mink data available from a recent study by Bursian et al. (2013) provide similar but slightly higher TRVs based growth and reproduction and Fuchsman et al. (2008) calculated a similar mink reproduction EC20. Based on these considerations, the reproductive NOAEL and LOAEL are considered adequately protective, while growth effects are not clearly tied to population-level impacts in mink, and therefore the

mink TRV based on the growth endpoint is more uncertain. HQ results based on the dietary measured tissue exposure model for both TRVs are summarized for the most sensitive receptor (otter).

- Dietary HQs based on mammal/mink reproduction and growth TRVs for PCBs indicated that risk to the most sensitive species (otter) is high in all reaches and EUs. Results for the mink were slightly lower, but all results were predicted as high risk. The HQs based on growth endpoint TRVs are considered to have moderate confidence and the HQs based on the reproductive endpoint TRVs are considered to have moderate/high confidence.

In addition to the evaluation of the aquatic mammal communities and the HQs, habitat suitability for mink and otter were assessed qualitatively based on the 2006 and 2007 surveys and considered as a supporting LOE. Evidence of river otters and mink were observed in some locations within OU-4. Potentially suitable habitat for mink and otter is present in some areas of OU-4. However, there are also areas where habitat may be unsuitable. For mink, given their smaller relative home range, presence of a relatively contiguous riparian corridor along Choccolocco Creek that represents suitable impounded stream habitat, presence of prey items, and observations of mink tracks, it seems likely that individuals use portions of OU-4 for foraging. Suitable habitat is present such that there is the potential for a breeding mink population to reside in the vicinity as well, although no evidence of this has been observed. For river otters, although prey items are present throughout the creek, this species has a larger home range and prefers a permanent foraging base, such the lacustrine conditions present only at the western/southern end of OU-4. As such, it is possible that river otter may be present in OU-4.

Based on the WOE, the comparison of estimated dietary dose to mink reproduction TRVs is considered to have relatively higher level of confidence, compared with the results based growth-based TRVs, in predicting risks to piscivorous mammal communities or populations from PCBs in sediment. Risk from PCBs is considered high in all reaches.

Aerial Insectivores

For aerial insectivorous mammals (little brown bat) exposed to PCBs in sediment EUs, HQs are included based on two dietary exposure models (one based on measured prey tissue and one based on modeled prey tissue). The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on BAFs for which no significant relationship was identified between OU-4 sediment and prey tissue (i.e., emergent insects). HQ results based on the dietary measured tissue exposure model are summarized for the little brown bat. The TRVs for small mammals used in the HQ calculations were based on an approximate 31% reduction in off-spring per month and a 13 to 15% reduction in body weight of newborns. This study provided the basis for both the dietary TRVs and the CTCs and is considered to have a moderate level of uncertainty as discussed in Section 6.2.3.7.

- Dietary HQs for PCBs indicated that risk is considered moderate in reach C1 through C4 and the UAA. Risk in all other EUs is considered negligible. The primary uncertainty is associated with the measured prey tissue. The emergent insects consisted primarily of a mixture of mayflies, damselflies, and crane files, with the exception of two samples in the UAA which were exclusively cranefly tissue. The PCB concentrations reported by the laboratory were over an order of magnitude greater than the other samples found within OU-4. As discussed in Section 6.2, there is some uncertainty associated with these results. However, because the dietary HQ results are based on site-specific measured

prey tissue and receptor specific parameters but highly conservative TRVs, confidence in the risk prediction for insectivorous/invertivorous aquatic mammals based on this LOE is moderate to high.

Based on the WOE, the comparison of measured dietary dose to mammal TRVs is considered to have the highest relative confidence in predicting risks to aerial insectivorous aquatic mammals from PCBs in sediment. While the findings for the UAA have some associated added uncertainty, the findings from this LOE are consistent with the findings from the modeled HQ approach downstream of teach C4. Risk from PCBs is considered negligible in reaches C5 and C10 and moderate in reaches C1 through C4.

6.3.7.2 Terrestrial Mammals

Three feeding guilds representative of terrestrial mammals, potentially present onsite, were evaluated in this OU-4 BERA: herbivore, insectivore/invertivore, and carnivore. The risk findings for terrestrial mammals are summarized in Table 6-26 and discussed below.

For terrestrial large and small mammals, the community metrics indicate that mean abundance, species richness, diversity, and dominance did not significantly differ between OU-4 and reference locations. Based on this evaluation, the health of the large and small mammal community within OU-4 appears to be similar compared to reference areas. Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial large and small mammal community. There is moderate level of confidence in this LOE because although it was based on site-specific observations, the evaluation was based on limited data and statistical analysis.

Herbivorous Mammals

For the terrestrial herbivorous mammals (white-tailed deer) exposed to PCBs in floodplain soil, in addition to the community metrics assessment as discussed above, HQs were estimated based on two dietary exposure models (one based on measured prey tissue and one based on modeled prey tissue). The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based on BAFs for which no significant relationship was identified between OU-4 sediment and prey tissue (i.e., terrestrial plant tissue). The dietary HQ results based on measured prey tissue for the white-tailed deer are discussed as follows:

- Dietary HQs indicated that risk is negligible in all EUs and AAs. As discussed above for aerial insectivorous mammals, this evaluation is considered to be moderately conservative because the mammal TRVs for PCBs used in this evaluation are conservative and based on small mammal multi-generational studies. White-tailed deer and other herbivorous mammals (eastern cottontail, chipmunk) have been observed onsite. Because the HQ results are based on measured plant tissue, receptor specific parameters, and conservative TRVs, and because herbivorous mammals have been observed onsite, confidence in the risk prediction for such mammals based on this LOE is moderate to high.

Invertivorous Mammals

For the terrestrial insectivorous/invertivorous mammals (short-tailed shrew), exposed to PCBs in floodplain soil, in addition to the community metrics assessment discussed above, dietary HQs and tissue HQs based on small mammal tissue CTCs were calculated and results are discussed as follows:

- Dietary HQs estimated using measured prey tissue indicate that predicted risk to the shrew-1 (most sensitive scenario) is moderate in reaches C1 through C4 and negligible in all EUs downstream. The second shrew exposure scenario (shrew-2) resulted in near identical findings. As discussed above for aerial insectivores, this evaluation is considered to be moderately conservative because the mammal TRVs for PCBs used in this evaluation are conservative and based on small mammal multi-generational studies. The short-tailed shrew was observed onsite. Because the HQ results are based on site-specific measured prey tissues, receptor specific parameters, and conservative TRVs, and because insectivorous/invertivorous mammals have been observed onsite, confidence in the risk prediction for such mammals based on this LOE is moderate to high.
- Tissue HQs were estimated by comparing the whole body mammal tissue concentrations to mammal tissue CTCs. Risk based on this approach is considered negligible in all AAs. Because measured mammal tissue concentrations are not available for each EU, mammal tissue concentrations were estimated on an AA-basis. This evaluation is considered to be moderately conservative because the tissue EPCs are an upper confidence limit on the mean for the AA datasets. The mammal tissue HQs were estimated using appropriate and conservative TRVs based on multigenerational studies and considered to be adequately protective of terrestrial mammals in OU-4. As a result, confidence in the risk prediction based on this LOE is high.

Based on the WOE, the tissue-based HQs are considered to have the highest weight because there is less uncertainty associated with evaluating a direct measure of the exposure than with modeling the exposure through the food web. The dietary TRVs and the tissue-based CTCs are considered to have a similar level of uncertainty because they are based on the same underlying study. Thus the findings of risk for small terrestrial mammals in OU-4 is negligible in all AAs and confidence in this finding is considered high relative to other LOEs.

Carnivorous Mammals

For the carnivorous mammals (weasel and red fox) exposed to PCBs in floodplain soil, in addition to the community metrics assessment as discussed above, dietary HQs were calculated using both modeled and measured prey tissue concentrations. For the weasel (the more sensitive of the two receptors), the primary dietary component is small mammals and a significant relationship was found between OU-4 soil and small mammal tissue. The remaining portion of the diet is comprised on snakes for which no relationship was found with soil. The primary uncertainty with the dietary exposure model based on measured tissue is associated with the representativeness of the measured tissue across areas that were not sampled. Because a good predictive relationship was found, the dietary HQs based on modeled tissue are considered to have a slightly lower level of uncertainty. Results for the weasel are discussed as follows:

- Dietary HQs based on modeled prey tissue indicate that risk to the weasel is moderate in reach C1 West, low in reach C1 East, C3 and C4, and negligible in reach C2 and all reaches downstream of C4. As discussed above for other terrestrial mammals, this evaluation is considered to be moderately conservative because the mammal TRVs for PCBs used in this evaluation are conservative and based on small mammal multi-generational studies. Weasels and other carnivorous mammals (eastern coyote and bobcat) were observed onsite. Because the HQ results are based on site-specific uptake model, receptor specific parameters, and conservative TRVs, and because carnivorous

mammals have been observed onsite, confidence in the risk prediction for carnivorous mammals based on this LOE is moderate to high

6.3.7.3 Mammals with Mixed Aquatic and Terrestrial Diet

For the omnivorous mammals (raccoon-1 and 2) exposed to PCBs in floodplain soil, riparian soil, and sediment, in addition to the community metrics assessment as discussed above, dietary HQs based on both measured and modeled prey tissue were estimated. The dietary HQs for exposure based on measured prey tissue are considered to have higher weight than those calculated using modeled prey tissue because the modeled tissue is based largely on BAFs for which no significant relationship was identified between OU-4 soil or sediment and prey tissue. The dietary HQ results based on measured prey tissue for the raccoon are discussed as follows:

- Dietary HQs based on measured prey tissue indicated that risk to the raccoon-2 is low in all reaches and AAs for the riparian EUs and for C1 through C4 floodplain EUs. Predicted risk is negligible for floodplain EUs downstream of Reach C4. As discussed above for other terrestrial mammals, this evaluation is considered to be moderately conservative because the mammal TRVs for PCBs used in this evaluation are conservative and based on small mammal multi-generational studies. Raccoons and other mammals with similar feeding guilds were observed. Because the HQ results are based on site-specific measured prey tissue, receptor specific parameters, and conservative TRVs, and because omnivorous mammals have been observed onsite, confidence in the risk prediction for omnivorous mammals based on this LOE is moderate to high.

6.3.8 AE 7: Survival, Growth, and Reproduction of Amphibians or Reptiles

As discussed in Section 6.1.7, metrics for evaluating amphibians and reptiles are limited. Comparisons of surface water concentrations to ADEM WQSs indicated that risk is predicted for aquatic life in all reaches. Additional sediment or tissue based toxicity values were not available due to limited toxicity data. Individual studies were considered in the uncertainty analysis and as described in Section 6.2.3.8 and 6.2.3.13, sediment, surface water, and tissue concentrations of PCBs and mercury measured in OU-4 media were similar to or below no or low effect concentrations observed in the available studies. While there are uncertainties associated with each of these metrics, the combined results suggest that risk to amphibians is unlikely.

7 REMEDIAL GOAL OPTIONS

RGOs protective of ecological receptors are included herein for those COPCs and receptors for which potential risk was indicated in this OU-4 BERA. These values will support the Feasibility Study and risk management discussions for OU-4. Based on the requirements of the PCD, the range of ecological RGOs developed is based on both NOAEL and LOAEL (or equivalent) levels of protection for each AE. The complete set of RGOs is provided in Tables 7-1- through 7-3. RGOs are rounded to whole numbers when 10 or greater and to one decimal place or one significant figure when less than 10. Selection of specific RGO values is described below.

For benthic invertebrates, the results of the OU-4 sediment toxicity testing were used as the basis for PCB and mercury RGOs (Table 7-1). Specifically, the PCB RGO values for reproduction and survival ranged from 1.4 to 152 mg/kg for effects from 0 and 20% after accounting for reference sediment toxicity (i.e., EC0* to EC20*) for two species. The EC0* represents a value at and below which site-related effects are not expected. Some concentration above the EC0* may result in some level of effects on some toxicity endpoints. Given the variability in the control, reference, and site responses, it is likely that the EC0* value is not the break point between reference and site conditions, but that the full range of reference conditions is larger than the responses observed in the six tested reference sediment samples. Given the sometimes large variability in control responses for a toxicity endpoint, in particular for reproductive endpoints which ranged from 25 to 137%, large variability can also be expected in responses of organisms exposed to OU-4 sediments. The EC10* and EC20* are PCB concentrations that would cause percentage responses lower than the lowest response observed in the control and reference sediments, although they might or might not exceed the threshold for above-background responses if the full range of possible reference responses were known. For the purposes of this analysis, the EC10* and EC20* are considered to be reasonable and conservative estimates that are appropriate for use as upper bound RGO values.

For non-mercury metals, the benthic invertebrates RGOs are simply the media-based toxicity benchmarks selected for the BERA screening (Table 7-2). These values are not site-specific and are considered to have high associated uncertainty. RGOs for other lower trophic level receptors (i.e., aquatic and terrestrial plants and terrestrial invertebrates) were not estimated as the WOE for these receptors indicated generally negligible risk.

For fish, the tissue-based HQs were given the highest weight in the WOE. Because the sediment-to-fish BAFs gave very different HQs compared to the tissue HQs, they were not used to back-calculate RGOs for fish. Instead, the fish tissue HQs were compared to the piscivorous wildlife HQs to determine the relative sensitivity of these two receptor groups. Piscivorous wildlife HQs were higher than fish tissue HQs in almost every case. Therefore, the piscivorous wildlife RGOs are considered protective of fish, and fish-specific RGOs were not calculated.

For aquatic and terrestrial wildlife, RGOs are presented in Tables 7-2 and 7-3, respectively. The RGO calculation for birds and mammals uses the dietary dose equation described in Section 4.4. To determine the RGO, the dose model that was given the highest weight in the WOE was employed to estimate the associated RGOs. Because in most cases, the dose model with the highest weight is based on measured prey tissue data, the RGO is simply calculated as the EPC divided by the soil or sediment HQ. Site-wide EPCs were employed in this calculation. For the carnivores, for which the modeled dietary tissue exposure

was given highest weight, the RGOs were calculated using an Excel solver that determines the soil or sediment concentration at which the NOAEL or LOAEL HQ equals 1.

Because of the added uncertainty associated with RGO calculation for mixed diet receptors and egg-based exposure models and because risk results were very similar to or lower than those for all aquatic and all terrestrial dietary exposure scenarios, RGOs are not presented for receptors categorized as mixed diet receptors (Carolina wren–2, spotted sandpiper–1, raccoon–1 and -2, and mink–1), and egg-based exposures for birds. However, some receptors that were generally categorized as terrestrial or aquatic have a small fraction of the diet from the aquatic or terrestrial food chain. For these receptors that include the great blue heron, mink–2, and red-tailed hawk, soil or sediment RGOs were calculated based on the media associated with the dominant portion of the diet and the target HQ of 1. For example, sediment RGOs calculated for great blue heron and mink–2 are based only on the dietary dose associated with sediment and a target HQ of 1. These sediment RGOs exclude exposure to terrestrial food items (i.e., small mammals). Small mammals comprise 1% of the diet for great blue heron and 6% of the diet for the mink–2. Similarly, the hawk is assumed to consume a diet containing 87% small mammals (modeled from soil) and 13% snakes (modeled from sediment). Soil RGOs were calculated for hawk based on the terrestrial fraction of the diet only and the target HQ of 1. Note that for hawk, relatively high PCB HQs were estimated (Table 6-14a and b) based on a high dietary dose due primarily from snake ingestion (the snake BAFs were among the highest estimated for all prey tissue types in OU-4). The corresponding sediment NOAEL and LOAEL PCB RGOs for hawk are 0.5 and 1.6 mg/kg, respectively based on the mid-sensitivity TRVs.

The RGOs for all aquatic and all terrestrial dietary exposure scenarios for the range of bird and mammal receptors evaluated in this OU-4 BERA are considered protective of mixed diet or egg-based exposures. In addition, RGOs for PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ[15] were not calculated because OU-4 predicted risk was not indicated.

As discussed in detail in the risk characterization, key elements of each risk scenario used in RGO calculations have varying levels of uncertainty. Each uncertainty is mitigated by making conservative assumptions resulting in compounded conservatism in the RGO calculations that likely result in overestimates of exposure and effects.

Table 7-4 summarizes the range of RGOs for each receptor group and COPC. For PCBs and benthic invertebrates, the RGOs are based on the range of effect concentrations for the species tested for reproduction and survival. For birds and mammals, the selected RGOs are based on the NOAEL and LOAEL TRVs and receptor-specific dose models assuming 100% site use for the range of species selected to represent the AEs.

[15] Risk findings for PCDD/PCDF TEQ, DL-PCB TEQ, and total TEQ are based on the TEQ calculated using ND=0 for non-detected congeners. Additional detail is provided in Appendix F.

8 CONCLUSIONS

This OU-4 BERA has been conducted using a wide range of scientific data and information along with input and direction from USEPA to develop various LOEs for characterizing risks. To complete this OU-4 BERA, ecological community data, habitat studies, chemical data from abiotic media (surface water, sediment and soil), a range of biotic tissue data collected over the course of the last 15 years, and the outcomes of site-specific sediment toxicity and bioaccumulation studies were used. The results of these studies and data collection activities provide a great deal of site-specific information for a robust risk assessment. These results, complemented with relevant literature-based information, have been incorporated into this OU-4 BERA to formulate a WOE to support a range of conclusions regarding potential risks to ecological receptors that may reside or forage within OU-4.

Multiple MEs and LOEs were evaluated along with specific uncertainties associated with each to evaluate each AE identified for this OU-4 BERA. In most cases, uncertainties were mitigated with conservative assumptions – as a result, risk estimates and conclusions are more likely to overestimate, rather than underestimate risk.

Based on the risk findings, PCBs are the primary risk driver in OU-4. Risks for other COPCs were also assessed, and are reported for completeness. The key conclusions for other COPCs are:

- Small sample sizes precluded statistical comparisons to reference conditions for COPCs other than PCBs and mercury for soil and biotic tissues.
- With respect to mercury, comparisons to reference areas and among AAs indicate that while OU-4 concentrations were higher than reference conditions, there is no upstream to downstream trend in mercury concentrations in either sediment or biotic tissue. There was a detectable upstream to downstream trend in mercury concentrations in soil, but it was similar to that of PCBs.
- Although HQ-based risk estimates for other metal COPCs are greater than 1 in some parts of OU-4, no apparent upstream to downstream trend was observed in media concentrations, indicating that these COPCs are not likely site-related.

The potential risks predicted for ecological receptors exposed to PCBs in OU-4, based on the LOEs with the highest confidence (most site-specific and least uncertain), are summarized below.

Lower Trophic Level Receptors

A total of six lower trophic level receptors were evaluated, including four aquatic receptor groups and two terrestrial receptor groups. Risks based on the WOE for plants, fish, and terrestrial invertebrates are summarized in Table 8-1 (below), and risks to benthic invertebrates are summarized in Figure 8-1 (below). Overall, risks to plants, fish, and terrestrial invertebrates are low or moderate – there are no findings of high risk in any of the OU-4 reaches for any of these receptors. For benthic invertebrates, there are some individual locations showing potential high risk for the most sensitive reproduction endpoint (see top graph in Figure 8-1), but the majority of findings point to low or negligible risks throughout OU-4. Benthic communities sampled in the three AAs were similar to reference.

For aquatic plants, the LOE with the highest confidence was a comparison of AA-specific surface water EPCs to plant-specific water benchmarks. For fish (three trophic levels), the LOE with the highest confidence was a comparison of AA-specific tissue EPCs to fish CTCs. For terrestrial plants and

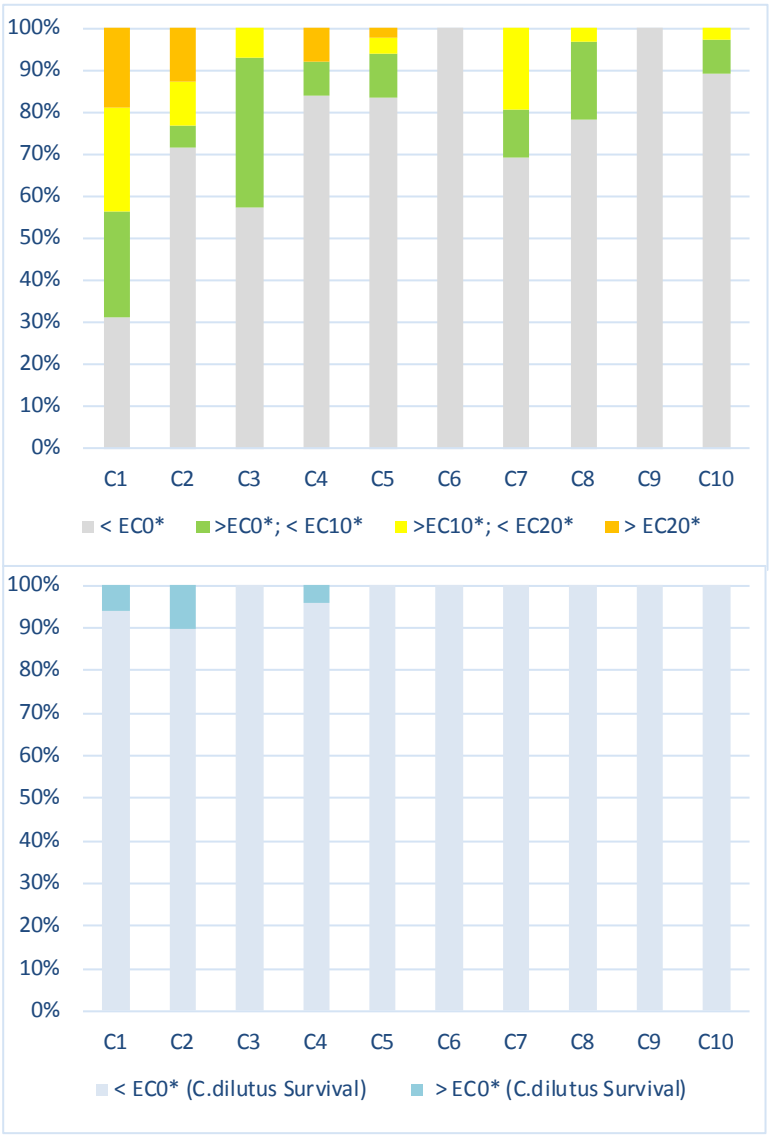
invertebrates, the LOE with the highest confidence was a comparison of EU-specific EPCs to soil-based benchmarks protective of plants and invertebrates, respectively. For benthic invertebrates, the LOE with the highest confidence is a comparison of individual sample concentrations to site-specific sediment toxicity thresholds.

Table 8-1. Predicted Risk for Lower Trophic Level Receptors Exposed to PCBs in OU-4 based on the WOE

Receptors	OU-4 Reaches									
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10[a]
	UAA				MAA		LAA			
Aquatic Plants[a]	M	N			N		N			
Forage Fish[a]	na	L			L		L			
Bottom Fish[a]	na	M			L		M			
Predator Fish[a]	na	M			M		M			
Terrestrial Plants	M	N	N	N	N	N	N	N	N	N
Terrestrial Invertebrates[a]	na	N			N		N			

Notes:
a: results based on assessment area rather than individual reaches
L: low risk; M: moderate risk; N: risk is negligible (*de minimis*)
LAA: lower assessment area; MAA: middle assessment area; UAA: upper assessment area
na: not applicable - Reach C1 was not assessed based on the LOE with highest confidence because tissue data were not collected in this reach.
LOE: line of evidence

Figure 8-1. Summary of Benthic Invertebrate Toxicity Threshold Exceedance Analysis



Notes:

[a] EC0*, EC10*, and EC20* are the regression-predicted PCB concentrations that would cause an additional 0%, 10%, or 20% effect beyond the lowest response measured in the reference sediments. Most sensitive reproduction endpoint is *Hyalella azteca* young per female normalized to survival

Negligible risk when concentration is below EC0* for most sensitive reproduction endpoint
Low risk based on exceedance of EC0* for most sensitive reproduction endpoint
Moderate risk based on exceedance of EC10*for most sensitive reproduction endpoint
High risk based on exceedance of EC20* for most sensitive reproduction endpoint
Risk based on EC0* for most sensitive survival endpoint.

Birds

Potential risks to nine different birds were evaluated as part of this OU-4 BERA – five aquatic birds (including piscivores, aquatic insectivores/invertivores, and aerial invertivores), and four terrestrial birds (including herbivores, terrestrial insectivores/invertivores, omnivores, and carnivores). In addition, two scenarios for mixed aquatic and terrestrial diets were evaluated. Predicted risks based on the WOE are summarized in Table 8-2 (below). Predicted risks for most birds in most areas of OU-4 are negligible. The key exceptions are piscivores (risks across OU-4 are predicted as moderate for piscivores), and terrestrial carnivores and mixed diet insectivores/invertivores (risks are predicted as moderate for just under half of the AAs).

The LOE with highest confidence for all birds except carnivores is the dietary HQ calculated based on AA-specific measured prey tissue EPCs. For carnivores, the HQs based on modeled prey tissue have slightly higher confidence because the model is based on a significant predictive relationship between soil and small mammal prey tissue.

Table 8-2. Predicted Risk for Birds Exposed to PCBs in OU-4 based on the WOE

Birds	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10[a]
		UAA			MAA		LAA			
Aquatic Birds										
Piscivores (heron)	M	M	M	M	M	M	M	M	M	M
Insectivores/Invertivores (sandpiper)	L	L	N	N	N	N	N	N	N	N
Aerial Invertivores (swallow)	M	M	M	M	N	N	N	N	N	N
Terrestrial Birds										
Herbivores (dove)	N (e) & M (w)	N	N	N	N	N	N	N	N	--
Insectivores/Invertivores (wren)	M	M	M	M	N	N	N	N	N	--
Omnivores (blue jay)	L (e) & M (w)	L	L	L	N	N	N	N	N	--
Carnivores (hawk)	M (e) & H (w)	M	L	M	N (n) & L(s)	N	N	N	N	--
Birds with Mixed Aquatic and Terrestrial Diet										
Insectivores/Invertivores (wren)	M	M	M	M	N	N	N	N	N	--

Notes:
[a]: Floodplain soil/riparian soil not evaluated in reach C10; HQs not estimated for terrestrial and mixed diet receptors (--).
H: high risk; L: low risk; M: moderate risk; N: risk is negligible (*de minimis*).
e: east; w: west; n: north; s: south
LAA: lower assessment area; MAA: middle assessment area; UAA: upper assessment area
NA: not applicable
WOE: weight of evidence

Mammals

Potential risks to mammals were assessed by evaluating three aquatic mammals (including piscivores and aerial invertivores) and four terrestrial mammals (including herbivores, terrestrial insectivores/invertivores, and carnivores). In addition, two scenarios for mixed aquatic and terrestrial diet were evaluated for one species. Based on the WOE, risks are as summarized in Table 8-3 (below). Piscivores are predicted to have high risk. All other mammalian receptors are predicted to have negligible or low risks in the MAA and LAA, with moderate risks to aerial invertivores in the UAA and moderate risk to carnivores in reach C1 West only.

As with birds, the LOE with the highest confidence for all mammals except carnivores is the dietary HQ based on measured prey tissue EPCs. For carnivores, the dietary HQ based on modeled prey tissue had slightly higher confidence.

Table 8-3. Predicted Risk for Mammals Exposed to PCBs in OU-4 based on the WOE

Mammals	OU-4 Reaches									
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10[a]
		UAA			MAA		LAA			
Aquatic Mammals										
Piscivores (otter/mink)	H	H	H	H	H	H	H	H	H	H
Aerial Invertivores (bat)	M	M	M	M	N	N	N	N	N	N
Terrestrial Mammals										
Herbivores (deer)	N	N	N	N	N	N	N	N	N	--
Insectivores/Invertivores (shrew)	N	N	N	N	N	N	N	N	N	--
Carnivores (weasel)	L (e) & M (w)	N	L	L	N	N	N	N	N	--
Mammals with Mixed Aquatic and Terrestrial Diet										
Omnivore – sediment/ riparian/floodplain (raccoon)	L	L	L	L	N	N	N	N	N	--
Omnivore – sediment/ riparian (raccoon)	L	L	L	L	L	L	L	L	L	--

Notes:
a: Floodplain soil/riparian soil not evaluated in reach C10; HQs not estimated for terrestrial receptors. Mixed diet receptor intakes were modified to be aquatic only or were not evaluated (--).
H: high risk; L: low risk; M: moderate risk; N: risk is negligible (*de minimis*).
e: east; w: west; n: north; s: south
LAA: lower assessment area; MAA: middle assessment area; UAA: upper assessment area
WOE: weight of evidence

Amphibians and Reptiles

Toxicity data for evaluation of PCB exposure to amphibians and reptiles are limited – as a result, HQs were not calculated for these receptors. Comparisons of sediment, surface water, and tissue concentrations of PCBs measured in OU-4 media to the limited toxicity data available indicate that concentrations are similar to or below the no or low effect concentrations. While there are uncertainties associated with this evaluation, the results suggest that risk to amphibians exposed to PCBs in OU-4 is unlikely.

Summary

Based on the assessment completed for a wide range of COPCs and receptors, PCBs are the primary risk driver in OU-4. Risk findings are based on a robust set of site-specific data collected over the past two decades, supplemented by literature-based inputs when necessary and when recommended by USEPA. From an overarching perspective, the estimates of risk presented throughout this OU-4 BERA are conservative in nature, as they are based on inputs specifically selected to overestimate rather than underestimate exposure and toxicity.

The highest concentrations of PCBs in sediment and several biotic tissue types are present in reaches C1 and C2, and there is an upstream to downstream decreasing trend in most cases, with fish tissue concentrations being a notable exception. The elevated concentrations of PCBs in sediment result in possible risk to aquatic receptors, with piscivorous birds and mammals having the highest estimated risk. Risk estimates with the highest confidence for all aquatic birds are moderate for all reaches, while for the aquatic mammals (mink and otter), predicted risks are high in all reaches. The similar risk findings for piscivorous receptors results from the fact that estimates are based on measured fish tissue concentrations, and these PCB concentrations are similar across all of OU-4 demonstrating no clear upstream to downstream trend. After the piscivorous birds and mammals, the greatest aquatic risk was predicted for fish, followed by invertivorous birds and mammals, and benthic invertebrates, in that order. These predicted risks decreased from upstream to downstream, similar to PCB concentrations in sediment and several biotic tissue types.

For floodplain soil and riparian soil, there is an apparent upstream to downstream concentration trend for PCBs. The highest PCB concentrations are in C1 West, followed by C1 East, and EUs in reaches C2 and C3. These elevated concentrations of PCBs in soil result in possible risk to terrestrial receptors, with carnivorous birds (represented by the red-tailed hawk) having the highest estimated risk, followed by insectivorous birds, carnivorous mammals, omnivorous mammals, and herbivorous birds and mammals. Risk estimates with the highest confidence for all terrestrial birds are high in reach C1 West, low to moderate in reaches C1 East and C2 through C4 and in C5 South. In all reaches downstream, predicted risk is negligible. For small mammals (i.e., the shrew) predicted risk is negligible throughout OU-4, and for mixed diet birds and mammals predicted risks downstream of C4 are low to negligible.

Based on these findings, risk is possible for ecological receptors in the aquatic and terrestrial habitats within OU-4. The HQ LOE predicted moderate to high risk to fish and piscivorous receptors throughout OU-4, with mink and otter having highest predicted risk. For other bird and mammal receptors, predicted risk based on HQs is highest in reaches C1 and C2, with lower risks found in reaches C3 and C4. Low to negligible risk downstream of reach C4 was indicated for non-piscivorous receptors.

As a supporting LOE, the ecological community evaluation for birds and mammals within OU-4 indicates that receptor communities were either similar to reference, or there was no upstream to downstream trend in community conditions to indicate that any differences are attributable to PCBs or other COPCs. However, since small datasets and other uncertainties associated with the sampling design for community metrics makes this LOE uncertain, this information is provided as a secondary LOE.

Risk to benthic invertebrate communities was evaluated based on individual sample point concentrations compared to site-specific toxicity thresholds. Based on the most sensitive reproduction endpoint, risk is considered negligible across the majority of samples, with a few samples indicating localized low, moderate, or high risk, primarily in reaches C1 and C2. Because of the uncertainty associated with the reproductive endpoint, survival endpoints were also considered, and results indicate negligible risk for the majority of samples and possible low risk for a small number of samples in reaches C1, C2, and C4 (see lower graph, Figure 8-1 above). The benthic community analysis indicated that there is no difference between the structure, diversity, or abundance of benthic invertebrates in sediments of Choccolocco Creek as compared to reference areas; therefore, there is no apparent relationship between the relatively low range of PCBs in OU-4 sediments and potential risks to these communities. These findings of no impact to the community are consistent with the fact that the site-specific toxicity thresholds for survival are rarely exceeded in OU-4.

Based on the results for the receptors evaluated in this OU-4 BERA, a range of RGOs was calculated. For birds and mammals, the RGOs are specifically based on the food web model inputs employed for HQ calculations for all COPCs for which possible risk was indicated. For benthic invertebrates, RGOs are based on the site-specific sediment toxicity thresholds. The range of RGOs for PCBs based on the receptors evaluated in this OU-4 BERA spans two orders of magnitude. RGOs and their associated uncertainty will be considered in the feasibility study for OU-4 within the context of the overall risk management process.

9 REFERENCES

ADEM. 2015. Water Division – Water Quality Program. Volume 1. Available at: http://www.adem.state.al.us/alEnviroRegLaws/files/Division6Vol1.pdf.

Ahn, DU, SM Kim, and H Shu. 1997. Effect of egg size and strain and age of hens on the solids content of chicken eggs. Poultry Sci. 76:914-919.

Albers, PH, MT Koterba, R Rossmann, WA Link, JB French, RS Bennett, and WC Bauer. 2007. Effects of methylmercury on reproduction in American kestrels. Environ. Tox. Chem. 26(9):1856 1866.

Alexander, GR. 1977. Food of vertebrate predators on trout waters in North Central Lower Michigan. The Michigan Academician 10:181 195. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Allen, AW. 1986. Habitat suitability index models: Mink. Washington, D.C.: U.S. Fish and Wildlife Service, U.S. Department of the Interior Biological Report 82(10.127) (Revised). 23 p.

Anderson, RH, AG Prues, and MJ Kravitz. 2010. Determination of the biologically relevant sampling depth for terrestrial ecological risk assessments. Geoderma. 154: 336-339.

Arcadis. 2008. Site-Wide Quality Assurance Project Plan for the Anniston PCB Site. Revision 5, Anniston, Alabama. September.

Arcadis. 2009. Phase 2 Field Sampling Plan for OU-4, including Development of Toxicity Reference Values for OU-4. Anniston, Alabama. Revision 1 dated April 2009.

Arcadis. 2010a. Phase 2 Field Sampling Plan for Operable Unit 4. Revision 2, Anniston, Alabama. April.

Arcadis. 2010b. Phase 3 Sampling Plan for Operable Unit 4. Anniston PCB Site, Anniston, Alabama. October.

Arcadis. 2014. Streamlined Ecological Risk Assessment for the OU-1/OU-2 Portion of Snow Creek. Anniston, Alabama. December.

Arcadis. 2015. Draft Baseline Ecological Risk Assessment for Operable Unit 4, Anniston PCB Site, Anniston, Alabama. 2015.

Arcadis BBL. 2006a. Phase 1 Field Sampling Plan for Operable Unit 4 of the Anniston PCB Site. Revision 3. August.

Arcadis BBL. 2006b. Baseline Problem Formulation for OU-4 of the Anniston PCB Site.

Arcadis BBL. 2007. Operable Unit 4 Phase 1 Ecological Survey Report. December.

ASTM International. 2012. Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. Method E 1706-05 (2010). ASTM International, West Conshohocken, PA.

Atkinson, A, SJ Thompson, AT Khan; TC Graham, S, Ali, C Shannon, O Clarke, and L Upchurch. 2001. Assessment of a two-generation reproductive and fertility study of mercuric chloride in rats. Food and Chemical Toxicology 39 (2001) 73-84.

ATSDR. 1999a. Toxicological Profile for Lead. U.S. Department of Health and Human Services. July 1999. Available online at http://www.atsdr.cdc.gov/toxprofiles/tp13.html.

ATSDR. 1999b. Toxicological Profile for Mercury. U.S. Department of Health and Human Services. March 1999. Available online at http://www.atsdr.cdc.gov/toxprofiles/tp46.html.

ATSDR. 2004. Toxicological Profile for Cobalt. U.S. Department of Health and Human Services. April 2004. Available online at http://www.atsdr.cdc.gov/toxprofiles/tp33.html.

Aulerich RJ, RK Ringer, S. Iwamoto. 1974. Effects of dietary mercury on mink. Arch Environ Contam Toxicol. 2(1):43-51.

Aulerich, RJ, SJ Bursian, WJ Breslin, BA Olson, and RK Ringer. 1985. Toxicological Manifestations of 2,4,5- , 2,3,6,2',3',6'-, and 3,4,5,3',4',5'-Hexachlorobiphenyl and Aroclor 1254 in Mink. J. Toxicol. Environ. Health. 15:63-79.

Barbour, MT, J Gerritsen, BD Snyder, and JB Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish. Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, DC.

Bayne, DR. 1997. Intensive Water Quality and Biological Study of Choccolocco and Snow Creeks, Coosa River Basin. Department of Fisheries and Allied Aquaculture, Auburn University, AL.

BBL. 1999a. Supplemental RCRA Facility Investigation Work Plan for the Off-Site Portion of the RFI/CS Program. February.

BBL. 1999b. Quality Assurance/Supplemental Sampling and Analysis Project Plan for the Off-Site Portion of the RFI/CS Program. February.

BBL. 2000a. Phase II Off-Site (Floodplain) RFI/CS Investigation Work Plan. April.

BBL. 2000b. Resource Conservation and Recovery Act (RCRA) Facility Investigation for the Off-Facility Portion of the Site. June.

BBL. 2003. Phase I Conceptual Site Model Report for the Anniston PCB Site. Prepared for Solutia Inc. May.

BBL. 2005a. Data Summary Report for Operable Unit 4 Anniston PCB Site Revision 1. September.

BBL. 2005b. Screening-Level Ecological Risk Assessment (SLERA) for Operable Unit 4 of the Anniston PCB Site Revision 1. October.

Beal, FEL. 1922. Some Common Birds Useful to the Farmer. USDA Farmers' Bulletin 630. As cited in Tarvin and Woolfenden (1999) Blue Jay (*Cyanocitta cristatta*), The Birds of North American Online. Poole, A. (Ed.).

Beckvar, N, TM Dillon, and LB Read. 2005. Approaches for linking whole-body fish tissue residues of mercury or DDT to biological effect thresholds. Environ. Toxicol. Contam. 24(8):2094 2105.

Belwood, JJ and MB Fenton. 1976. Variation in the diet of *Myotis lucifugus* (Chiroptera: Vespertilionidae). Can. J. Zool. 54: 1674-1678. As cited in Sample and Suter 1994.

Bengtsson, BE. 1980. Long-term effects of PCB (Clophen A50) on growth, reproduction, and swimming performance in the minnow, Phoxinus. Water Res. 14:681 687.

Beyer, WN. 1990. Evaluating soil contamination. U.S. Fish Wildl. Serv., Biol. Rep. 90(2). 25 p.

Beyer, WN, E Conner, and S Gerould. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manage. 58: 375-382.

Biesinger KE, LE Anderson, and JG Eaton. 1982. Chronic effects of inorganic and organic mercury on *Daphnia magna*: toxicity, accumulation, and loss. Arch Environ Contam Toxicol 11: 769-774.

Birge, WJ, JA Black, AG Westerman, PC Francis, and JE Hudson. 1977. Embryopathic Effects of Waterborne and Sediment-Accumulated Cadmium, Mercury and Zinc on Reproduction and Survival of Fish and Amphibian Populations in Kentucky. University of Kentucky, Water Resources.

Birge, WJ, JA Black, and AG Westerman. 1979. Effects of Polychlorinated Biphenyl Compounds and Proposed PCB-Replacement Products on Embryo-Larval Stages of Fish and Amphibians. Res.Rep.No.118, Kentucky Water Resour. Res. Inst., Univ. of Kentucky, Lexington, KY. 44 p. (U.S.NTIS PB-290711).

Bishop, CA, NA Mahony, S Trudeau, and KA Pettit. 1999. Reproductive success and biochemical effects in tree swallows (*Tachycineta bicolor*) exposed to chlorinated hydrocarbon contaminants in wetlands of the Great Lakes and St. Lawrence River basin, USA and Canada. Environ. Toxicol. Chem. 18(2):263–271.

Blancher, PJ, CL Furlonger, and DK McNicol. 1987. Diet of nestling tree swallows (*Tachycineta bicolor*) near Sudbury, Ontario, summer 1986. Can. Wildl. Serv. Tech. Rep. Ser. No. 31. As cited in Robertson et al. (1992) Tree swallow (*Tachycineta bicolor*). In: The Birds of North America, No. 11. Poole, A., P. Stettenheim, and F. Gill (Eds.).

Blankenship, A.L, M.J. Zwiernik, K.K. Coady, D.P. Kay, J.L. Newsted, K. Strause, C, Park, P.W. Bradley, A.M Neigh, S.D. Millsap, P.D. Jones, J.P. Giesy. 2005. Differential Accumulation of Polychlorinated Biphenyl Congeners in the Terrestrial Food Web of the Kalamazoo River Superfund Site, Michigan. Environ. Sci. Technol. 39: 5954-5963.Bloom, NS. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Can J Fish Aquat Sci 49:1010.

Boening, DW. 2000. Ecological effects, transport, and fate of mercury: a general review. Chemosphere 40:1335-1351.

Boonstra, R and L Bowman. 2003. Demography of short-tailed shrew populations living on polychlorinated biphenyl-contaminated sites. ET & C. V. 22, No. 6 pp 1394- 1403.

Borgmann, U, WP Norwood, and KM Ralph. 1990. Chronic toxicity and bioaccumulation of 2,5,2N,5N- and 3,4,3N,4N-tetrachlorobiphenyl and Aroclor 1242 in the amphipod *Hyalella azteca*. Arch. Environ. Contam. Toxicol. 19:558-564.

Borgmann, U, WP Norwood, and C Clarke. 1993. Accumulation, regulation, and toxicity of copper, zinc, lead, and mercury in *Hyalella azteca*. Hydrobiologia 259:79-89.

Britton, WM and TM Huston. 1973. Influence of Polychlorinated Biphenyls in the Laying Hen. Poultry Sci. 52 (Part II): 1620-1624.

Brown, L and D Amadon. 1968. Eagles, hawks and falcons of the world. McGraw-Hill Book Co., New York. 443 pp.

Brunstrom, B, BO Lund, A Bergman, L Asplund, I Athanassiadis, M Athanasiadu, S Jensen, and J Orberg. 2001. Reproductive Toxicity in Mink (*Mustela Vison*) Chronically Exposed to Environmentally Relevant Polychlorinated Biphenyl Concentrations. Environ. Toxicol. Chem. 20(10):2318-2327.

Burger, J and M Gochfeld. 1997. Risk, Mercury Levels, and Birds: Relating Adverse Laboratory Effects to Field Biomonitoring. Env. Res.75:160–172.

Burton, DT, SD Turley, DJ Fisher, DJ Green, and TR Shedd. 2006. Bioaccumulation of total mercury and monomethylmercury in the earthworm *Eisenia fetida*. Water, Air, and Soil Pollution 170: 37-54.

Bursian, S.J., J. Kern, R.E. Remington, J.E. Link, and S.D. Fitzgerald. 2013. Dietary exposure of mink (*Mustela vison*) to fish from the Upper Hudson River, New York, USA: Effects on reproduction and offspring growth and mortality. Environmental Toxicology and Chemistry 32(4):780–793.

Calder, WA III and EJ Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 244, R601–R606.

CalEPA. 2000. Use of Navy/USEPA Region 9 Biological Technical Advisory Group (BTAG) Toxicity Reference Values (TRVs) for Ecological Risk Assessment. HERD ERA Note Number 4. Available online at: http://www.dtsc.ca.gov/AssessingRisk/upload/econote4.pdf. December.

Campbell LM, RJ Norstrom, KA Hobson, DCG Muir, S Backus, A Fisk. 2005. Mercury and other trace elements in a pelagic Arctic marine food web (Northwater Polynya, Baffin Bay). Science of the Total Environment 351–352: 247–263.

Chang, LW, KR Reuhl, and AW Dudley, Jr. 1974. "Effects of methylmercury chloride on *Rana pipiens* tadpoles." Environ. Res. 8(1): 82-91.

Charbonneau, P and L Hare. 1998. Burrowing behavior and biogenic structures of mud-dwelling insects. North American Benthological Society Journal. Vol. 17(2). p. 239-249.

Clarke, DG, MR Palermo, and TC Sturgis. 2001. Subaqueous Cap Design: Selection of Bioturbation Profiles, Depths, and Process Rates. DOER Technical Notes Collection. ERDC TNDOER-C21. US Army Engineer Research and Development Center, Vicksburg, MS.

Clark DR Jr. and RM Prouty. 1977. Experimental feeding of DDE and PCB to female brown bats (*Eptesicus fuscus*). J. Toxicol. Environ. Health 2:917 928.

Collopy, MW. 1984. Parental care, productivity, and predator-prey relationships of ospreys in three North Florida lakes: Preliminary report. In: Westall, MA (Ed.), Proc. Southeastern U.S. and Caribbean Osprey Symposium, pp. 85 98. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Cristol, DA, RL Brasso, AM Condon, RE Fovargue, SL Friedman, KK Hallinger, AP Monroe, AE White. The movement of aquatic mercury through terrestrial food webs. Science 2008, 320, 335.

Custer, CM, TW Custer, CJ Rosiu, MJ Melancon, JW Bickham, and CW Matson. 2005. Exposure and effects of 2,3,7,8-tetrachlorodibenzo- p-dioxin in tree swallows (*Tachycineta bicolor*) nesting along the Woonasquatucket River, Rhode Island, USA. Environ. Toxicol. Chem. 24:93–109.

Dahlgren, RB, RL Linder, and CW Carlson. 1972. Polychlorinated biphenyls: Their effects on penned pheasants. Environ. Health Perspect. 89:101.

Dansereau, M, N. Lariviere, D Du Trembley, and D Belanger. 1999. Reproductive Performance of Two Generations of Female Semidomesticated Mink Fed diets containing organic mercury contaminated freshwater fish. Arch. Environ. Contam. Toxicol. 36:221-226.

Davis, WJ. 1982. Territory size in Megaceryle Alcyon along a stream habitat. Auk 99:353 362. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

DeGraaf, RM and M Yamasaki. 2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England, Hanover, NH.

Di Toro DM, CS Zarba, DJ Hansen, WJ Berry, RC Swartz, CE Cowan, SP Pavlou, HE Allen, NA Thomas, and PR Paquin. 1991. Technical basis for establishing sediment quality criteria for non-ionic organic chemicals using equilibrium partitioning. Environ. Toxicol. Chem. 10:1541–1583.

Dillon, TM. 1977. Mercury and the Estuarine Marsh Clam, *Rangia Cuneata* Gray. I. Toxicity Arch Environ Contam Toxicol 06:249-255.

Dillon, TM. 1984. Biological Consequences of Bioaccumulation in Aquatic Animals: an Assessment of the Current Literature. U.S. Army Corps of Engineers Report Technical Report D 84 2.

DTSC. 1998. Human and Ecological Risk Division (HERD) EcoNote 1: Depth of soil samples used to set exposure point concentrationfor burrowing mammals and burrow-dwelling birds in ecological risk assessments. May.

Duke, TW, JI Lowe, and AJ Wilson, Jr. 1970. A polychlorinated biphenyl (Aroclor 1254) in the water, sediment, and biota of Escambia Bay, Florida. Bull. Environ. Contam. Toxicol. 5:171-180.

Dunning, JB. 1984. Body weights of 686 species of North American Birds. West. Bird Banding Assoc. Monogr. No. 1. Eldon Publ. Co. Cave Crk, AZ. 38 pp.

Efroymson, RA, ME Will, GW Suter II, and AC Wooten. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 128 pp. ES/ER/TM-85/R3.

Efroymson, RA, ME Will, and GW Suter II. 1997b. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-126/R2.

Eisler, R. 1986. Chromium hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85 (1.6). 60 pp.

Eng ML, JE Elliott, SP Jones, TD Williams, KG Drouillard, and SW Kennedy. 2014. Amino acid sequence of the AhR1 ligand-binding domain predicts avian sensitivity to dioxin like compounds: in vivo verification in European starlings. Environ Toxicol Chem. 33(12):2753-8.

ENSR International. 2004. Development Of A Standardized Approach For Assessing Potential Risks To Amphibians Exposed To Sediment And Hydric Soils. Prepared for Naval Facilities Engineering Service Center (NFESC) Port Hueneme, California Technical Report TR-2245-ENV.May

ENVIRON. 2014. Preliminary Site Characterization Summary Report for Operable Unit 4 of the Anniston PCB Site, Anniston, Alabama. April.

Environment Canada and Ministere de l'Envionnement du Quebec. 1992. Interim Criteria for Quality Assessment of St. Lawrence River Sediment. Environment Canada, Ottawa.

Fagervold, SK, Y Chai, JW Davis, M Wilken, G Cornelissen, and U Ghosh. 2010. Bioaccumulation of polychlorinated dibenzo-p-dioxins/dibenzofurans in E. fetida from floodplain soils and the effect of activated carbon amendment. Environ Sci Technol. 44(14):5546-52. doi: 10.1021/es9027138.

Farmahin R, GE Manning, D Crump, D Wu, LJ Mundy, SP Jones, ME Hahn, SI Karchner, JP Giesy, SJ Bursian, MJ Zwiernik, TB Fredricks, and SW Kennedy. 2012. Amino acid sequence of the ligand-binding domain of the aryl hydrocarbon receptor 1 predicts sensitivity of wild birds to effects of dioxin-like compounds. Toxicol. Sci. 131(1):139-52.

Farnsworth, GL, KH Pollock, JD Nichols, TR Simons, JE Hines, and JR Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. The Auk, 119(2), 414-425.

Fernie, KJ, JE Smits, GR Bortolotti, and DM Bird. 2001. Reproductive success of American kestrels exposed to dietary polychlorinated biphenyls. Environmental Toxicology and Chemistry 20:776-781.

Ficko SA., C Luttmer, BA Zeeb, K Reimer. 2013. Terrestrial ecosystem recovery following removal of a PCB point source at a former pole vault radar station in Northern Labrador. Science of the Total Environment 461-462:81-87.

Fimreite, N. 1979. Accumulation of effects of mercury on birds. Pp 601- 627. The biogeochemistry of mercury in the environment. Editor: JO Nriagu. Elsevier/North-Holland Biomedical Press. Ontario, Canada.

Fisher, S, SW Chordas III, PF Landrum. 1999. Lethal and sublethal body residues for PCB intoxication in the oligochaete, *Lumbriculus variegatus*. Aquatic Toxicology Volume 45, Issues 2–3: 115–126.

Fisher, MA, AM Jelaso, A Predenkiewicz, L Schuster, J Means and CF Ide. 2003. Exposure to the polychlorinated biphenyl Aroclor® 1254 alters melanocyte and tail muscle morphology in developing *Xenopus* laevis tadpoles. Environ. Toxicol. Chem. 22:321-328..

Ford, JB. 1962. The vertical distribution of larval chironomidae (Diptera) in the mud of a stream. Hydrobiologia. Vol. 19, p. 262-272.

Fowler, SW, GG Polikarpov, DL Elder, P Parsi, and JP Villeneuve. 1978. Polychlorinated biphenyls: Accumulation from contaminated sediments and water by the polychaete *Nereis diversicolor.* Marine Biology 48:303-309.Frederick, P and N Jayasena. 2011. Altered pairing behavior and reproductive success in white ibises exposed to environmentally relevant concentrations of methylmercury. Proc. R. Soc. B. 278:1851-1857.

Fredricks, TB, M. Zwiernik, RM Seston, SJ Coefield, DL. Tazelaar, SA Roark, DP Kay, JL Newsted, and P Giesy. 2011. Effects on tree swallows exposed to dioxin-like compounds associated with the Tittabawassee River and floodplain near Midland, Michigan, USA. Environ. Toxicol. Chem. 30:1354–1365.

French, JB, MB Voltura, and TE Tomasi. 2001. Effects of pre- and postnatal polychlorinated biphenyl exposure on metabolic rate and thyroid hormones of white-footed mice. Environ. Toxicol. Chem. 20(8):1704‑1708.

Friedmann AS, MC Watzin, T Brinck-Johnsen, and JC Leiter. 1996. Low levels of dietary methylmercury inhibit growth and gonadal development in juvenile walleye (*Stizostedion vitreum*). Aquatic Tox. 35:265 278.

Fuchsman, PC, TR Barber, JC Lawton, and KB Leigh. 2006. An evaluation of cause-effect relationships between polychlorinated biphenyl concentrations and sediment toxicity to benthic invertebrates. Environ. Tox. Chem 25(10): 2601-2612.

Fuchsman, PC, TR Barber, and MJ Bock. 2008. Effectiveness of various exposure metrics in defining dose-response relationships for mink (*Mustela vison*) exposed to polychlorinated biphenyls. Archives of Environmental Contamination and Toxicology 54:130–144.

Giesy, JP and K Kannan. 1998. Dioxin-like and non-dioxin-like toxic effects of polychlorinated biphenyls (PCBs): Implications for risk assessment. Crit. Rev. Toxicol. 28:511-569.

Gillardin, V, F Silvestre, C Divoy, JP Thomé and P Kestemont. 2009. Effects of Aroclor 1254 on oxidative stress in developing *Xenopus laevis* tadpoles. Ecotoxicol. Environ. Saf. 72:546-551.

Gilmour, CC, Riedel, GS, Riedel, G, Kwon, S, Landis, R, Brown, SS, Menzie, CA, and U Ghosh. 2013. Activated carbon mitigates mercury and methylmercury bioavailability in contaminated sediments. Environ. Sci. Technol. 47(22): 13001-13010.

Gotelli, NJ and A Chao. 2013. Measuring and estimating species richness, species diversity, and biotic similarity from sampling data. Encyclopedia of Biodiversity 5:195-211.

Gotelli, NJ, and RK Colwell. 2001. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. Ecology letters 4.4 (2001): 379-391.

Greene, EP, AE Greene, and B Freedman. 1983. Foraging behavior and prey selection by ospreys in coastal habitats in Nova Scotia, Canada. In: Biology and Management of Bald Eagles and Ospreys. Bird, D.M. N.R. Seymour, and J. Gerrard (Eds.). Harpell Press, St. Anne de Bellvue, Quebec: pp. 257 267. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Hamilton, WJ, Jr. 1930. The food of the Soricidae. J. Mammal. 11(1):26 39. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Hamilton, WJ, Jr. 1940. The summer food of minks and raccoons on the Montezuma Marsh, New York. J. Wildl. Manage. 4:80 84. As cited in Sample and Suter (1994) Estimating Exposure of Terrestrial Wildlife to Contaminants.

Hansen, DJ, SC Schimmel, and J Forester. 1974. Aroclor 1254 in eggs of sheepshead minnows: effect of fertilization success and survival of embryos and fry. Proc. 27th Annu. Conf. Southeastern Assoc. Game Fish. Comm. Pp 420-423.

Haseltine, SD and RM Prouty.1980. Aroclor 1242 and Reproductive Success of Adult Mallards (*Anas platyrhynchos*). Environ. Res. 23:29-34.

Haseltine, SD, L Sileo, DJ Hoffman, and BM Mulhern. Effects of chromium on reproduction and growth of black ducks. Unpublished (Cited in Eisler 1986 and Custer et al. 1986).

Heaton, SN, SJ Bursian, JP Giesy, DE Tillitt, JA Render, PD Jones, DA Verbrugge, TJ Kubiak, and RJ Aulerich. 1995. Dietary exposure of mink to carp from Saginaw Bay, Michigan. 1. Effects on reproduction and survival, and the potential risks to wild mink populations. Arch. Environm. Contam. Toxicol. 28(3): 334 343.

Heinz, GH, DJ Hoffman, and LG Gould.1989. Impaired reproduction of mallards fed an organic form of selenium. J. Wildl. Mgmt. 53:418-428.

Heinz, GH, DJ Hoffman, JD Klimstra, KR Stebbins, SL Kondrad, and CA Erwin. 2009. Species differences in the sensitivity of avian embryos to methylmercury. Arch. Environ. Contam. Toxicol. 56:129 138.

Hill, CH. 1979. The effect of dietary protein levels on mineral toxicity in chicks. J Nutr. 109(3): 501-7.

Hill, EF, and CS Schaffner. 1976. Sexual maturation and productivity of Japanese Quail fed graded concentrations of mercuric chloride. Poult. Sci. 55: 1449-1459.

Hilsenhoff, WJ. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc, 7(1):65-68.

Hilton, JW and WJ Bettger. 1988: Dietary vanadium toxicity in juvenile rainbow trout: a preliminary study. Aquatic Toxicology 12(1): 63-71.

Holcombe, GW, DA Benoit, EN Leonard, and JM McKim. 1976. Long-term effects of lead exposure on three generations of brook trout (*Salvelinus fontinalis*). J. Fish. Res. Board Can. 33: 1731-1741.

Hornshaw, TC, RJ Aulerich, and HE Johnson. 1983. Feeding Great Lakes fish to mink: Effects on mink and accumulation and elimination of PCBs by mink. J. Toxicol. Environ. Health 11:933 946.

Hughes, J. 1983. On Osprey Habitat and Productivity: a Tale of Two Habitats. In: Biology and Management of Bald Eagles and Ospreys. Bird, D.M., N. Seymour, and J.M. Gerrard (Eds.). Harpell Press, St. Anne de Bellvue, Quebec: Harpell Press. Pp. 269 273. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Ingersoll, C, T Dillon, and G. Biddinger. 1995. Ecological Risk Assessment of Contaminated Sediments. SETAC Press, Pensacola, FL.

Ingersoll CG, PS Haverland, EL Brunson, TJ Canfield, FJ Dwyer, CE Henke, NE Kemble, DR Mount, and RG Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella azteca* and the midge *Chironomus riparius*. J. Great Lakes Res. 22:602–623.

Ingersoll, CG, JA Steevens, and DD MacDonald, eds. 2014. Evaluation of toxicity to the amphipod, *Hyalella azteca*, and to the midge, *Chironomus dilutus*; and bioaccumulation by the oligochaete,

Lumbriculus variegatus, with exposure to PCB-contaminated sediments from Anniston, Alabama: U.S. Geological Survey Scientific Investigations Report 2013–5125, 122 p. http://dx.doi.org/10.3133/sir20135125.

Jackson, AK, DC Evers, MA Etterson, AM Condon, SB Folsom, J Detweiler, J Schmerfeld, and DA Cristol. 2011. Mercury exposure affects the reproductive success of a free-living terrestrial songbird, the Carolina wren (*Thryothorus ludovicianus*). The Auk 128(4):759 769.

Janes, SW. 1984. Influences of territory composition and interspecific competition on red-tailed hawk reproductive success. Ecology 65:862 870. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Jayaraman, S, DE Nacci, DM Champlin, RJ Pruell, KJ Rocha, CM Custer, TW Custer, and M Cantwell. 2009. PCBs and DDE in tree swallow (*Tachycineta bicolor*) eggs and nestlings from an estuarine PCB Superfund site, New Bedford Harbor, MA, USA. Environmental Science and Technology 43:8387–8392.

Jeffress, MR, CP Paukert, JB Whittier, BK Sandercock, and PS Gipson. 2011. Scale-dependent factors affecting North American river otter distribution in the Midwest. American Midland Naturalist 166:177–193.

Jelaso, AM, E Lehigh-Shirey, A Predenkiewicz, J Means and CF Ide. 2002. Aroclor 1254 alters morphology, survival, and gene expression in *Xenopus laevis* tadpoles. Environ. Molec. Mutagen. 40:24-35.

Jensen, J, ST Ingvertsen, J Magid. 2012. Risk evaluation of five groups of persistent organic contaminants in sewage sludge. Danish Ministry of the Environment. Environmental Project No. 1406 2012. 132 pp.

Jofre, MB and WH Karasov. 2008. Effect of mono-ortho and di-ortho substituted polychlorinated biphenyl (PCB) congeners on leopard frog survival and sexual development. Chemosphere 70:1609-1619.

Kaufman, K, R Bowers, and N Bowers. 2004. Field Guide to Mammals of North America. Singapore: Houghton Mifflin. 351 p.

Kay, DP, AL Blankenship, KK Coady, AM Neigh, MT Zwiernik, SD Millsap, K Strause, C Park, P Bradley, JL Newsted, PD Jones, and JP Giesy. 2005. Differential accumulation of PCB congeners in the aquatic food web at the Kalamazoo River Superfund Site, Michigan. 2005. Environmental Science and Technology. 39:5964-5974.

Kelly, JF, ES Bridge, and MJ Hamas. 2009. Belted kingfisher (*Megaceryle alcyon*). In: The Birds of North America Online, A. Poole (Ed.). Ithaca: Cornell Lab of Ornithology; The Birds of North America Online: http://bna.birds.cornell.edu/bna/species/084 doi:10.2173/bna.84.

Knable, AE. 1974. Seasonal trends in the utilization of major food groups by the red fox (*Vulpes fulva*) in Union County, Illinois. Trans. Ill. State Acad. Sci. 66:113 115. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Korschgen, LJ. 1958. December food habits of mink in Missouri. J. Mammal. 39:521 527. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Korschgen, LJ. 1959. Food habits of the red fox in Missouri. J. Wildl. Manage. 23:168 176. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Koval, PJ, TJ Peterle, and JD Harder. 1987. Effects of Polychlorinated Biphenyls on Mourning Dove Reproduction and Circulating Progesterone Levels. Bull. Environ. Contam. Toxicol. 39:663-670.

Kushlan, JA. 1977a. Sexual Dimorphism in White Ibis. The Wilson Bulletin 89(1):92-98.

Kushlan, JA. 1977b. Population energetics of the American White Ibis. Auk 94: 114-122.

Landrum PF; M Leppanen, SD Robinson, DC Gossiaux, GA Burton, M Greenberg, JVK Kukkonen, BJ Eadie, MB Lansing. 2004. Effect of 3,4,3′,4′-tetrachlorobiphenyl on the reworking behavior of *Lumbriculus variegatus* exposed to contaminated sediment. Environ Tox & Chem 23:178-186. Lewis, JC. 1993. Foods and feeding ecology. In: Ecology and Management of the Mourning Dove. Baskett, TS, MW Sayre, RE Tomlinson, and RE Mirarchi Eds. Stackpole Books, Harrisburg, Pennsylvania. Pp. 181 204.

Lillie, RJ, HC Cecil, J Bitman, and GF Fries. 1974. Differences in response of caged white leghorn layers to various polychlorinated biphenyls (PCBs) in the diet. Poult. Sci. 53:726 732.

Linzey, AV. 1987. Effects of chronic polychlorinated biphenyl exposure on reproductive success of white-footed mice (*Peromyscus leucopus*). Arc. Environm. Contam. Toxicol. 16:455 460.

Llewellyn, LM and FM Uhler. 1952. The foods of fur animals of the Patuxent Research Refuge, Maryland. Am. Midl. Nat. 48:193 203. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Long, ER and LG Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration, Seattle, WA, 175 pp. + appendices.

Loranger, AJ. 1981. Late fall and early winter foods of the river otter (*Lutra canadensis*) in Massachusetts. Proceedings of the Worldwide Furbearer Conference 1: 599-605.

Lowe, JI, PR Parrish, JA Patrick, Jr., and J Forester. 1972. Effects of the polychlorinated biphenyl Aroclor 1254 on the American oyster *Crassostrea virginica*. *Marine Biol*. 17:209-214.

MacDonald, DD, LM Dipinto, J Field, CG Ingersoll, ER Long, and RC Swartz. 2000a. Development and evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls. Environ. Toxicol. Chem. 19:1403-1413.

MacDonald, DD, CG Ingersoll, and TA Berger. 2000b. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.

MacKay, D, WY Shiu, and KC Ma. 1992. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. Volume I. Lewis Publishers, Boca Raton. 697 pp.

MacMillen, RE. 1962. The minimum water requirements of mourning doves. Condor. 64(2):165-166.

Masuda, Y, R Kagawa, H Kuroki, S Tokudome, M Kuratsune. 1979. Transfer of various polychlorinated biphenyls to the fetuses and offspring of mice. *Food Cosmet.Toxicol.* 17(6):623-627.

Matisoff, G, J Fisher, and S Matis, 1985. Effects of benthic macroinvertebrates on the exchange of solutes between sediments and freshwater. Hydrobiologia. Vol. 122, p. 19-33.

McCoy, G, MF Finlay, A Rhone, K James, and GP Cobb. 1995. Chronic polychlorinated biphenyls exposure on three generations of oldfield mice (*Peromyscus polionotus*): Effects on reproduction, growth, and body residues Arch. Environ. Contam. Toxicol. 28(4):431 435.

McLane, MAR, and DL Hughes. 1980. Reproductive success of screech owls fed Aroclor 1248. Archives of Environmental Contamination and Toxicology 9:661–665.Melquist, WE and MG Hornocker. 1983. Ecology of river otters in west central Idaho. Wildlife Monograph 83:1–60.

Melquist, WE, PJ Polechla, and D Toweill. 2003. River otter (*Lontra canadensis*). Pages 708–728 in JA Chapman, BC Thompson, and GA Feldhamer, editors. Wild mammals of North America. Second edition. John Hopkins University Press, Baltimore and London.

Mercado, RC and BG Bibby. 1973. Trace element effects on enamel pigmentation incisor growth and molar morphology in rats. Arch. Oral Biol. 18(5): 629-635.

Mills, LS. 2012. Conservation of Wildlife Populations, 2nd Edition. John Wiley and Sons.

Moore, JN, MJ Zwiernik, JL Newsted, SD Fitzgerald, JE Link, PW Bradley, D Kay, R Budinsky, JP Giesy, and SJ Bursian. 2012. Effects of dietary exposure of mink (*Mustela vison*) to 2,3,7,8-tetrachlorodibenzo-p-dioxin, 2,3,4,7,8-pentachlorodibenzofuran, and 2,3,7,8-tetrachlorodibenzofuran on reproduction and offspring viability and growth. Environ. Toxicol. Chem. 31:360–369.

Nagy, KA. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B, 71:21R-31R.

Naiman RJ, Décamps H, eds. 1990. Ecology and Management of Aquatic-Terrestrial Ecotones. Paris, Carnforth (UK): UNESCO, Parthenon Publishing Group.

Nebeker, AV and FA Puglisi. 1974. Effect of polychlorinated biphenyls (PCBs) on survival and reproduction of Daphnia, Gammarus and Tanytarsus. Trans. Am. Fish. Soc. 4, 722– 728.

NRC. 2001. A Risk Management Strategy for PCB-Contaminated Sediments. Washington, DC: National Academy Press.

OEHHA. 2012. The Air Toxics Hot Spots Program Guidance manual for Preparation of Health Risk Assessments. California Environmental Protection Agency. August. Scientific Review Draft.

OEHHA. 2013. Toxicity Criteria Database. California Environmental Protection Agency. Available online at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp.

OEHHA. 2015. The Air Toxics Hot Spots Program Guidance manual for Preparation of Health Risk Assessments. March.

Ó Foighil D. L Jingchun, T Lee, P Johnson, R Evans, JB Burch. 2011. Conservation genetics of a critically endangered limpet genus and rediscovery of an extinct species. PLoS ONE 6(5): e20496. doi:10.1371/journal.pone.0020496.

Okey, AB. 2007. An aryl hydrocarbon receptor odyssey to the shores of toxicology: the Deichmann Lecture, International Congress of Toxicology-XI. Toxicological Sciences 98 (1): 5–38.

Olson, GF, DI Mount, VM Snarski, and TW Thorslund. 1975. Mercury residues in fathead minnows, *Pimephales promelas* Rafinesque, chronically exposed to methylmercury in water. Bull. Environ. Contam. Toxicol. 14(2):129 134.

Oring, LW, EM Gray, and JM Reed. 1997. Spotted sandpiper (*Actitis macularius*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/289

Orn, S, PL Anderson, L Forlin, M Tysklind, and L Norrgren. 1998. The impact on reproduction of an orally administered mixture of selected PCBs in zebrafish (*Danio rerio*). Arch. Environ. Contam. Toxicol. 35:53 57.

Paine, JM, MJ McKee, and ME Ryan. 1993. Toxicity and bioaccumulation of soil PCBs in crickets: comparison of laboratory and field studies. Environ Tox Chem 12: 2097-2103.

Pant, P, Allen, M, and B Tansel. 2011. Mercury uptake and translocation in *Impatiens walleriana* plants grown in the contaminated soil from Oak Ridge. International Journal of Phytoremediation 13: 168-176.

Parmelee, RW, CT Phillips, RT Checkai, and PJ Bohlen. 1997. Determining the effects of pollutants on soil faunal communities and trophic structure using a refined microcosm system. Environmental Toxicology and Chemistry 16(6):1212–1217.

Pawlisz, AV, RA Kent, UA Scheider, and C Jefferson. 1997. Canadian Water Quality Guidelines for Chromium. Environ Toxicol Water Qual 12: 185–193.

Peakall, DB, Lincer, JL, and Bloom, and SE 1972. Embryonic Mortality and Chromosomal Alterations Caused by Aroclor 1254 in Ring Doves. Environ. Health Perspect. April:103-104.

Peakall, DB, and ML Peakall. 1973. Effect of a polychlorinated biphenyl on the reproduction of artificially and naturally incubated dove eggs. The Journal of Applied Ecology 10(3):863–868.

Persaud D, R Jaagumagi, and A Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch, Ontario Ministry of the Environment, Toronto. 27 pp.

Plafkin JL, MT Barbour, KD Porter, SK Gross, and RM Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. Benthic macroinvertebrates and fish. US Environmental Protection Agency. EPA/444/4-89-001.

Prose, BL. 1985. Habitat suitability index models: belted kingfisher. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.87).

Restum, J, S Bursian, J Giesy, J Render, W Helferich, E Shipp, D Verbrugge, and R Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink: 1. Effects on mink reproduction, kit growth, and survival, and selected biological parameters. J. Toxicol. Environ. Health Part A 54: 343 375.

Robertson, RJ, BJ Stutchbury, and RR Cohen. 1992. Tree Swallow (*Tachycineta bicolor*). P. 1-26. In A Poole, P Stettenheim and F Gill (ed.) The Birds of North America, No. 11. The Birds of North America, Inc., Philadelphia, PA, USA.

Rodriguez-Grau, J, BJ Venables, LC Fitzpatrick, and AJ Goven. 1989. Suppression of secretory rosette formation by PCBs in *Lumbriculus terrestris*: an earthworm assay for humoral immunotoxicity of xenobiotics. Environ Tox Chem 8: 1201-1207.

Rosenshield, ML, MB Jofre and WH Karasov. 1999. Effects of polychlorinated biphenyl 126 on green frog (*Rana clamitans*) and leopard frog (*Rana pipiens*) hatching success, development, and metamorphosis. Environ. Toxicol. Chem. 18:2478-2486.

Rossaro B, GF Gaggino, R Marchetti. 1986. Accumulation of mercury in larvae and adults, *Chironomus riparius (Meigen)*. Bull Environ Contam Toxicol 37:402-406.

Rushneck, DR, A Beliveau, B Fowler, C Hamilton, D Hoover, K Kaye, M Berg, T Smith, WA Telliard, H Roman, E Ruder, and L Ryan. 2004. Concentrations of dioxin-like PCB congeners in unweathered Aroclors by HRGC/HRMS using EPA Method 1668A. *Chemosphere* 54: 79-87.

Salyer, JC and KF Lagler. 1946. The eastern belted kingfisher, *Megaceryle alcyon alcyon* (Linnaeus), in relation to fish management. Trans. Am. Fish. Soc. 76:97 117. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Sample, BE and GW Suter, II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. ES/ER/TM-125. Oak Ridge National Laboratory, Oak Ridge TN.

Sample, BE, DM Opresko, and GW Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86-R3. U.S. Department of Energy, Office of Environmental Management.

Sample, BE, GW Suter, JJ Beauchamp, RA Efroymson. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. Environ Tox Chem 18(9):2110-2120.

Sanders, HO and JH Chandler. 1972. Biological magnification of a polychlorinated biphenyl (Aroclor 1254) from water by aquatic invertebrates. Bull. Environ. Contam. Toxicol. 7(5), 257-63.

Saouter, E, L Hare, PGC Campbell, A Boudou, and F Ribeyre. 1993. Mercury accumulation in the burrowing mayfly *hexagenia rigida* (ephemeroptera) exposed to CH_3, HgCl, or $HgCl_2$ in water and sediment. *Water Research* 27: 1041-1048.

Sappington, KG, TS Bridges, SP Bradbury, RJ Erickson, A Jan Hendriks, RP Lanno, JP Meador, DR Mount, MH Salazar, and DJ Spry. 2011. Application of the tissue residue approach in ecological risk assessment. Integr Environ Assess Manag 7:116–140.

Savage, WK, FW Quimby, and AP DeCaprios. 2002. Lethal and sublethal effects of polychlorinated biphenyls on Rana Sylvatica tadpoles. Env. Tox. And Chem. 21(1):168-174.

Scott, ML, JR Zimmerman, S Marinsky, PA Mullenhoff, GL Rumsey, and RW Rise. 1975. Effects of PCBs, DDT, and mercury compounds upon egg production, hatchability, and shell quality in chickens and Japanese Quail. Poult. Sci. 54:350 368.

Segre, M, S Arena, EH Greeley, MJ Melancon, DA Graham, and JB French Jr. 2002. Immunological and physiological effects of chronic exposure of *Peromyscus leucopus* to Aroclor 1254 at a concentration similar to that found at contaminated sites. *Toxicology*. 174: 163-172.

Shang, H, P Wang, T Wang, Y Wang, H Zhang, J Fu, D Ren, W Chen, Q Zhang, G Jiang. 2013. Bioaccumulation of PCDD/Fs, PCBs, and PBDEs by earthworms in field soils of an E-waste

dismantling area in China. Environ International 54: 50-58.Shannon, CE. 1948. A mathematical theory of communication. Bell System Technical Journal, 27, 379–423.

Sheffield, SR and HH Thomas. 1997. *Mustela frenata*. Mammal. Species 570:1 9.

Smith, SL, DD MacDonald, KA Keenleyside, CG Ingersoll, and J Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. J. Great Lakes Res. 22:624–638.

Smith, WP. 1991. *Odocoileus virginianus*. Mammal. Species 388:1 163. As cited in Sample and Suter (1994) Estimating Exposure of Terrestrial Wildlife to Contaminants.

Smith, Kimberly G., Keith A. Tarvin and Glen E. Woolfenden. 2013. Blue Jay (*Cyanocitta cristata*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/blujay.

Solutia. 2011a. Letter from Solutia Inc. to EPA Re: OU4 Phase 3 Field Sampling Plan – Addendum No. 1, Anniston PCB Site, Anniston, Alabama. September 13, 2011.

Solutia. 2011b. Letter from Solutia Inc. to EPA Re: OU4 Phase 3 Field Sampling Plan – Addendum No. 2, Revision 1, Anniston PCB Site, Anniston, Alabama. November 30, 2011.

Son, J, M Ryoo, J Jung, and K Cho. 2007. Effects of cadmium, mercury and lead on the survival and instantaneous rate of increase of *Paronychiurus kimi* (Lee) (Collembola). Applied Soil Ecology 35: 404-411.

Spalding, MG, PC Frederick, HC McGill, SN Bouton, and LR McDowell. 2000. Methylmercury accumulation in tissues and its effects on growth and appetite in captive great egrets. J. Wildl. Dis. 36(3):411-422.

Steevens, JA, MR Reiss, and AV Pawlisz. 2005. A methodology for deriving tissue residue benchmarks for aquatic biota: A case study for fish exposed to 2,3,7,8- tetrachlorodibenzo-p-dioxin and equivalents. Integr Environ Assess Manag 1:142–151.

Stephan, CE, DI Mount, DJ, Hansen, JH Gentile, GS Chapman, and WA Brungs. 1985. Guidelines for deriving numerical water quality criteria for the protection of aquatic organisms and their uses. PB85-227049. National Technical Information Service. Springfield, VA.

Suter, G. 2007. Ecological Risk Assessment. CRC Press, New York, NY, USA.

Suter, GW II, LW Barnthouse, SM Bartell, T Mill, D MacKay, and S Peterson. 1993. Ecological Risk Assessment. Boca Raton, FL: Lewis Publishers.

Suter, GW II and CL Tsao. 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104 pp. ES/ER/TM-96/R2.

Taber, WB, Jr. 1928. A method to determine the weight of food digested daily by birds. Auk. 45(3):339-341.

Tarvin, KA and GE Woolfenden. 1999. Blue jay (*Cyanocitta cristatta*). In: The Birds of North American Online. Poole, A. (Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North American Online: http://bna.birds.cornell.edu/bna/species/469 doi:10.2173/bna.469

Thain, JE. 1984. Effects of mercury on the prosobranch mollusc *Crepidula fornicata*: acute lethal toxicity and effects on growth and reproduction of chronic exposure. Mar. Environ. Res. 12:285-309.

Thompson, DR. 1996. Mercury in Birds and Terrestrial Mammals. Pp341-356 In: Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations.

Thurow, RF, JT Peterson, and JW Guzevich. 2006. Utility and Validation of Day and Night Snorkel Counts for Estimating Bull Trout Abundance in First- to Third-Order Stream. North American Journal of Fisheries Management 26:217–232.

Todd, BD, JD Willson, CM Bergeron, and WA Hopkins. 2011. "Do effects of mercury in larval amphibians persist after metamorphosis?" Ecotoxicology DOI:10.1007/s10646-011-0768-0.

Toweill, DE and JE Tabor. 1982. River otter. Pages 688–703 in J. A. Chapman, and G. A. Feldhamer, editors. Wild mammals of North America: biology, management, and economics. Johns Hopkins University Press, Baltimore and London.

Unrine, JM and CH Jagoe. 2004. Dietary mercury exposure and bioaccumulation in southern leopard frog (*Rana Sphenocephala*) larvae. Env. Tox. Chem. 23(12): 2956-2963.

USACE. 2013. Environmental Residue Effects Database. Available online at: https://ered.el.erdc.dren.mil/.

USEPA. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses. Office of Research and Development. PB85-227049. December 2010 electronic version available at: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/85guidelines.pdf.

USEPA. 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA/540/1-89-002. December.

USEPA. 1991. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part B: Development of Risk-Based Preliminary Remediation Goals). EPA/540/R-92/003. December.

USEPA. 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/187. Washington, DC.

USEPA. 1995. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife: DDT, Mercury, 2,3,7,8-TCDD, PCBs. EPA 820 B 95 0083. Washington, DC.

USEPA. 1996. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*. EPA 905-R96-008. Great Lakes National Program Office, Region V, Chicago, IL.

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA 540 R 97 006. Office of Solid Waste and Emergency Response. June 5.

USEPA. 1998. Guidelines for Ecological Risk Assessment. Final. Risk Assessment Forum. May.

USEPA. 1999. Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites. Memorandum to Superfund National Policy Managers from

Stephen D. Luftig, Director, OSWER Directive 9285.7-28 P. USEPA Office of Emergency and Remedial Response. October 7.

USEPA. 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. Second Edition. EPA/600/R-99/064. USEPA, Washington, DC.

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume III - Part A, Process for Conducting Probabilistic Risk Assessment.

USEPA. 2002. Partial Consent Decree, United States of America v. Pharmacia Corporation (p/k/a Monsanto Company) and Solutia Inc., Civil Action No. CV-02-PT-0749-E, October 2002, Effective Date August 4, 2003.

USEPA. 2003. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River. Prepared by Weston Solutions, Inc. for the U.S. Army Corps of Engineers, New England District, and the U.S. Environmental Protection Agency, New England Region, West Chester, Pennsylvania. July.

USEPA. 2005a. Clarifications to Data Quality Objectives (DQOs). Anniston PCB Site, Anniston, Alabama. Letter from USEPA Region 4 to Alabama Department of Environmental Management. EPA CERCLA IS: ALD000400123. August 19 2005.

USEPA. 2005b. Ecological Soil Screening Level (Eco-SSL) Guidance: OSWER Directive 9285.7-55. Office of Solid Waste and Emergency Response. Washington, D.C.

USEPA. 2005c. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, OSWER Publication 9355.0-85, United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, http://www.epa.gov/superfund/resources/sediment/guidance.htm.

USEPA. 2005d. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). Office of Research and Development. EPA-600-R-02-011. January. 121 pp.

USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs): Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OWSER Directive 9285.7-55. (Issued November 2003, Revised February 2005, Revised April 2007).

USEPA. 2008. Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment. U.S. Environmental Protection Agency, Office of the Science Advisor, Washington, D.C. EPA/100/R-08/004.

USEPA. 2009. PCBres Database. Available online at: http://www.epa.gov/med/Prods_Pubs/pcbres.htm

USEPA. 2012a. Letter from USEPA to Solutia, Inc. Re: Constituents of Potential Concern (COPC) Evaluation White Paper, Anniston PCB Site, Anniston, AL. Letter dated June 26, 2012.

USEPA. 2012b. Operable Unit 1/Operable Unit 2 (OU-1/OU-2) Proposed Revisions to the RI/FS Work Plan Milestone Schedule, Anniston PCB Site. Letter dated November 16, 2012.

USEPA. 2012c. Estimation Program Interface (EPISuite) software v 4.11. November. Available online: https://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-v411

USEPA. 2013a. ECOTOX Database. Website updated daily: http://cfpub.epa.gov/ecotox/. U.S. Environmental Protection Agency.

USEPA. 2013b. Ecological Risk Assessment. Frequently Asked Questions. https://www.epa.gov/risk/btag-frequently-asked-questions

USEPA 2015a. Supplemental Guidance to Risk Assessment Guidance for Superfund (RAGS): Region 4 Bulletins, Ecological Risk Assessment. August.

USEPA. 2015b. Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic ERAs. Ecological Risk Assessment Support Center, Cincinnati, OH, EPA/600/R-15/176.

USEPA. 2016a. ProUCL Version 5.1.00 User Guide (Draft). Office of Research and Development. EPA 600-R-07-038. May.

USEPA. 2016b. ProUCL Version 5.1.00 Technical Guide (Draft). Office of Research and Development. EPA EPA/600/R-07/041. May.

USEPA. 2016c. ProUCL Version 5.1.00 Software. Available online: http://www.epa.gov/osp/hstl/tsc/software.htm.http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2016d. Formal Comments on the Draft OU-4 BERA. July.USEPA. 2016e. National Ambient Water Quality Criteria (NAWQC) for Protection of Aquatic Life. Available online: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table.

USFWS. 2014. Threatened and Endangered Species Known or Believe to Occur in Calhoun Co, AL. Available online: http://ecos.fws.gov/tess_public/reports/species-by-current-range-county?fips=01015.

USFWS. 2015. Evaluation of the Toxicity of Sediments from the Anniston PCB Site to the Mussel *Lampsilis siliquoidea*. Version 2.0. Prepared for US Fish and Wildlife Service Alabama Field Office – Birmingham Suboffice, but MacDonald Environmental Sciences Ltd. and US Geological Survey Columbia Environmental Research Center. September 2015. Available online at https://www.fws.gov/daphne/contaminants/Anniston%20Mussel%20Tox%20Report_Final_2016-01-11.pdf

Van Daele, LJ and HA Van Daele. 1982. Factors affecting the productivity of ospreys nesting in west central Idaho. Condor 84: 292 299. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Van den Berg, M, L Birnbaum, ATC Bosveld, B Brunstrom, P Cook, M Feeley, JP Giesy, A Hanberg, R Hasegawa, SW Kennedy, T Kubiak, JC Larsen, FX van Leeuwen, AK Liem, C Nolt, RE Peterson, L Poellinger, S Safe, D Schrenk, D Tillitt, M Tysklind, M Younes, F Waern, and T Zacharewski. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ Health Perspect 106(12):775-792.

Van den Berg, M, LS Birnbaum, M Denison, M De Vito, W Farland, M Feeley, H Fiedler, HHakansson, A Hanberg, L Haws, M Rose, S Safe, D Schrenk, C Tohyama, A Tritscher, JTuomisto, M Tysklind, N Walker, R Peterson. 2006. The 2005 World Health Organization reevaluation of human and mammalian TEFs for dioxins and dioxin-like compounds. Toxicological Sciences 93:223-241.

Verschuuren, HG, R Kroes, EM Den Tonkelaar, JM Berkvens, PW Helleman, AG Rauws, PL Schuller and GJ Van Esch. 1976. Toxicity of methylmercury chloride in rats III: long-term toxicity study. Toxicology 6:107-123.

Wagemann, R, E Trebacz, G Boila, WL Lockhart. 1998. Methylmercury and total mercury in tissues of arctic marine mammals The Science of the Total Environment 218: 19-31.

Walters, DM, MA Mills, KM Fritz, DF Raikow. 2010. Spider-mediated flux of PCBs from contaminated sediments to terrestrial ecosystems and potential risks to arachnivorous birds. Environ Sci Tech 44: 2849-2856.

Webber HM and TA Haines. 2003. Mercury effects on predator avoidance behavior of a forage fish, golden shiner (*Notemigonus crysoleucas*). Environ. Toxicol. Chem. 22:1556 1561.

Whitaker, JO, Jr. and MG Ferraro. 1963. Summer food of 220 short-tailed shrews from Ithaca, New York. J. Mammal. 44:419. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

WHO. 1988a. IPCS International Programme on Chemical Safety. Chromium – Environmental Health Criteria Document 61. WHO, Geneva, 1988.

WHO. 1988b. IPCS International Programme on Chemical Safety. Vanadium – Environmental Health Criteria Document 81. WHO, Geneva, 1988. Available online at http://www.inchem.org/documents/ehc/ehc/ehc81.htm

WHO. 1989. IPCS International Programme on Chemical Safety. Mercury –Environmental Health Criteria Document 86. WHO, Geneva, 1989.

WHO. 1990. IPCS International Programme on Chemical Safety. Barium –Environmental Health Criteria Document 107. WHO, Geneva, 1990.

WHO. 1991. IPCS International Programme on Chemical Safety. Inorganic Mercury. Environmental Health Criteria Document 118. WHO, Geneva, 1991.

WHO. 1993. IPCS International Programme on Chemical Safety. Polychlorinated Biphenyls and Terphenyls – Environmental Health Criteria Document 140. WHO, Geneva, 1993. Available online at http://www.inchem.org/documents/ehc/ehc/ehc140.htm

Wolff, JO, RD Dueser, DS Berry. 1985. Food habits of sympatric *Peromyscus leucopus* and *Peromyscus maniculatus*. J. Mammal. 66: 795-798.

Zahid, ZR, ZS Hakkak, AHH Kadhim, EA Elias, and IS Al Jumaily. 1990. Comparative effects of trivalent and hexavalent chromium on spermatogenesis of the mouse. Toxicol. Environ. Chem. 25(2-3): 131-136.

Zielinski, S. 2011. Alabama Snail Returns from the Dead. http://www.smithsonianmag.com/science-nature/alabama-snail-returns-from-the-dead-13021380/

Zwiernik, MJ, KJ Beckett, SJ Bursian, DP Kay, RR Holem, JN Moore, B Yamini, and JP Giesy. 2009. Chronic effects of polychlorinated dibenzofurans on mink in laboratory and field environments. Integr. Environ. Assess. Manag. 5:291–301.

TABLES

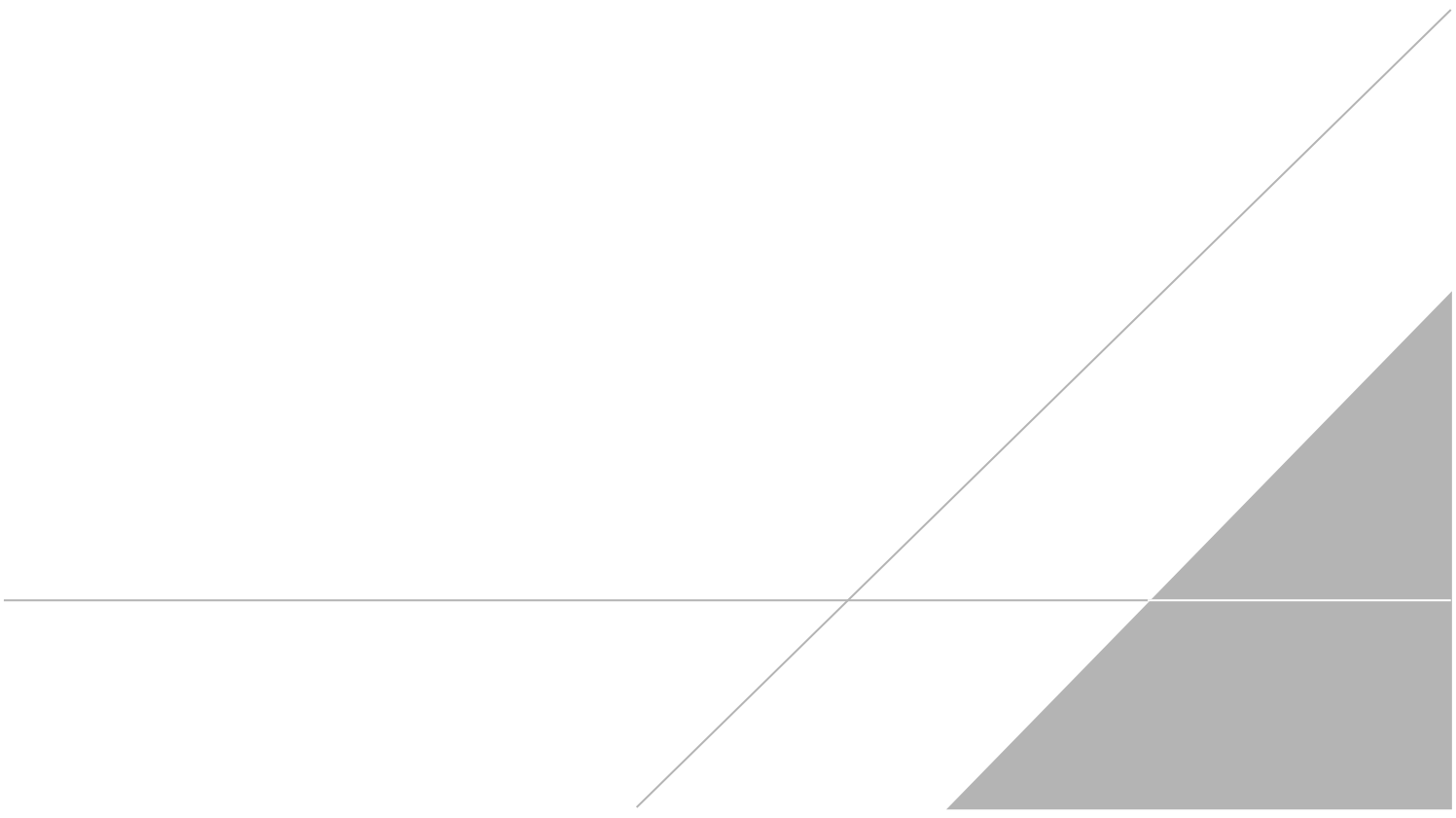


Table 2-1. Ecological Data Survey Events
Anniston PCB Site, Anniston, Alabama

	Data Collected	Sampling Efforts and Reports					
		Bayne Water Quality and Biological Study	Off-Site RFI Habitat and Biological Assessment	Off-Site RFI Phase 2 Floodplain Surveys	RI/FS Phase 1 Ecological Surveys	RI/FS Phase 1 Supplemental Ecological Surveys	RI/FS Phase 2 Biological Sampling
		1995-1997	September 1999	Fall 2001 and Spring 2002	Fall 2006; Winter, Spring, Summer 2007	Spring 2008	2009
Biological and Ecology Data	Land use delineation		X				
	Aquatic habitat characterization[1]	X	X	X			
	Floodplain habitat type identification			X			
	Floodplain vegetation species counts			X			
	Floodplain vegetation species observations				X		
	Benthic macroinvertebrate counts and biotic index scores	X			X		
	Benthic macroinvertebrate species observations		X				
	Fish species observations						
	Fish species counts				X		
	Terrestrial macroinvertebrate counts				X		
	Terrestrial reptile and amphibian observations				X		
	Species observations of birds and mammals in floodplain				X		
	Bird and mammal species counts			X (fp only)	X (aq only)		
	Reptile and amphibian species counts				X	X	
	Small mammal species counts				X		

Notes:
[1] Habitat characterization included RBP in Bayne Water Quality and Biological Study and Off-Site RFI Habitat and Biological Assessment and RBP-like observations in the OU-4 DSR.
aq: aquatic habitat
DSR: Data Summary Report
fp: floodplain
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl
RBP: Rapid Bioassessment Protocol
RFI: Resource Conservation and Recovery Act Facility Investigation
RI/FS: remedial investigation/feasibility study
X: indicates data were collected; blank indicates data were not collected

Table 2-2. Summary of Benthic Macroinvertebrates Collected from the Assessment and Reference Areas[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type	Sample Location	Total Taxa	Number of Organisms	Number of EPT Species	Percent EPT	Diversity[2]	Tolerance Index	Mean Total PCBs (mg/kg dw)[3]
October/November 2006								
Upper Assessment Area								
Backwater	1	11	97	0	0	1.47	8.4	0.84
Backwater	1R	6	84	0	0	0.58	8.9	0.84
Depositional	1	7	20	1	5	1.61	5.4	0.89
Depositional	1R	5	8	0	0	1.56	6.3	0.89
Emergent Aquatic Vegetation	1	9	50	0	0	1.85	7.8	1.17
Emergent Aquatic Vegetation	1R	6	72	0	0	0.63	8.8	1.17
Riffle	1	9	145	3	32	1.24	3.6	0.10
Riffle	1R	12	226	4	58	1.41	4.5	0.10
Run	1	8	28	3	11	1.14	2.8	0.10
Run	1R	7	27	2	7.4	1.33	3.8	0.10
Backwater	2	5	14	0	0	0.99	8.9	2.35
Backwater	2R	10	28	1	3.6	1.74	8.6	2.35
Depositional	2	5	10	0	0	1.42	7.3	2.35
Depositional	2R	6	14	0	0	1.47	7.3	2.35
Emergent Aquatic Vegetation	2	4	59	0	0	0.32	8.8	1.22
Emergent Aquatic Vegetation	2R	11	86	2	2.3	0.76	8.5	1.22
Riffle	2	9	79	5	76	1.64	5.1	0.33
Riffle	2R	13	107	4	71	1.85	4.9	0.33
Run	2	6	14	2	64	1.57	6.5	0.37
Run	2R	7	18	3	67	1.56	5.2	0.37
Middle Assessment Area								
Backwater	1	14	125	0	0	2.05	7.2	1.08
Backwater	1R	9	26	0	0	1.70	7.0	1.08
Depositional	1	7	15	0	0	1.68	5.0	2.56
Depositional	1R	13	56	0	0	2.17	5.9	2.56
Emergent Aquatic Vegetation	1	8	32	5	28	1.36	3.0	0.99
Emergent Aquatic Vegetation	1R	8	58	5	40	1.57	3.1	0.99
Riffle	1	19	238	10	76	1.98	4.3	0.50
Riffle	1R	13	169	8	92	1.90	4.3	0.50
Run	1	13	89	4	39	2.09	4.9	1.35
Run	1R	10	44	4	30	1.49	3.2	1.35
Depositional	2	11	21	0	0	2.31	7.1	1.73
Depositional	2R	8	17	0	0	1.79	7.9	1.73
Emergent Aquatic Vegetation	2	14	101	3	5.0	1.75	6.1	1.08
Emergent Aquatic Vegetation	2R	11	55	2	3.6	1.72	5.4	1.08
Riffle	2	14	382	7	74	1.91	4.0	--
Riffle	2R	16	281	7	60	2.14	4.4	--
Run	2	8	65	4	31	1.18	2.9	0.85
Run	2R	8	24	5	54	1.86	4.0	0.85
Lower Assessment Area								
Backwater	1	15	86	0	0	2.02	7.0	3.14
Backwater	1R	16	71	1	1.4	2.25	7.3	3.14
Depositional	1	4	15	0	0	0.86	8.5	--
Depositional	1R	4	23	0	0	0.64	8.9	--
Emergent Aquatic Vegetation	1	8	67	3	6.0	1.49	5.7	--
Emergent Aquatic Vegetation	1R	7	81	2	4.9	1.42	5.7	--
Riffle	1	16	202	9	75	1.65	3.7	0.09
Riffle	1R	16	178	7	74	1.80	4.3	0.09
Run	1	13	158	4	44	1.92	3.5	0.09
Run	1R	14	155	5	36	1.91	3.9	0.09
Backwater	2	19	74	4	14	2.52	7.3	0.70
Backwater	2R	14	87	2	10	1.99	8.0	0.70
Depositional	2	7	55	0	0	0.93	7.3	2.37
Depositional	2R	11	39	0	0	2.05	6.8	2.37
Emergent Aquatic Vegetation	2	6	29	2	6.9	0.91	3.0	2.22

Table 2-2. Summary of Benthic Macroinvertebrates Collected from the Assessment and Reference Areas[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type	Sample Location	Total Taxa	Number of Organisms	Number of EPT Species	Percent EPT	Diversity[2]	Tolerance Index	Mean Total PCBs (mg/kg dw)[3]
Emergent Aquatic Vegetation	2R	27	195	2	3.6	2.00	4.6	2.22
Riffle	2	12	78	5	64	1.98	4.1	2.45
Riffle	2R	17	95	9	68	2.20	4.5	2.45
Run	2	12	96	6	21	1.77	4.5	2.08
Run	2R	7	56	3	25	1.59	3.8	2.08
Reference Area 1								
Emergent Aquatic Vegetation	1	16	23	6	35	2.60	6.5	0.05
Emergent Aquatic Vegetation	1R	14	35	3	14	2.08	7.7	0.05
Riffle	1	13	340	8	10	0.94	2.2	0.04
Riffle	1R	27	374	14	31	1.78	2.9	0.04
Run	1	36	102	9	22	3.03	6.2	0.04
Run	1R	27	66	14	41	2.98	5.5	0.04
Reference Area 2								
Emergent Aquatic Vegetation	1	15	47	3	6.4	2.06	4.0	0.05
Emergent Aquatic Vegetation	1R	14	110	3	2.7	1.30	3.2	0.05
Riffle	1	19	92	9	29	2.16	2.9	0.04
Riffle	1R	21	78	10	55	2.61	4.0	0.04
Run	1	6	11	1	9.1	1.54	3.5	0.04
Run	1R	10	21	2	10	1.96	3.3	0.04
Reference Area 3								
Backwater	1	5	11	1	9.1	1.47	6.5	0.08
Backwater	1R	12	42	1	2.4	2.03	6.9	0.08
Emergent Aquatic Vegetation	1	8	14	1	7.1	1.77	5.7	0.06
Emergent Aquatic Vegetation	1R	8	13	1	7.7	1.99	6.5	0.06
Run	1	7	16	1	6.3	1.45	7.8	0.06
Run	1R	9	24	3	13	1.73	7.1	0.06
Spring 2007								
Upper Assessment Area								
Backwater	1	13	352	0	0	1.9	6.7	0.84
Backwater	1R	10	275	0	0	1.5	6.8	0.84
Depositional	1	13	119	0	0	1.9	7.0	0.89
Depositional	1R	9	30	0	0	1.8	7.5	0.89
Emergent Aquatic Vegetation	1	16	242	6	9.5	1.6	5.9	1.17
Emergent Aquatic Vegetation	1R	16	200	2	4.0	1.7	6.3	1.17
Riffle	1	18	416	3	26	1.8	5.7	0.10
Riffle	1R	28	1099	8	30	2.4	5.3	0.10
Run	1	16	86	1	1.2	2.2	7.0	0.10
Run	1R	25	417	6	21	2.2	6.0	0.10
Backwater	2	7	275	0	0	1.0	6.8	2.35
Backwater	2R	8	199	0	0	1.2	7.5	2.35
Depositional	2	11	64	0	0	1.6	7.4	2.35
Depositional	2R	10	250	0	0	1.9	7.1	2.35
Emergent Aquatic Vegetation	2	33	481	4	2.1	2.2	6.5	1.22
Emergent Aquatic Vegetation	2R	20	340	4	9.1	2.0	6.1	1.22
Riffle	2	19	458	7	48	2.2	5.8	0.33
Riffle	2R	27	553	7	50	2.5	5.8	0.33
Run	2	16	235	2	2.6	2.2	6.9	0.37
Run	2R	24	329	4	6.1	2.3	7.1	0.37
Middle Assessment Area								
Backwater	1	14	85	1	1.2	1.9	7.7	1.08
Backwater	1R	9	116	0	0	1.1	7.7	1.08
Depositional	1	11	50	0	0	2.0	6.3	2.56
Depositional	1R	13	143	0	0	2.0	7.2	2.56
Emergent Aquatic Vegetation	1	18	173	8	13	2.0	4.4	0.99
Emergent Aquatic Vegetation	1R	19	359	7	28	2.2	4.6	0.99
Riffle	1	48	304	14	36	3.2	5.6	0.50
Riffle	1R	33	145	9	23	2.9	5.3	0.50

Table 2-2. Summary of Benthic Macroinvertebrates Collected from the Assessment and Reference Areas[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type	Sample Location	Total Taxa	Number of Organisms	Number of EPT Species	Percent EPT	Diversity[2]	Tolerance Index	Mean Total PCBs (mg/kg dw)[3]
Run	1	36	258	11	53	2.8	5.3	1.35
Run	1R	31	307	7	18	2.6	6.2	1.35
Backwater	2	14	72	0	0	2.1	7.2	2.71
Backwater	2R	19	150	1	1.3	2.4	6.9	2.71
Depositional	2	6	18	0	0	1.5	6.3	1.73
Depositional	2R	8	33	0	0	1.4	6.6	1.73
Emergent Aquatic Vegetation	2	29	839	1	0	2.7	6.4	1.08
Emergent Aquatic Vegetation	2R	40	573	2	3.0	2.8	6.3	1.08
Riffle	2	41	957	11	14	2.2	4.2	--
Riffle	2R	35	976	14	35	1.9	5.2	--
Run	2	30	402	10	20	2.5	6.2	0.85
Run	2R	21	726	6	14	2.0	6.4	0.85
Lower Assessment Area								
Backwater	1	12	47	2	6.4	1.8	7.4	3.14
Backwater	1R	23	90	0	0	2.5	6.8	3.14
Depositional	1	17	57	0	0	2.4	7.5	--
Depositional	1R	20	93	2	3.2	2.4	7.4	--
Emergent Aquatic Vegetation	1	26	655	0	0	1.8	4.5	--
Emergent Aquatic Vegetation	1R	28	499	4	1.6	1.6	3.5	--
Riffle	1	27	457	9	57	2.4	4.7	0.09
Riffle	1R	16	275	7	26	1.8	3.6	0.09
Run	1	25	162	11	29	2.1	4.0	0.09
Run	1R	35	326	13	32	2.6	4.7	0.09
Backwater	2	12	62	2	13	1.7	8.0	0.70
Backwater	2R	23	106	1	15	2.7	6.5	0.70
Depositional	2	19	150	0	0	2.2	7.5	2.37
Depositional	2R	17	97	0	0	2.2	7.7	2.37
Emergent Aquatic Vegetation	2	33	243	8	26	2.7	4.7	2.22
Emergent Aquatic Vegetation	2R	36	301	7	7.0	2.6	5.1	2.22
Riffle	2	24	284	11	74	2.4	5.1	2.45
Riffle	2R	31	486	11	37	2.3	4.3	2.45
Run	2	21	95	8	32	2.6	4.9	2.08
Run	2R	12	80	4	31	2.2	5.0	2.08
Reference Area 1								
Depositional	1	12	72	1	1.4	1.8	6.7	0.06
Depositional	1R	18	120	2	1.7	2.1	6.0	0.06
Emergent Aquatic Vegetation	1	22	444	6	27	2.1	6.0	0.05
Emergent Aquatic Vegetation	1R	29	510	2	4.9	1.9	6.2	0.05
Riffle	1	20	276	8	18	1.5	3.2	0.04
Riffle	1R	21	137	8	34	2.4	5.4	0.04
Run	1	28	203	6	11	2.4	6.1	0.04
Run	1R	14	47	2	13	2.2	5.9	0.04
Reference Area 2								
Emergent Aquatic Vegetation	1	26	608	6	13	1.1	2.9	0.05
Emergent Aquatic Vegetation	1R	26	1468	10	11	1.8	5.5	0.05
Riffle	1	37	1128	12	84	2.4	5.1	0.04
Riffle	1R	35	649	14	52	2.5	5.6	0.04
Run	1	16	1164	3	3.7	1.0	2.7	0.04
Run	1R	26	560	6	62	1.9	4.9	0.04

Table 2-2. Summary of Benthic Macroinvertebrates Collected from the Assessment and Reference Areas[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type	Sample Location	Total Taxa	Number of Organisms	Number of EPT Species	Percent EPT	Diversity[2]	Tolerance Index	Mean Total PCBs (mg/kg dw)[3]
Reference Area 3								
Backwater	1	3	3	0	0	1.1	6.1	0.08
Backwater	1R	1	3	0	0	0.0	6.0	0.08
Depositional	1	13	22	1	4.5	2.4	5.9	0.08
Depositional	1R	13	28	1	3.6	2.2	6.5	0.08
Emergent Aquatic Vegetation	1	20	241	3	2.5	1.8	6.2	0.06
Emergent Aquatic Vegetation	1R	22	86	5	14	2.4	6.1	0.06
Run	1	14	35	4	37	2.3	6.1	0.06
Run	1R	25	192	8	16	2.1	6.3	0.06

Notes:
[1] Data are from Remedial Investigation/Feasibility Study Phase 1 Ecological Surveys (Arcadis BBL 2007a).

[2] Diversity is based on Shannon-Wiener formula: $H' = -\sum p_i * \ln p_i$

[3] Mean total PCB concentration of surface sediment samples in a similar habitat within a half mile range of the benthic location.

-- Not estimated, no sediment samples within habitat within a half mile range.
Macroinvertebrate survey locations shown on Figures 2-1a through 2-1k.
BBL: Blasland, Bouck, and Lee, Inc. (now Arcadis)
EPT: Ephemeroptera-Plecoptera-Tricoptera
mg/kg dw: milligrams per kilogram dry weight
PCB: polychlorinated biphenyl
R: replicate sample

Table 2-3. Summary of Fish Sampling Results
Anniston PCB Site, Anniston, Alabama

Species	Tolerance Category[1]	2006														
		Upper Assessment Area				Middle Assessment Area				Lower Assessment Area				Ref-1		
		Backwater	Riffle	Run	EAV	Backwater	Riffle	Run	EAV	Backwater	Riffle	Run	EAV	Riffle	Run	EAV
Alabama Hog Sucker	NA	0.5	11.0	2.4	2.0		0.5	1.0	0.5		2.0	1.0	0.5	22.0	1.0	
Alabama Shiner	NA		1.9													
Banded Sculpin	M	0.5	5.8	0.5			2.5		1.5	0.5	6.0	0.5		7.0	1.0	
Black Crappie	M															
Black Redhorse	I	1.0		2.5												
Blackbanded Darter	NA	0.5	2.0	0.5	1.0		1.0	1.5		0.5	0.5	1.0	1.0	3.0	6.0	1.0
Blackspotted Topminnow	NA					1.0			2.0	7.0			1.5			1.0
Blacktail Redhorse	NA	5.5		3.4	0.5	2.0	2.0	1.5		1.0		1.5	1.0	1.0	5.0	1.9
Blacktail Shiner	NA			1.9												
Bluegill	M	14.5		0.9		9.5		8.0	1.0	15.0		1.0	16.0		7.0	14.6
Bluegill x Green Sunfish	M/T															
Bronze Darter	NA						0.5					0.5				
Bullhead Minnow	M															
Channel Catfish	M			0.5											4.0	
Coldwater Darter	NA		0.9			0.5			0.5	0.5			0.5		2.0	
Common Carp	NA			0.5											4.0	
Coosa Darter	NA		1.0	1.0			0.5									
Coosa Shiner	NA															
Creek Chub	T									0.5						
Emerald Shiner	M															
Flathead Catfish	M															
Freshwater Drum	M			4.3								0.5				
Golden Redhorse	M			3.9											12.0	
Green Sunfish	T	0.5				3.5		1.5	1.5	1.5		0.5	0.5			
Greenbreast Darter	NA		0.5				3.5				1.0	0.5				
Largemouth Bass	M	0.5		0.5	0.5											1.0
Largescale Stoneroller	M	8.0	2.0		15.0		6.0		6.0	2.5	14.0	1.5	21.5	5.0		
Longear Sunfish	I	12.5		1.0	4.5	6.5		5.5		5.5			2.5		4.0	3.9
Longnose Gar	M															
Mimic Shiner	I															
Mobile Log Perch	NA						1.5				0.5					
Orangespotted Sunfish	M							1.5								
Redbreast Sunfish	M	13.0			4.0	1.5			0.5			0.5			1.0	
Redear Sunfish	M	1.0				2.5		1.5	0.5			0.5	3.5		3.0	
Redeye Bass	NA															
Redspotted Sunfish	NA															
Riffle Minnow	NA		4.7				4.5	2.0			4.0	2.5	0.5	14.0		
Rock Bass	M											0.5				
Shadow Bass	NA															
Silverstripe Shiner	NA	5.0		1.0	3.0	1.5	1.5	2.5		0.5	0.5	9.5		17.0	1.0	
Southern Studfish	NA															
Speckled Darter	NA		2.4													
Spotted Bass	NA	2.5	1.5	3.4	1.5	3.5	1.5	0.5	0.5	2.5		1.5	2.5		2.0	1.0
Spotted Sucker	NA					1.0				0.5						
Striped Shiner	M															
Tri Color Shiner	NA	11.0	8.0		2.5	4.5	8.0	2.5	3.0	0.5	10.5	3.0	4.0		2.0	
Unknown	NA		29.0			2.5		1.0		0.5	0.5		1.0			
Warmouth	M															2.9
Western Mosquitofish	M	6.5			6.0	0.5			1.0	2.0						

Table 2-3. Summary of Fish Sampling Results
Anniston PCB Site, Anniston, Alabama

Species	Tolerance Category[1]	2006						2007							
		Ref-2			Ref-3			Upper Assessment Area				Middle Assessment Area			
		Riffle	Run	EAV	Backwater	Run	EAV	Backwater	Riffle	Run	EAV	Backwater	Riffle	Run	EAV
Alabama Hog Sucker	NA	9.5	19.8	3.8		0.8	0.9	6.9	20.3	1.0	0.5		5.0		2.0
Alabama Shiner	NA	15.9							11.3				22.5	0.5	2.0
Banded Sculpin	M	21.5	4.5	10.4					16.7		2.2	1.0	9.0	1.5	6.0
Black Crappie	M											0.5			
Black Redhorse	I		22.6		1.9	7.6		2.7	7.2	7.4					
Blackbanded Darter	NA		4.5	0.9		2.3	2.8	1.3	2.6	1.1	5.4		4.0	0.5	2.0
Blackspotted Topminnow	NA			7.6								21.0			5.0
Blacktail Redhorse	NA				6.6	6.1	1.9	15.8	1.9	15.2	3.2		3.0	7.5	11.5
Blacktail Shiner	NA				1.9	16.8		1.4	3.4	1.5				4.0	0.5
Bluegill	M		17.1	50.2	40.2	0.8	4.7	17.7	1.0	5.3	1.6	7.0	1.0	14.0	14.5
Bluegill x Green Sunfish	M/T								0.5						
Bronze Darter	NA	4.0	1.8					1.7	0.5				3.0	2.5	2.0
Bullhead Minnow	M														
Channel Catfish	M									1.6				2.5	0.5
Coldwater Darter	NA	1.6													
Common Carp	NA									1.6					
Coosa Darter	NA		2.7	0.9			0.9								
Coosa Shiner	NA	1.6						1.1	2.4	1.0					
Creek Chub	T														
Emerald Shiner	M							3.4	6.7	1.0		0.5	75.5		2.0
Flathead Catfish	M								0.5	1.0			0.5	0.5	
Freshwater Drum	M								1.0	13.3				1.0	
Golden Redhorse	M				0.9	5.3	0.9	2.8	4.8	3.8				1.0	
Green Sunfish	T		0.9	10.4				2.7	2.9	2.1	2.2	10.5	1.5	3.5	1.5
Greenbreast Darter	NA	2.4							1.0				2.0		0.5
Largemouth Bass	M		0.9					2.0		0.5		3.0	0.5	0.5	1.5
Largescale Stoneroller	M	9.5	2.7	51.1		0.8	3.7	5.7	50.8		4.9	22.5	25.5		82.5
Longear Sunfish	I		9.9	3.8	0.9	4.6	11.2	29.9	1.9	1.6	11.9	29.0	1.5	2.0	16.5
Longnose Gar	M											0.5			
Mimic Shiner	I							1.1	9.0	2.5		14.0	37.5		40.5
Mobile Log Perch	NA		5.4							1.1			2.0	4.0	
Orangespotted Sunfish	M			0.9				1.1				1.5			
Redbreast Sunfish	M		0.9		1.9	3.0		14.0	1.4	1.5	1.1	26.0	0.5	3.5	13.0
Redear Sunfish	M		1.8	1.9	1.9		1.9	0.7		1.1				1.0	
Redeye Bass	NA		5.4			0.8									
Redspotted Sunfish	NA			0.9											0.5
Riffle Minnow	NA	0.8							2.4	0.5			18.0		5.0
Rock Bass	M														
Shadow Bass	NA		2.7												
Silverstripe Shiner	NA			1.9				1.7	1.9	1.5			0.5		22.5
Southern Studfish	NA			1.9			4.7								
Speckled Darter	NA				0.9	2.3	1.9	0.6	0.5		0.5	0.5		1.5	2.5
Spotted Bass	NA		1.8			0.8	0.9	8.2	2.4	7.8	0.5	6.0	1.0	5.0	3.5
Spotted Sucker	NA		0.9		9.4					0.5				1.0	
Striped Shiner	M		14.4	0.9									19.0		9.5
Tri Color Shiner	NA	9.5		0.9		9.1	8.4								
Unknown	NA	7.2				3.0	0.9								
Warmouth	M		1.8	1.9	1.9	0.8		0.7							
Western Mosquitofish	M			9.5				33.5			7.6	9.5			2.0

Table 2-3. Summary of Fish Sampling Results
Anniston PCB Site, Anniston, Alabama

Species	Tolerance Category[1]	2007												
		Lower Assessment Area				Ref-1			Ref-2			Ref-3		
		Backwater	Riffle	Run	EAV	Riffle	Run	EAV	Riffle	Run	EAV	Backwater	Run	Vegetation
Alabama Hog Sucker	NA		2.5			49.2	0.8		14.9	10.8	1.0		1.0	1.2
Alabama Shiner	NA		31.0			1.0			12.9					1.2
Banded Sculpin	M	11.1	6.5	1.5		8.0			57.5		5.8			
Black Crappie	M									1.0		0.7		
Black Redhorse	I			0.5		28.1	5.1	4.0		9.8		1.4		
Blackbanded Darter	NA	2.3	3.0	0.5	4.0	11.0		2.0	4.0		3.9		2.0	
Blackspotted Topminnow	NA	14.5	0.5	1.0	4.5				1.0	2.0	2.9			1.2
Blacktail Redhorse	NA			11.5	2.0		5.1	3.0				4.2	4.0	
Blacktail Shiner	NA		0.5	0.5		1.0	4.2			1.0				
Bluegill	M	13.0		14.5	20.4			6.9		9.8	8.7	20.5	2.0	13.2
Bluegill x Green Sunfish	M/T										1.0			
Bronze Darter	NA		1.5	0.5					6.9		1.0			
Bullhead Minnow	M					1.0								
Channel Catfish	M		0.5	2.5										
Coldwater Darter	NA								3.0			1.4	1.0	
Common Carp	NA							1.0						
Coosa Darter	NA				0.5						1.0			
Coosa Shiner	NA				0.5	5.0	0.8		6.0	1.0	1.0			
Creek Chub	T													
Emerald Shiner	M		48.0	3.0	4.4	11.0								
Flathead Catfish	M													
Freshwater Drum	M			1.0										
Golden Redhorse	M	0.7		0.5		13.0	3.4	6.9		3.0		2.8	1.0	
Green Sunfish	T	0.8	0.5		1.0	1.0	1.7	2.0	2.0	2.0	7.7	0.7	1.0	
Greenbreast Darter	NA		5.5	1.0										
Largemouth Bass	M	2.3		2.0	1.5					2.0		2.1		1.2
Largescale Stoneroller	M	0.8	33.0		23.9	66.2			102.1		20.3			2.4
Longear Sunfish	I	6.8		3.5	5.5	4.0		8.9	1.0	6.9	18.4		5.0	
Longnose Gar	M			0.5	1.0									
Mimic Shiner	I		12.5	0.5	114.0									
Mobile Log Perch	NA		1.5	2.5				2.0	3.0	3.0	1.0		2.0	
Orangespotted Sunfish	M	0.8		0.5	1.0							2.1		4.8
Redbreast Sunfish	M	12.3		4.5	9.0		5.9			2.0		2.8	17.0	15.6
Redear Sunfish	M			1.5								0.7		
Redeye Bass	NA					1.0			3.0	6.9				
Redspotted Sunfish	NA		0.5		0.5						1.0			
Riffle Minnow	NA		11.5			7.0			3.0					
Rock Bass	M													
Shadow Bass	NA				0.5	1.0				3.0	1.0			1.2
Silverstripe Shiner	NA				1.5	9.0	1.7	1.0						1.2
Southern Studfish	NA					11.0			2.0		1.0			2.4
Speckled Darter	NA	0.7		1.0	0.5		0.8				1.9			
Spotted Bass	NA	1.5	1.0	5.0	3.0	6.0		1.0		5.9		0.7	2.0	
Spotted Sucker	NA			0.5								4.9		1.2
Striped Shiner	M								14.9					
Tri Color Shiner	NA					1.0					2.9			
Unknown	NA													
Warmouth	M				1.0			1.0		1.0		2.1		
Western Mosquitofish	M	22.2			0.5	1.0								

Table 2-3. Summary of Fish Sampling Results
Anniston PCB Site, Anniston, Alabama

Notes:

[1]Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

EAV: emergent aquatic vegetation

I : intolerant

M: moderate

NA: not available

PCB: polychlorinated biphenyl

T: tolerant

Table 2-4. Bird Species Observed During Aquatic Habitat Surveys[1]
Anniston PCB Site, Anniston, Alabama

Species		Assessment Area														
		Upper				Middle				Lower				Ref 1	Ref 2	Ref 3
Common Name	Scientific Name	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2007	Spring 2007	Spring 2007
American Ahninga	*Ahninga ahninga*									X						
American Osprey	*Pandion haliaetus*								X							
Belted Kingfisher	*Megaceryle alcyon*	X	X	X	X	X	X	X	X	X	X		X			
Black Vulture	*Coragyps atratus*							X								
Canada Goose	*Branta canadensis*											X				
Cooper's Hawk	*Accipiter cooperii*					X				X			X			
Duck sp.	Anatidae			X	X			X						X		
Great Blue Heron	*Ardea herodias*	X	X	X	X	X	X	X	X	X	X	X	X			
Great Egret	*Ardea alba*				X							X				
Green Heron	*Butorides virescens*			X	X			X	X			X	X			
Hawk sp.	Accipitridae				X											
Hooded Merganser	*Lophodytes cucullatus*						X									
Killdeer	*Charadrius vociferus*			X												
Mallard	*Anas platyrhynchos*					X	X	X			X					
Northern Harrier	*Circus cyaneus*											X				
Owl sp.	Strigidae								X							
Red-headed Woodpecker	*Melanerpes erythrocephalus*	X				X										
Red-shouldered Hawk	*Buteo lineatus*	X	X		X	X	X		X	X			X			
Red-tailed Hawk	*Buteo jamaicensis*	X		X	X		X	X		X	X	X				
Ruby-throated Hummingbird	*Archilochus colubris*						X									
Sharpshin Hawk	*Accipiter striatus*					X										
Snowy Egret	*Egretta thula*											X				
Swallows sp.	*Hirundinidae sp.*	X														
Turkey Vulture	*Cathartes aura*						X					X				
Wild Turkey	*Meleagris gallopavo*	X														
Wood Duck	*Aix sponsa*	X	X	X	X	X	X	X	X	X	X	X	X	X		

Notes:
[1] Data are from RI/FS Phase 1 Ecological Surveys performed by season using float trips through OU-4 and reference stream reaches. Based on observations, some birds were not able to be identified to species level. Additionally, some terrestrial bird species are noted within the aquatic/riparian corridor.
X: indicates presence; blank indicates none observed
OU-4: Operable Unit 4
Ref: reference location
RI/FS: remedial investigation/feasibility study
PCB: polychlorinated biphenyl

Table 2-5. Mammal Species Observed During Aquatic Habitat Surveys[1]
Anniston PCB Site, Anniston, Alabama

Species		Assessment Area														
		Upper				Middle				Lower				Ref 1	Ref 2	Ref 3
Common Name	Scientific Name	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2007	Spring 2007	Spring 2007
Beaver	*Castor canadensis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X[2]
Coyote	*Canis latrans*	X									X					
Eastern Chipmunk	*Tamias striatus*	X														
Fox	Canidae													X		
Gray Fox	*Urcyon cinereoargenteus*		X													
Gray Squirrel	*Sciurus carolinensis*															
Groundhog	*Marmota monax*	X		X										X		
Long-tailed Weasel	*Mustela frenata*	X		X												
American Mink	*Neovison vison*	X	X					X	X	X			X			
Muskrat	*Ondatra zibethicus*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X[2]
Opossum	*Didelphia virginiana*		X													
Raccoon	*Procyon lotor*	X	X	X	X	X	X	X	X	X	X	X	X	X		
Skunk	*Mephitis mephitis*			X												
White-tailed Deer	*Odocoileus virginianus*	X		X	X	X		X	X	X	X	X	X	X		

Notes:
[1] Data are from RI/FS Phase 1 Ecological Surveys performed by season using float trips through OU-4 and reference stream reaches. Some terrestrial mammals were observed and are noted within the aquatic/riparian corridor.
[2] Survey observation noted either species, based on distant visual observation along bank.
X: indicates presence; blank indicates none observed
PCB: polychlorinated biphenyl
OU-4: Operable Unit 4
Ref: reference location
RI/FS: remedial investigation/feasibility study

Table 2-6. Reptile and Amphibian Species Observed During Aquatic Habitat Surveys[1]
Anniston PCB Site, Anniston, Alabama

Species		Assessment Area																			
		Upper					Middle					Lower					Reference				
Species	Scientific Name	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008
Black Racer	*Coluber constrictor*			X																	
Bull Frog	*Rana catesbeiana*					X															
Common Map Turtle	*Graptemys geographica*	X		X	X	X	X		X	X	X		X	X							
Common Musk Turtle	*Sternotherus odoratus*			X		X			X					X							X
Copperhead	*Agkistrodon contortrix*			X										X							
Cottonmouth	*Agkistrodon piscivorous*				X	X								X							
Cricket Frog	*Acris sp.*					X															
Eastern Painted Turtle	*Chrysemys picta*				X				X					X							
Eastern Ribbon Snake	*Thamnophis sauritus sauritus*					X															
Garter Snake	*Thamnophis sirtalis*			X																	
Gray Rat Snake	*Elaphe obsoleta spiloides*										X										
Gray Treefrog	*Hyla Versicolor/Chrysoscelis*					X															
Green Frog	*Rana clamitans*					X															
Midland Water Snake	*Nerodia sipedon pleuralis*					X					X										
Queen Snake	*Regina septemvittata*					X					X										X
River Cooter	*Pseudemys concinna*	X		X		X	X														
Scarlet Kingsnake	*Lampropeltis triangulum elapsoides*										X										
Snapping Turtle	*Chelydra serpentina*			X	X	X							X								
Softshell Turtle	*Apalone sp.*					X					X			X							
Spring Peeper	*Pseudacris crucifer*					X															X
Stripeneck Musk Turtle	*Sternotherus minor peltifer*																				X
Unidentified Frog*	--			X		X								X							
Unidentified Snake*	--			X		X			X		X										
Unidentified Tadpole*	--																				X
Unidentified Turtle*	--			X		X	X	X	X		X			X							
Upland Chorus Frog	*Pseudacris triseriata feriarum*					X															
Yellowbelly Slider	*Trachemys scripta scripta*					X															

Notes:

[1] Data are from RI/FS Phase 1 Ecological Surveys performed by season using float trips through OU-4 and reference stream reaches. Based on observations, some species were not able to be identified to species level. Additionally, some terrestrial species were noted within the aquatic/riparian corridor.

X: indicates presence; blank indicates none observed

* : was observed, but unable to be identified to species level during survey

-- : no scientific name because of unidentified species

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

RI/FS: remedial investigation/feasibility study

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	**Scientific Name**																				
Herbaceous Species																					
Alligator Weed	*Alternanthera philoxeroides*	2	2	1	2			3	1	2	1		1	1							
Annual Rye	*Lolium multiflorum*		1								3										1
Aster	*Aster sp.*	4		1				2		1		2		4		1		3		1	
Balloon Vine	*Cardiospermum*	4				1		2													
Beautyberry	*Callicarpa sp.*											2								1	
Bedstraw (sp.)	*Galium sp.*				1																
Bicknell's Cranesbill	*Geranium bicknellii*				1						1										
Birdsfoot Trefoil	*Lotus corniculatus*			1																	
Blackberry	*Rubus fruticosus*	6	2			2	1	1	3	1	1	4	2	3	2		1	3	3		
Blue Toadflax	*Nuttallanthus canadensis*														2						
Blue Vervain	*Verbena hastata*				1																
Blue Waxweed	*Cuphea viscosissima*	1																			
Bluestem	*Andropogon sp.*		2		1				2		1										2
Broad-leaf Arrowhead	*Sagittaria latifolia*									1											
Broadleaf Cattail	*Typha latifolia*			1	2																
Broomsedge	*Andropogon sp.*			1				1		2		1		2							
Buckeye	*Aesculus sp.*												1				1		1		
Bulbous Buttercup	*Ranunculus bulbosus*										1										
Bull Thistle	*Cirsium vulgare*				1		1		1		2						1		1		1
Bur Marigold	*Bidens aristosa*	5	6	3	2	4	3		1	3			2	1	1	1	1	2	1	2	3
Buttercup	*Ranunculus sp.*		5		7		5		4		2		1						2		
Buttonbush	*Cephalanthus occidentalis*							2	3												
Cardinal Flower	*Lobelia cardinalis*															1					
Catleaved Primrose	*Oenothera laciniata*														1						
Christmas Fern	*Polystichum acrostichoides*						2				1		2			1	1		2	1	1
Clayton's Bedstraw	*Galium tinctorium*		4								1		2		1						2
Clover	*Trifolium sp.*	1																			
Cocklebur	*Xanthium sp.*	1		1		1															
Common Blue-Eyed Grass	*Sisyrinchium angustifolium*		2		1				1				1				1		1		
Common Cinquefoil	*Potentilla simplex*			1																	
Common Dodder	*Cuscuta gronovii*					1															
Common Fleabane	*Erigeron philadelphicus*		2		2		4		3		3		2		3				2		3
Common Hop	*Humulus lupulus*		3		1				1		1						1				

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	**Scientific Name**																				
Common Milkweed	*Asclepias syriaca*		3										1								
Common Mullin	*Verbascum thapsus*		2																		
Common Smartweed	*Polygonum hydropiper*	1		1		2				2								1			
Common Sow Thistle	*Sonchus oleraceus*						2						1				1				
Coreopsis	*Coreopsis sp.*							1						1					1		
Corn Salad	*Valerianella locusta*																				1
Cow's Vetch	*Vicia cracca*						1		2						1						
Crabgrass	*Digitaria sp.*		1		1						1							1			1
Curled Dock	*Rumex crispus*							1													
Cutleaf Primrose	*Oenothera laciniata*														2						
Cynthia	*Krigia biflora*										1		1				1				
Dandelion	*Taraxacum sp.*		1										1		1		1		1		2
Dewberry	*Rubus trivialis*						1														
Dock (sp.)	*Rumex sp.*		1		5		3		5						3						1
Dogbane	*Apocynum sp.*																	1			
Dogfennel	*Eupatorium capillifolium*									1								1			
Dogwood	*Cornus sp.*	3	1				1						4		2		3	2	2		
Duckweed	*Lemnaceae sp.*						2														
Dwarf Snapdragon	*Antirrhinum majus dwarf*	1																			
English Plantain	*Plantago lanceolata*		1		1		1				1	1	1				1		1		
False Nettle	*Boehmeria cylindrica*	3	4	3	1	3	3			1	2		1					1	1	2	
Field Peppergrass	*Lepidium campestre*				1																
Field Sow Thistle	*Sonchus arvensis*						1														
Fox Grape	*Vitis labrusca*	2												1							
Fox Sedge	*Carex vulpinoidea*		1				3		1		2										
Fox Tail	*Alopecurus sp.*	3		1	2	2	1	1	1	1	3			1				1			
Fruit Trees	*not applicable*													1	1						
Gama Grass	*Tripsacum dactyloides*																	1			
Garlic Mustard	*Alliaria petiolata*	4	4	2	1		1				1										
Golden Ragwort	*Packera aurea*		2						1		1				3				2		1
Goldenrod	*Solidago sp.*	7	10	1	3	2	10	3	5		4	2	6	5	4	2	4	4	4		2
Grape	*Vitis sp.*		3	1			5	1	1	1		4	4		1		1		3	1	1
Grasses	*Poaceae sp.*	5	4	1	6	1	6		6	1		1	2		3				2	3	
Ground Cherry	*Physalis sp.*							1													

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	Scientific Name																				
Ground Ivy	*Glechoma hederacea*		5		1		1		1												
Ground Sorrell	*Rumex acetosa*								1				1	1							
Hackberry	*Celtis sp.*		1		2	1	9				1		1		3		1		2		1
Hay	*Alfalfa sp.*																		1		
Highbush Blueberry	*Vaccinium corymbosum*															1					
Hoary Vervain	*Vervain family*			1				1	1					2							
Honey Locust	*Gleditsia triacanthos*									2								1			
Honeysuckle	*Lonicera sp.*															1					
Horn Poppy	*Glaucium flavum*		2		2				1		1										
Horseweed	*Conyza canadensis*	1	2					1	1		1			3				1	1		
Indian Strawberry	*Potentilla indica*	1																			
Hysop Scullcap	*Scutellaria integrifolia*												1								
Jack-in-the-Pulpit	*Arisaema triphyllum*																				1
Japanese Honeysuckle	*Lonicera japonica*	1	5	1	2		6	1	2		2	5	7		5	1	3	3	4		4
Jewelweed	*Impatiens capensis*		2				1				1		1		1						2
Johnson Grass	*Sorghum halepense*	2	5	2	1		2	3	1		2		1	2	2		1	1			3
Knapweed	*Centaurea diffusa*	2		3		2		2		3		1				1		3		2	
Lady's Thumb	*Persicaria maculosa*	1		1		2				2				1		1		2			
Lance-Leaved Tearthumb	*Polygonum arifolium*	1																			
Large Houstonia	*Houstonia purpurea*												1		2						
Least Hop Clover	*Trifolium dubium*				1				2												1
Lespodisa	*Lespodisa sp.*	1																			
Little Bluestem	*Schizachyrium scoparium*																	1			
Low Hop Clover	*Trifolium campestre*		3				1		2				1		1				1		1
Mayapple	*Podophyllum peltatum*																	1			
Milkweed	*Asclepias sp.*		1											1				1			
Mint	*Mentha sp.*		2						2		1										
Mistflower	*Ageratina riparia*	1		3		3		2		3		1		1		1				1	
Morning Glory	*Ipomoea sp.*	1																			
Multiflora Rose	*Rosa multiflora*	2	8	2	1	2	5		1		1								1		
Nightshade	*Solanaceae sp.*	3	3	2	2			1	1	3			1	1	1		1	1	1		1
Nut Sedge	*Cyperus rotundus*					1															
One-Headed Flatsedge	*Cyperus laevigatus*			1				2		1											
Panic Grass	*Panicum virgatum*		5		1						1										1

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	**Scientific Name**																				
Panicum Grass	*Panicum sp.*					3															
Pennycrest	*Thlaspi arvense*										1										
Persimon	*Diospyros sp.*	1																			
Pinkweed	*Polygonum pensylvanicum*	1						1													
Poa	*Poa sp.*		1																		
Poison Ivy	*Toxicodendron radicans*	4	3		2	4	9	1	1	1	3	4	6	4	5	2	3	3	5	3	3
Pokeberry	*Phytolacca sp.*	2		3		1		2		1				3				2		1	
Polkberry	*Phytolacca sp.*		1		3		3		1				1				1				
Polygonum (sp.)	*Polygonum sp.*		1				1														
Polypody Fern	*Polypodiaceae sp.*																	1			
Potamogeton	*Potamogeton sp.*										1										
Privet	*Ligustrum sp.*	12	8	5	6	6	12	2	2	1	5	7	4	6	4		2	3	4	5	3
Purple Gerardia	*Agalinis purpurea*							1													
Queen Anne's Lace	*Daucus carota*	1																			
Rabbitfoot Clover	*Trifolium arvense*						1		1												
Ragweed	*Ambrosia sp.*	3	4	1	1	2	3	1				1	1	2				3	1		1
Raspberry	*Idaeobatus sp.*				1																
Red Buckeye	*Aesculus pavia*														1				1		1
Red Clover	*Trifolium pratense*		1		1		1						1								
Reed Grass	*Phalaris arundinacea*							1													
Rough Bedstraw	*Galium asprellum*																				1
Rye	*Secale cereale*						2												2		
Rye Grass	*Lolium sp.*					1															
Sedge (sp.)	*Cyperaceae sp.*		2				4		2												
Sensitive Fern	*Onoclea sensibilis*		3	1			6			1	1		2			1					
Showy Goldenrod	*Solidago speciosa*																	1			
Silktree	*Albizia julibrissin*		2				1		1		1					1			2		
Smartweed	*Polygonum sp.*										1										
Smilax	*Smilax sp.*	2	4	2	2	4	7	3	2	1	5	6	4	3	5	2	3	2	4	2	3
Sneezeweed	*Helenium autumnale*									1						1		1			
Smooth Hawksbeard	*Crepis capillaris*		2																		
Soft Rush	*Juncus effusus*	2	5		4			2	4	2	4		1								
Southern Hackberry	*Celtis laevigata*	1		1		2								3				2		1	
Stinging Nettle	*Urtica dioica*		2				1				1					1					

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	**Scientific Name**																				
Stout's Blue-eyed Grass	*Sisyrinchium angustifolium*				1		1				2										
Sumac	*Rhus sp.*	2				1		1	1			1					1	1	1		
Summer Grape	*Vitis aestivalis*	1		1																	
Switch Grass	*Panicum virgatum*	2		1		1		3		2		1				1					
Tall Nettle	*Urtica procera*	1																			
Tansy Ragwort	*Jacobaea vulgaris*										1										
Thistle	*Asteraceae spp.*	2						1		1				1				1			
Timothy Grass	*Phleum pratense*			2				2		2				2				1			1
Trumpet Creeper	*Campsis radicans*	1	9	1		3	7		3		1	3	4	4	4	1	1	2	4	4	3
Tussock Sedge	*Carex stricta*					1					2										
Vasey Grass	*Paspalum urvillei*	1								2											
Venus Looking Glass	*Triodanis perfoliata*				1				1						3						1
Virginia Creeper	*Parthenocissus quinquefolia*					1	4		1		1		4	1	1		1		3	1	2
Water Pepper	*Persicaria hydropiper*	1		1																	
Wheat	*Triticum spp.*					1	2														
White Beardtongue	*Penstemon multiflorus*																		1		
White Clover	*Trifolium repens*		1		2		3				1		1				1		1		1
White Snakeroot	*Ageratina altissima*			2			2	4	2			3	1	2	2		1			1	
Wild Garlic	*Allium ursinum*		2				2		5		1		3		4				1		3
Wild Geranium	*Geranium maculatum*						3		2				1		5						1
Wild Lettuce	*Lactuca virosa*		3				1				1										
Wild Oat	*Avena sp.*	3				1				2		1		1		2		1			
Wild Onion	*Allium sp.*		2								1		2								
Wild Strawberry	*Fragaria vesca*		3		2		3												1		2
Wild Yam	*Dioscorea villosa*						1		1										1		
Yellow Avens	*Geum aleppicum*		1																		
Yellow Nut Sedge	*Cyperus esculentus*					1				1								1			
Total		113	171	57	82	63	162	57	88	49	82	51	87	64	80	24	39	61	73	32	63

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	**Scientific Name**																				
Canopy Species																					
American Elm	*Ulmus americana*	2	3	2	3	3	2	1	2	1	2		4	3	4	1	2	3		2	1
Ash	*Fraxinus sp.*							1													
Atlantic White Cedar	*Chamaecyparis thyoides*										1										
Bamboo	*Bambuseae*					2	1	1					1		1	2	2		1	2	3
Basswood	*Tilia americana*				1	1	2		1					1			1			2	2
Beech	*Fagus sp.*					1						1									
Birch	*Betula sp.*											1									
Black Cherry	*Prunus serotina*	1		1										1				3		2	
Black Walnut	*Juglans nigra*																				1
Blackjack Oak	*Quercus marilandica*																	1			
Black Willow	*Salix nigra*		4		3				2		1										
Box Elder	*Acer negundo*	13	14	1	4	2	9	1	2	1	2	2	3	1	4			1	3	2	3
Burr Oak	*Quercus macrocarpa*																1				
Catalpa	*Catalpa sp.*					1										1					
Eastern Red Cedar	*Juniperus virginiana*			1	1		3	1	1		1	1	3	1	3	1	1	3	3		1
Eastern White Oak	*Quercus alba*																	2			
Elm (sp.)	*Ulmus sp.*																		1		
European Buckthorn	*Rhamnus cathartica*	1																			
Florida Maple	*Acer floridanum*					2							3		1				2		1
Green Ash	*Fraxinus pennsylvanica*	4	6	2	3		12		3	1	2	1	4	2		1	2		2		4
Hickory	*Carya sp.*			2		4		1		1		3		3		1				3	
Holly	*Ilex sp.*												1								
Loblolly Pine	*Pinus taeda*	1		1								2		1		2		2		1	
Musclewood	*Carpinus caroliniana*					3	2			1	3	6	3	1		1	3	1	3		
Oak	*Quercus sp.*																	1			
Pawpaw	*Asimina sp.*		2		1	4	7	1		1	3	3		1	2	1	1		1		1
Pignut Hickory	*Carya glabra*																	1			
Pecan	*Carya illinoinensis*		2		1				1		1		4		1		2		1		1
Pine (sp.)	*Pinus sp.*		1		1								2		1		1		3		
Post Oak	*Quercus stellata*											2									
Red Maple	*Acer rubrum*	9	7	1	2	1	7			2	3	3	3	2	3	1	3		1	1	1
Red Oak	*Quercus rubra*		1	1	1				1			1				1	2		3		1
Redbud	*Cercis canadensis*																	1			

Table 2-7. Distribution of Vegetation Species Observations among Floodplain Transects, Choccolocco Creek Floodplain[1] - Fall 2001 and Spring 2002
Anniston PCB Site, Anniston, Alabama

Floodplain Transect[2]:		C- FP01		C-FP02		C-FP03		C-FP04		C-FP05		C-FP06		C-FP07		C-FP08		C-FP09		C-FP10	
Plant		Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002	Fall 2001	Spring 2002
Common Name	Scientific Name																				
River Birch	*Betula nigra*	1	1	1		5	5			3	1	1	1	2		2	1				
Sassafras	*Sassafras albidum*										1						1	1			
Scarlet Oak	*Quercus coccinea*																	1			
Shagbark Hickory	*Carya ovata*		1					1							1						1
Silver Maple	*Acer saccharinum*	1				1	4	1	1												
Striped Maple	*Acer pensylvanicum*					1															
Sugar Maple	*Acer saccharum*			1																	
Swamp White Oak	*Quercus bicolor*						1									2					
Sweetgum	*Liquidambar styraciflua*	2	3			3	2	1	2	1	3	4	4	2	2		1	3	4	3	2
Sycamore	*Platanus occidentalis*	6	7	3	4	4	4	2	2	4	4	2	2	2		1		4	4	2	1
Tulip Poplar	*Liriodendron tulipifera*					2	1		1				1	1	2	1	2	2	1		1
Walnut	*Juglans regia*																			3	
Water Oak	*Quercus nigra*	1	2		1	2	7	1	2		6	4	4	2	3	1	3		3	2	3
White Ash	*Fraxinus americana*					1												1			
White Mulberry	*Morus alba*					1															
White Oak	*Quercus alba*						2				1		1		1	1	1		3	1	2
Wild Black Cherry	*Prunus serotina*								1				1		1		1		3		
Willow	*Salix sp.*	4		1				2		1		1									
Willow Oak	*Quercus phellos*					1		1		1	2	1	4		2			1	1		
Winged Elm	*Ulmus alata*														1				1	2	1

Notes:

[1]Data are from OU-4 Data Summary Report.

[2] Floodplain transects are shown on Figures 2-1a through 2-1k.

Blank indicates none observed.

BBL: Blasland, Bouck, and Lee, Inc. (now Arcadis)

C-FPO: Choccolocco Creek Floodplain

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

Table 2-8. Floodplain Vegetation Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Stratum	Common Name	Scientific Name	Assessment Area												
			Upper			Middle			Lower			Ref 1		Ref 2	Ref 3
			FF	MF	SF	FF	MF	SF	FF	MF	SF	FF	SF	FF	FF
Fall 2006															
Tree	Allegany Chinkapin	*Castanea pumila*				X									
	Ash, green	*Fraxinus pennsylvanica*							X				X	X	
	Box Elder	*Acer negundo*	X[d]		X[d]			X	X					X	X
	Butternut	*Juglans cinerea*													X
	Cherry	*Prunus* sp.				X		X	X			X			X
	Eastern Hophornbean	*Ostrya virginiana*				X									
	Eastern Red Cedar	*Juniperus virginiana*				X		X							
	Elm	*Ulmus* sp.				X									
	Elm, American	*Ulmus americana*	X		X	X									
	Hickory	*Carya* sp.				X						X		X	X
	Hickory, shagbark	*Carya laciniosa*				X									
	Honey Locust	*Gleditsia triacanthos*							X						
	Maple, red	*Acer rubrum*				X		X				X			
	Maple, silver	*Acer saccharinum*	X		X										
	Oak, black/red	*Quercus* sp.	X		X	X									
	Oak, swamp chesnut	*Quercus prinus*							X						
	Paw Paw	*Asimina triloba*				X		X							
	Pecan	*Carya* sp.	X		X										
	Pine, long leaf	*Pinus palustris*				X		X	X			X	X		
	Pine, short-leaved	*Pinus echinata*				X									
	Southern Catalpa	*Catalpa bignonioides*										X			
	Sweetgum	*Liquidambar styrae*	X[d]		X[d]	X		X	X			X	X		
	Sycamore	*Platanus occidentalis*	X[d]		X[d]				X					X	X
	Tulip Tree	*Liriodendron tulipifera*							X				X	X	
	Walnut, black	*Juglans nigra*												X	
	Water Oak	*Quercus nigra*	X[d]		X[d]	X[d]		X	X			X			X
Shrubs/ Vines	Ash, green	*Fraxinus pennsylvanica*							X			X		X	
	Black Willow	*Salix nigra*	X[d]		X[d]				X						
	Blackberry	*Rubus* sp.	X		X							X		X	
	Boxwood	*Buxus* sp.										X			
	Buckeye	*Aesculus* sp.							X			X			
	Chinaberry	*Melia azedarach*							X						
	Chinese Privet	*Legustrum sinense*	X[d]		X[d]	X		X	X			X	X	X	X
	Common Greenbrier	*Smilax rotundifolia*	X		X	X		X	X			X			X
	Eastern Hophornbean	*Ostrya virginiana*				X			X			X		X	
	Eastern Red Cedar	*Juniperus virginiana*							X						
	Grape, wild	*Vitis vinifera*										X		X	
	Japanese Honeysuckle	*Lonicera japonica*	X		X				X			X		X	X
	Maple, red	*Acer rubrum*				X			X				X	X	
	Maple, silver Seedling	*Acer saccharinum*										X			
	Oak, white	*Quercus alba*							X						
	Paw Paw	*Asimina triloba*							X					X	
	Poison Ivy	*Rhus radicans*	X		X									X	
	Sassafras	*Sassafras albidum*							X					X	
	Silktree Seedling	*Albizia julibrissin*				X									
	Southern Catalpa	*Catalpa bignonioides*				X								X	
	Sumac	*Rhus* sp.				X									X
	Sweetgum	*Liquidambar styrae*							X						
	Sycamore Seedling	*Platanus occidentalis*										X	X		
	Tulip Tree	*Liriodendron tulipifera*										X		X	

Table 2-8. Floodplain Vegetation Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Stratum	Common Name	Scientific Name	Assessment Area												
			Upper			Middle			Lower			Ref 1		Ref 2	Ref 3
			FF	MF	SF	FF	MF	SF	FF	MF	SF	FF	SF	FF	FF
Herbaceous	Aster	*Aster* sp.				X		X					X	X	X
	Bamboo	*Banbusa* sp.				X						X			X
	Barley	*Hordeum* sp.				X									
	Bedstraw	*Galium* sp.									X				
	Blackberry	*Rubus* sp.					X						X		
	Bull Rush	*Scirpus* sp.	X		X										
	Cat Tail	*Typha latifolia*	X		X										
	Chinese Lantern Plant	*Physalis alkenkaengi*	X		X						X				
	Chinese Privet	*Legustrum sinense*				X									
	Clover Species	*Trifolium* sp.					X								
	Common Clotbur	*Xanthium chinenese*									X				
	Common Rush	*Juncus effusus*	X		X									X	
	Corn	*Zea mays*									X				
	Curly Dock	*Rumex crispus*					X				X				
	Dandelion	*Taraxacum officinale*									X				
	Flatsedge, flatleaved	*Cyperus planifolius*												X	
	Geranium	*Geranium* sp.									X				
	Goldenrod	Solidago sp.	X		X	X		X	X		X	X	X	X	X
	Grasses	*Poa* sp.	X	X[d]	X	X	X			X[d]			X		X
	Horse Nettle	*Solanum carolinensis*					X				X				
	Milo Water Pepper	*Polygonum hydropiperoides*									X				
	Morning Glory	*Ipomoea purpurea*									X				
	Mustard Seedling	NA									X				
	Poison Ivy	*Rhus radicans*				X									
	Pokeweed	*Phytolacca americana*				X	X						X		X
	Prickly Lettuce	*Lactuca scariola*									X				
	Scarlet Morning Glory	*Ipomoea* sp.									X				
	Sedge	*Carex* sp.												X	
	Sedge, Shining	*Cyperus* sp.	X		X										
	Sickle Pod	*Arabis canadensis*									X				
	Smartweed	*Polygonum* sp.	X		X		X								
	Sorrel	*Oxalis* sp.									X				
	Star of Bethlehem	*Ornithogalum* sp.					X								
	Strawberry	*Fragaria* sp.					X								
		Species Diversity per Transect:	22	1	22	30	9	12	25	1	16	21	12	23	15

Species Diversity per Habitat:		OU-4	Ref
Forested Floodplain	=	56	39
Maintained Field	=	9	NA
Successional Field	=	42	12

Notes:

[1] Data are from RI/FS Phase 1 Ecological Surveys.

[d] dominant species

X: indicates presence; blank indicates none observed
FF: forested floodplain
MF: maintained field
NA: not available
PCB: polychlorinated biphenyl
Ref: reference location
RI/FS: remedial investigation/feasibility study
SF: successional field

Table 2-9. Floodplain Dominant Vegetation Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Stratum	Common Name	Scientific Name	Assessment Area															
			Upper			Middle			Lower			Ref 1		Ref 2			Ref 3		
			FF	MF	SF	FF	MF	SF	FF	MF	SF	MF	SF	FF	MF	SF	FF	SF
Tree	Ash, green	*Fraxinus pennsylvanica*				X			X					X				
	Birch, river	*Betula nigra*				X		X						X				
	Box Elder	*Acer negundo*	X		X	X								X				
	Maple, red	*Acer rubrum*	X															
	Oak, black/red	*Quercus* sp.	X			X												
	Oak, swamp chesnut	*Quercus prinus*				X		X										
	Paw Paw	*Asimina triloba*				X												
	Pine, loblolly	*Pinus taeda*			X	X												
	Sweetgum	*Liquidambar styrae*						X	X					X				
	Sycamore	*Platanus occidentalis*						X	X					X				
	Tulip Tree	*Liriodendron tulipifera*				X		X	X					X			X	
	Water Oak	*Quercus nigra*							X					X				
	Willow, black	*Salix nigra*				X												
Shrubs/ Vines	Ash, green	*Fraxinus pennsylvanica*			X				X				X					
	Basswood	*Tilia americana*												X				
	Black Willow	*Salix nigra*	X		X													
	Blackberry	*Rubus* sp.			X			X					X					
	Box Elder	*Acer negundo*												X				
	Buttonbush	*Cephalanthus occidentalis*	X		X													
	Chinese Privet	*Legustrum sinense*	X		X	X			X					X			X	
	Common Greenbrier	*Smilax rotundifolia*				X								X				
	Eastern Hophornbean	*Ostrya virginiana*				X			X					X				
	Elderberry	*Sambucus canadensis*			X													X
	Hackberry	*Celtis occidentalis*							X									
	Hickory	*Carya* sp.							X									
	Japanese Honeysuckle	*Lonicera japonica*												X				X
	Maple, red	*Acer rubrum*			X	X			X					X				
	Maple, southern sugar	*Acer saccharum*												X				
	Mountain Laurel	*Kalmia latifolia*	X															
	Paw Paw	*Asimina triloba*							X						X			
	Poison Ivy	*Rhus radicans*				X												
	Sassafras	*Sassafras albidum*				X												
	Spicebush	*Lindera* sp.												X				
	Sumac	*Rhus* sp.									X							X
	Sweetgum	*Liquidambar styrae*											X					
	Sycamore Seedling	*Platanus occidentalis*											X					
	Trumpet Vine	*Campsis radicans*			X	X		X						X				
	Virginia Creeper	*Parthenocissus quinquefolia*						X					X					
Herbaceous	Aster	*Aster* sp.						X										
	Amaranth, thorny	*Amaranthus spinosus*					X											
	Bahia Grass	*Paspalum notatum*					X					X			X			
	Beggars tick, white	*Bidens alba*	X															
	Beggars tick, hairy	*Bidens pilosa*	X			X												
	Boneset	*Eupatorium* sp.						X										
	Brazilian Vervain	*Verbena brasiliensis*				X		X					X					X
	Christmas Fern	*Polystichum acrostichoides*				X												
	Clearweed	*Pilea pumila*	X			X			X								X	
	Clover, red	*Trifolium pratense*		X														
	Clover, white	*Trifolium repens*		X			X											
	Common Clotbur	*Xanthium chinenese*	X															
	Common Rush	*Juncus effusus*			X													
	Cotton	*Gossypium* sp.								X								
	Crabgrass	*Digitaria* sp.					X	X			X	X			X			X
	Dallisgrass	*Paspalum dilatatum*			X			X										
	False Nettle	*Boehmeria cylindrica*	X											X			X	
	Florida Pusley	*Richardia scabra*					X											
	Foxtail, yellow	*Setaria glauca*		X	X		X	X			X	X	X		X	X		X
	Goldenrod	*Solidago* sp.			X			X			X		X			X		X
	Grasses	*Panicum* sp.			X	X												
	Ground Ivy	*Glechoma hederacea*	X		X													
	Horse Nettle	*Solanum carolinensis*		X			X											
	Horseweed	*Conyza canadensis*						X										
	Ironweed	*Vernonia* sp.			X			X			X					X		
	Japanese Stilt Grass	*Microstegium vimineum*	X		X	X			X					X			X	
	Jewelweed	*Impatiens* sp.															X	

Table 2-9. Floodplain Dominant Vegetation Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Stratum	Common Name	Scientific Name	Assessment Area															
			Upper			Middle			Lower			Ref 1		Ref 2			Ref 3	
			FF	MF	SF	FF	MF	SF	FF	MF	SF	MF	SF	FF	MF	SF	FF	SF
Herbaceous	Johnson's Grass	*Sorghum halepense*			X								X		X	X		
	Jumpseed	*Persicaria virginiana*				X			X									
	Knotgrass	*Paspalum distichum*		X														
	Knotweed	*Polygonum* sp.												X				
	Lady's Thumb	*Persicaria maculosa*											X					
	Little BlueStem	*Schizachyrium scoparium*					X	X			X		X		X	X		X
	Milo Water Pepper	*Polygonum hydropiperoides*			X											X		
	Nutsedge	*Cyperus* sp.						X										
	Partridge Pea	*Chamaecrista fasciculata*						X										
	Plantain, narrow leaf	*Plantago lanceolata*		X								X						
	One-seed Burr Cucumber	*Sicyos angulatus*			X													
	Pokeberry	*Phytolacca americana*		X	X	X	X	X	X									X
	Prickly Mallow	*Sida spinosa*				X	X											
	Purpletop	*Tridens flavus*					X	X										
	Ragweed, giant	*Ambrosia trifida*			X						X							X
	Sensitive Fern	*Onoclea sensibilis*	X															
	Sneezeweed	*Helenium* sp.	X		X	X			X									
	Soybean	*Glycine max*								X								
	Stinging Nettle	*Urtica dioica*							X									
	Tearthumb	*Persicaria sagittata*			X													
	Wild Oat	*Avena fatua*				X												
	Woolgrass	*Scirpus cyperinus*			X													
		Species Diversity per Transect:	16	7	26	27	11	22	18	2	7	4	11	20	6	6	6	10

Species Diversity per Habitat:		OU-4	Ref
Forested Floodplain	=	44	22
Maintained Field	=	16	7
Successional Field	=	42	19

Notes:
[1] Data are from RI/FS Phase 2 Biological Sampling conducted at each BSA in September 2009.
X: indicates presence; blank indicates none observed
BSA: biological sampling area
FF: forested floodplain
MF: maintained field
PCB: polychlorinated biphenyl
Ref: reference location
RI/FS: remedial investigation/feasibility study
SF: successional field

Table 2-10. Terrestrial Soil Macroinvertebrate Survey Results[1]
Anniston PCB Site, Anniston, Alabama

	Maintained Field												Forested Floodplain												Successional Field											
	LAA						Ref 1			Ref 3			UAA			MAA			Ref 1			Ref 2			UAA			MAA			Ref 2			Ref 3		
Taxon	MF2-1	MF2-2	MF2-3	MF3-1	MF3-2	MF3-3	MF1-1	MF1-2	MF1-3	MF1-1	MF1-2	MF1-3	FF1	FF2	FF3	FF2-1	FF2-2	FF-3	FF1-1	FF1-2	FF1-3	FF1-1	FF1-2	FF1-3**	SF1-1	SF1-2	SF1-3	SF2-1	SF2-2	SF2-3	SF1-1*	SF1-2	SF1-3	SF1-1	SF1-2	SF1-3
Collembola**		12				28	4	20	4	16	20	20	256	76	192	12	20	4	16	1	8	20	8	23	8	252	60	88	8		24	32		20	20	
Other Small Invertebrates			4	4		8					4	4	4		12	4	8	4				8				8	16	76	8	8	4	8		8		
Spiders		4	1		1	3			1	3	5		2	6	4	1	5	3						3		1	3	2	5		5	1			4	2
Centipedes				1		1							3	3	2											1	1		1			1				
Millipedes	1	2															1																			
Isopods	1												2	2	1		1	1	1								7	2								
Earthworms						1							2	1			4						1				1									
Ants	7	19		1	6	5	4	1	4	7	28	2	11	1			22	9			6		10	17	5	2	3	14	65	6	21	3	17	11	3	6
Crickets										1	3							3								4					1					
Flies			1						3				1	1				9						29				5		1			3		
Beetles	3	7			2	4			1	5	3				1		3		1	1	2	1	2	13		1	3	2	3	1	3				1	
Beetle pupa							1																													
Beetle larva		3				1			1																											
Opilionids														2	10																					
Lepidoptera																1																				
Hemipteran			2																																	
Total Number of Organisms	12	47	8	6	9	51	9	21	14	32	63	26	281	92	222	18	64	33	18	2	16	29	21	85	13	269	94	189	90	16	58	45	17	42	28	8

Notes:
* Indicates that samples were counted three times for a quality assurance/quality control test, and the highest number was used.
** Collembola were in mineral oil pockets with the rest of the specimens and could not be sorted. All collembola were counted for a total of 23.
[1] Data are from RI/FS Phase 1 Ecological Surveys.
Blank indicates none observed.
FF: forested floodplain
LAA: lower assessment area
MAA: middle assessment area
MF: maintained field
PCB: polychlorinated biphenyl
Ref: reference location
RI/FS: remedial investigation/feasibility study
SF: successional field
UAA: upper assessment area

Table 2-11. Bird Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type:		Maintained Field									Forested Floodplain										Successional Field									
Assessment Area:		UAA			MAA		LAA	Ref 1	Ref 2	Ref 3	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA			MAA		LAA			Ref 1	Ref 2	Ref 3
Species	**Scientific Name** **Transect →**	**1**	**2**	**3**	**1**	**2**	**1 [3]**	**1 [2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1 [2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**1 [3]**	**2**	**3**	**1**	**1**	**1**
Fall 2006																																	
American Crow	*Corvus brachyrhynchos*					X											X		X	X	X		X					X			X		
American Goldfinch	*Spinus tristis*	X		X													X			X				X	X	X		X		X			
American Robin	*Turdus migratorius*										X		X											X				X	X				
Barred Owl	*Strix varia*																X																
Belted Kingfisher	*Ceryle alcyon*																X																
Black Vulture	*Coragyps atratus*																			X													
Black-Throated Green Warbler	*Dendroica virens*															X																	
Blue Jay	*Cyanocitta cristata*	X		X	X						X			X		X		X		X	X		X		X	X		X		X			
Blue-Winged Warbler	*Vermivora pinus*																X																
Brown Thrasher	*Toxostoma rufum*																	X		X					X								
Carolina Chickadee	*Poecile carolinensis*			X							X	X		X					X	X			X	X	X	X	X						
Carolina Wren	*Thryothorus ludovicianus*			X							X			X			X		X					X	X								
Cedar Waxwing	*Bombycilla cedrorum*										X	X												X	X								
Chipping Sparrow	*Spizella passerina*																			X	X												
Common Grackle	*Quiscalus quiscula*	X												X							X												
Cooper's Hawk	*Accipiter cooperii*																								X								
Dark-Eyed Junco	*Junco hyemalis*																												X				
Downy Woodpecker	*Picoides pubescens*																				X								X				
Eastern Bluebird	*Sialia sialis*	X																						X									
Eastern Phoebe	*Sayornis phoebe*															X	X	X						X				X					
Eastern Towhee	*Pipilo erythrophthalmus*		X								X									X				X				X					
European Starling	*Sturnus vulgaris*																							X									
Field Sparrow	*Spizella pusilla*																			X													
Gray Catbird	*Dumetella carolinensis*												X			X	X							X		X							
Great Blue Heron	*Ardea herodius*			X																				X									
Great Crested Flycatcher	*Myiarchus crinitus*																	X															
Hairy Woodpecker	*Picoides villosus*		X								X		X	X										X									
House Finch	*Carpodacus mexicanus*																								X								
Northern Cardinal	*Cardinalis cardinalis*																X			X					X								
Northern Flicker	*Colaptes auratus*		X		X										X						X			X			X						
Northern Mockingbird	*Mimus polyglottos*	X																						X									
Pileated Woodpecker	*Dryocopus pileatus*					X																											
Pine Warbler	*Dendroica pinus*																			X													
Red-Breasted Nuthatch	*Sitta canadensis*																	X															
Red-Headed Woodpecker	*Melanerpes erythrocephalus*																X																
Red-Shouldered Hawk	*Buteo lineatus*																															X	
Red-Tailed Hawk	*Buteo jamaicensis*																				X			X									
Red-Winged Blackbird	*Agelaius phoeniceus*	X																															
Ruby-Crowned Kinglet	*Regulus calendula*																			X													
Song Sparrow	*Melospiza melodia*	X																														X	
Tufted Titmouse	*Baeolophus bicolor*										X	X		X				X	X						X								
Turkey Vulture	*Cathartes aura*													X		X					X												
Unknown Empidonax Flycatcher	*Empidonax* sp.																X																
Unknown Parid	*N/A*											X																					
White-Throated Sparrow	*Zonotrichia albicollis*																			X												X	
Yellow Warbler	*Dendroica petechia*												X			X				X													
Yellow-Rumped Warbler	*Dendroica coronata*		X											X		X								X	X		X						

Table 2-11. Bird Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type:		Maintained Field									Forested Floodplain										Successional Field									
Assessment Area:		UAA			MAA		LAA	Ref 1	Ref 2	Ref 3	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA			MAA		LAA			Ref 1	Ref 2	Ref 3
Species	**Scientific Name** **Transect →**	**1**	**2**	**3**	**1**	**2**	**1[3]**	**1[2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1[2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**1[3]**	**2**	**3**	**1**	**1**	**1**
Winter 2007																																
American Goldfinch	*Spinus tristis*																						X									
American Robin	*Turdus migratorius*													X			X						X					X				
Blue Jay	*Cyanocitta cristata*													X									X									
Carolina Chickadee	*Poecile carolinensis*													X																		
Carolina Wren	*Thryothorus ludovicianus*													X																		
Cedar Waxwing	*Bombycilla cedrorum*		X																				X									
Common Grackle	*Quiscalus quiscula*		X											X			X															
Eastern Bluebird	*Sialia sialis*																						X									
Eastern Meadowlark	*Sturnella magna*		X																													
Eastern Phoebe	*Sayornis phoebe*					X																										
European Starling	*Sturnus vulgaris*		X																													
Killdeer	*Charadrius vociferus*		X																													
Mourning Dove	*Zenaida macroura*		X																				X									
Northern Cardinal	*Cardinalis cardinalis*																X									X						
Northern Flicker	*Colaptes auratus*													X																		
Northern Mockingbird	*Mimus polyglottos*																X						X									
Red-Bellied woodpecker	*Melanerpes carolinus*																X															
Red-Headed Woodpecker	*Melanerpes erythrocephalus*													X																		
Red-Tailed Hawk	*Buteo jamaicensis*													X																		
Tufted Titmouse	*Baeolophus bicolor*													X			X															
White-Throated Sparrow	*Zonotrichia albicollis*																X						X									
Spring 2007																																
Blue Jay	*Cyanocitta cristata*	-*			-*												X			X	X	X	X								-	
Carolina Chickadee	*Poecile carolinensis*	-			-												X														-	
Carolina Wren	*Thryothorus ludovicianus*	-			-									X						X	X		X								-	
Common Grackle	*Quiscalus quiscula*	-			-															X											-	
Eastern Kingbird	*Tyrannus tyrannus*	-	X		-																										-	
Eastern Towhee	*Pipilo erythrophthalmus*	-			-															X	X										-	
Gray Catbird	*Dumetella carolinensis*	-			-												X														-	
Indigo Bunting	*Passerina cyanea*	-			-	X											X														-	
Northern Cardinal	*Cardinalis cardinalis*	-			-	X											X			X			X								-	
Northern Mockingbird	*Mimus polyglottos*	-			-	X																									-	
Red-Bellied Woodpecker	*Melanerpes carolinus*	-			-												X														-	
Red-Eyed Vireo	*Vireo olivaceus*	-			-																	X									-	
Tufted Titmouse	*Baeolophus bicolor*	-			-												X														-	
Unknown Hummingbird	*Trochilidae (family)*	-			-												X					X									-	
Unknown Vireo	*Vireo* sp.	-			-									X																	-	
White-Eyed Vireo	*Vireo griseus*	-			-															X	X										-	
Yellow Warbler	*Dendroica petechia*	-			-												X														-	
Yellow-Rumped Warbler	*Dendroica coronata*	-			-									X																	-	
Summer 2007																																
American Crow	*Corvus brachyrhynchos*		X																										-			
American Goldfinch	*Spinus tristis*	X																		X			X						-			
American Robin	*Turdus migratorius*													X						X									-			
Barn Swallow	*Hirundo rustica*																						X						-			
Blue Jay	*Cyanocitta cristata*		X											X			X						X						-		X	
Blue-gray Gnatcatcher	*Polioptila caerulea*													X															-			
Blue-winged Teal	*Anas discors*	X																											-			
Brown-headed Cowbird	*Molothrus ater*																						X						-			

Table 2-11. Bird Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type:		Maintained Field									Forested Floodplain										Successional Field								
Assessment Area:		UAA			MAA		LAA	Ref 1	Ref 2	Ref 3	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA			MAA		LAA			Ref 1	Ref 2	Ref 3
Species	**Scientific Name** **Transect →**	**1**	**2**	**3**	**1**	**2**	**1[3]**	**1[2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1[2]**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**1[3]**	**2**	**3**	**1**	**1**	**1**
Carolina Chickadee	*Poecile carolinensis*													X			X											-					
Carolina Wren	*Thryothorus ludovicianus*					X											X											-					
Chimney Swift	*Chaetura pelagica*	X												X						X								-					
Common Grackle	*Quiscalus quiscula*																							X				-					
Common Yellowthroat	*Geothlypis trichas*	X																										-					
Downy Woodpecker	*Picoides pubescens*													X														-					
Eastern Bluebird	*Sialia sialis*					X																						-					
Eastern Phoebe	*Sayornis phoebe*													X														-					
Eastern Towhee	*Pipilo erythrophthalmus*																X											-					
European Starling	*Sturnus vulgaris*	X																										-					
Grey Catbird	*Dumetella carolinensis*																			X								-					
Indigo Bunting	*Passerina cyanea*																X			X				X				-					
Mallard	*Anas platyrhynchos*	X																										-					
Mourning Dove	*Zenaida macroura*	X				X														X		X		X				-				X	
Northern Cardinal	*Cardinalis cardinalis*							X						X			X											-					
Northern Mockingbird	*Mimus polyglottos*																					X						-					
Northern Rough-Winged Swallow	*Stelgidopteryx serripennis*																				X							-					
Red-Bellied Woodpecker	*Melanerpes carolinus*																			X								-					
Red-Breasted Nuthatch	*Sitta canadensis*													X														-					
Red-Winged Blackbird	*Agelaius phoeniceus*																							X				-					
Ruby-Throated Hummingbird	*Archilochus colubris*																			X				X				-					
Tree Swallow	*Tachycineta bicolor*																							X				-					
Turkey Vulture	*Cathartes aura*																				X							-					

Notes:
Fall avian surveys were conducted from October 24 to 27, 2006.
Winter avian surveys were conducted on February 7, 2007.
Spring avian surveys were conducted from May 29 to 30, 2007.
Summer avian surveys were conducted from August 12 to 13, 2007.
-: Indicates that a survey was performed, but no species were observed. Empty boxes indicate that no survey was performed along that particular transect.
[1] Data are from RI/FS Phase 1 Ecological Surveys.
[2] Transect line is different from previous investigations.
[3] Habitat classification was changed from successional to maintained due to a subsequent change in crop planting rotation.
X: indicates presence
LAA: lower assessment area
MAA: middle assessment area
N/A: not available
PCB: polychlorinated biphenyl
Ref: reference location
RI/FS: remedial investigation/feasibility study
UAA: upper assessment area

Table 2-12. Mammal Species Observed During Terrestrial Transect Surveys[1,2]
Anniston PCB Site, Anniston, Alabama

Habitat Type:			Maintained Field							Forested Floodplain										Successional Field									
Assessment Area:			UAA			MAA		LAA	Ref 1	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA		MAA		LAA			Ref 1	Ref 2
Species	Scientific Name	Transect	1	2	3	1	2	1[3]	1	1	2	3	1	2	3	1	2	3	1	1	1	1	2	1	2	1[3]	2	3	1	1
Fall 2006																														
Beaver	*Castor canadensis*									X																		-	
Cattle	*Bos taurus*		X	X	X																							-	
Eastern Chipmunk	*Tamias striatus*																X			X								-	
Eastern Cottontail	*Sylvilagus floridanus*																			X		X						-	
Eastern Coyote	*Canis latrans*																		X			X				X	X	-	
Gray Squirrel	*Sciurus carolinensis*																X		X									-	
Long-tailed Weasel[4]	*Mustela frenata*									X																		-	
White-tailed Deer	*Odocoileus virginianus*																		X			X				X		-	
Woodchuck	*Marmota monax*																					X						-	
Winter 2007																														
Armadillo	*Dasypus novemcinctus*															X														
Cattle	*Bos taurus*			X			X																							
Eastern Cottontail	*Sylvilagus floridanus*																					X				X				
Eastern Coyote	*Canis latrans*			X																		X				X				
Gray Squirrel	*Sciurus carolinensis*						X						X																	
Racoon	*Procyon lotor*												X																	
White-tailed Deer	*Odocoileus virginianus*			X																		X								
Woodchuck	*Marmota monax*																					X								
Spring 2007																														
Armadillo	*Dasypus novemcinctus*							-	-							X														-
Beaver	*Castor canadensis*							-	-												X									-
Cattle	*Bos taurus*		X		X			-	-																					-
Eastern Cottontail	*Sylvilagus floridanus*							-	-														X							-
Gray Squirrel	*Sciurus carolinensis*							-	-							X			X											-
Racoon	*Procyon lotor*							-	-					X																-
White-tailed Deer	*Odocoileus virginianus*							-	-							X				X										-
Summer 2007																														
Armadillo	*Dasypus novemcinctus*								-							X										-				-
Beaver	*Castor canadensis*								-												X					-				-
Bobcat	*Felis rufus*								-											X						-				-
Cattle	*Bos taurus*		X		X				-																	-				-
Eastern Cottontail	*Sylvilagus floridanus*								-														X			-				-
Gray Squirrel	*Sciurus carolinensis*								-							X			X							-				-
Racoon	*Procyon lotor*								-					X												-				-
White-tailed Deer	*Odocoileus virginianus*								-							X				X						-				-

Notes:

[1] Data are from RI/FS Phase 1 Ecological Surveys.

[2] Observations in this table were made during terrestrial wildlife surveys. Aquatic survey observations are not included.

[3] Habitat classification was changed from successional to maintained due to a subsequent change in crop planting rotation.

[4] Field notes recorded observation as a short-tailed weasel, but it was changed to long-tailed based on geographic range.

Fall wildlife surveys were conducted from October 24 to 27, 2006.

Winter wildlife surveys were conducted on February 7, 2007.

Spring wildlife surveys were conducted from May 29 to 30, 2007.

Summer wildlife surveys were conducted from August 12 to 13, 2007.

LAA: lower assessment area

MAA: middle assessment area

PCB: polychlorinated biphenyl

Ref: reference location

RI/FS: remedial investigation/feasibility study

UAA: upper assessment area

-: Indicates that a survey was performed, but no species were observed.

X: Indicates presence during fall, winter, spring, or summer terrestrial wildlife surveys.
Empty boxes indicate that no survey was performed along that particular transect.

Table 2-13. Terrestrial Small Mammal Survey Results[1]
Anniston PCB Site, Anniston, Alabama

Habitat Type:			Maintained Field										Forested Floodplain										Successional Field										
Assessment Area:			UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3	UAA			MAA			LAA			Ref 1	Ref 2	Ref 3
Species	**Scientific Name**	**Transect**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**1 [2]**	**2**	**3**	**1**	**2**	**3**	**1**	**1**	**1**
Fall 2006																																						
House Mouse	*Mus musculus*			0	1		0	0							0	0		0			0	0					1	0	0		0			0				
Hispid Cotton Rat	*Sigmodon hispidus*			1	1		0	0							0	0		0			0	0					2	3	0		1			0				
Harvest Mouse	*Reithrodontomys humulis*			1	0		1	2							0	0		0			0	0					0	0	0		0			6				
Cotton Mouse	*Peromyscus gossypinus*			0	0		0	0							1	2		1			1	1					0	1	1		0			0				
Eastern Wood Rat	*Neotoma floridana*			0	0		0	0							0	0		0			0	0					0	0	1		0			0				
Rice Rat	*Oryzomys palustris*			0	0		0	0							0	1		0			0	0					0	0	0		0			0				
Shorttail Shrew	*Blarina brevicauda*			0	0		0	1							0	0		0			0	0					0	0	0		0			0				
Total Organisms:				2	2		1	3							1	3		1			1	1					3	4	2		1			6				
Winter 2007																																						
Cotton Mouse	*Peromyscus gossypinus*						0	5							0			3									0				0							
Harvest Mouse	*Reithrodontomys humulis*						1	0							0			1									1				0							
Hispid Cotton Rat	*Sigmodon hispidus*						0	0							0			0									1				0							
House Mouse	*Mus musculus*						0	0							0			0									1				0							
Short-tailed Shrew	*Blarina brevicauda*						0	1							0			0									0				0							
White-Footed Mouse	*Preomyscus leucopus*						0	1							0			0									0				0							
Total Organisms:							0	7							0			4									3				0							
Spring 2007																																						
Cotton Mouse	*Peromyscus gossypinus*					0	0		0			0			0	0		0						0	0		3	0								0	0	
Deer Mouse	*Peromyscus maniculatus*					0	0		0			0			0	4		0						0	1		0	0								0	0	
Golden Mouse	*Peromyscus nuttalli*					0	0		0			0			0	0		1						1	0		0	0								0	0	
Harvest Mouse	*Reithrodontomys humulis*					0	2		0			0			0	0		0						0	0		0	0								0	0	
Hispid Cotton Rat	*Sigmodon hispidus*					0	0		0			1			0	0		0						0	0		1	0								1	0	
House Mouse	*Mus musculus*					0	0		0			0			0	1		0						0	0		0	0								0	3	
Norway Rat	*Rattus norvegicus*					0	0		0			3			0	0		0						0	0		0	1								0	0	
White-footed Mouse	*Preomyscus leucopus*					3	0		0			0			0	0		0						0	0		0	0								0	0	
Total Organisms:						0	2		0			4			0	5		1						1	1		4	1								1	3	

Notes:

[1] Data are from RI/FS Phase 1 Ecological Surveys.

[2] This successional field transect was reclassified as a maintained field due to a change in crop planting rotation between the winter and spring surveys.

Fall

Small mammal surveys were conducted from October 24 to November 1, 2006.

Winter

Small mammal surveys were conducted from February 6 to 7, 2007.

Spring

Small mammal surveys were conducted from May 15 to 18, 2007.

LAA: lower assessment area

MAA: middle assessment area

PCB: polychlorinated biphenyl

Ref: reference location

RI/FS: remedial investigation/feasibility study

UAA: upper assessment area

Blank indicates none observed.

Table 2-14. Reptile and Amphibian Species Observed During Terrestrial Transect Surveys[1]
Anniston PCB Site, Anniston, Alabama

Species		Assessment Area																			
Species	Scientific Name	Upper					Middle					Lower					Reference				
		Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008[2]	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008[2]	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008[2]	Fall 2006	Winter 2006	Spring 2007	Summer 2007	Spring 2008[2]
Black Racer	*Coluber constrictor*								X												
Bull Frog	*Rana catesbeiana*					X															
Carolina Anole	*Anolis carolinensis*															X			X		
Chorus Frog	*Pseudaris feriarum*								X												
Common Map Turtle	*Graptemys geographica*															X					
Cricket Frog	*Acris* sp.										X					X					
Eastern Box Turtle	*Terrapene carolina carolina*															X					
Eastern Narrowmouth Toad	*Gastrophryne carolinensis*															X					
Five-lined Skink	*Eumeces fasciatus*															X					
Gray Rat Snake	*Elaphe obsoleta spiloides*															X					
Green Frog	*Rana clamitans*					X															
Green Treefrog	*Hyla cinerea*															X					
Northern Slimy Salamander	*Plethodon glutinosus*										X					X					
Red-eared Slider	*Trachemys scripta elegans*					X															
River Cooter	*Pseudemys concinna*					X								X							
Snapping Turtle	*Chelydra serpentina*					X															
Southern Leopard Frog	*Rana utricularia*					X										X					
Spring Peeper	*Pseudacris crucifer*					X															
Unidentified Frog*	--					X															X
Unidentified Tadpole*	--					X										X					
Unidentified Turtle*	--			X					X												
Upland Chorus Frog	*Pseudacris triseriata feriarum*					X															X

Notes:

[1] Data from RI/FS Phase 1 Ecological Surveys performed by season using float trips through OU-4 and reference stream reaches. Based on observations, some species were not able to be identified to species level. Additionally, some aquatic herptile species were noted within the terrestrial survey locations.

[2] Data were collected during suplemental Phase 1 Ecological Surveys in Spring of 2008.

X: indicates presence

*: was observed, but unable to be identified to species level during survey

--: no scientific name because of unidentified species

OU-4: operable unit 4

PCB: polychlorinated biphenyl

RI/FS: remedial investigation/feasibility study

Table 2-15. OU-4 Constituents of Potential Concern List
Anniston PCB Site, Anniston, Alabama

Analyte Group	COPCs	Documents		
		Preliminary Consent Decree (USEPA 2002)	USEPA Wider List of Constituents (USEPA 2005)	OU-4 COPC (USEPA 2012)
Metals	Aluminum		X	
	Antimony		X	
	Arsenic	X	X	
	Barium	X	X	X
	Beryllium	X	X	
	Cadmium	X	X	
	Chromium	X	X	X
	Cobalt	X	X	X
	Copper		X	
	Lead	X	X	X
	Manganese	X	X	
	Mercury	X	X	X
	Nickel	X	X	
	Selenium		X	
	Silver		X	
	Titanium		X	
	Vanadium	X	X	X
	Zinc		X	
Organophophorous Pesticides	Parathion	X	X	
	Methyl parathion	X	X	
	Tetraethyldithiopyrophosphate	X	X	
Semivolatile Organic Compounds	1,2-Dichlorobenzene	X	X	
	1,4-Dichlorobenzene	X	X	
	2,4-Dichlorophenol	X	X	
	4-Nitrophenol	X	X	
	Polychlorinated biphenyls	X	X	X
	Phenol	X	X	
	Pentachlorophenol	X	X	
	2,4,5--Trichlorophenol	X	X	
	2,4,6-Trichlorophenol	X	X	
	o,o,o-Triethylphosphorothioate	X	X	
Volatile Organic Compounds	Chlorobenzene	X	X	
	Isopropyl benzene	X	X	
	Methylene chloride	X	X	
	1,1,2,2-Tetrachloroethane	X	X	
Other Organics	Polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans		X	X
	Polycyclic aromatic hydrocarbons		X	

Notes:
COPC: constituent of potential concern
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency

References:

USEPA. 2002. Partial Consent Decree. United States of America Vs. Pharmacia Corporation (p/k/a Monsanto Company) and Solutia Inc., Civil Action No. CV-02-PT-0749-E. October. Effective Date August 2, 2003.

USEPA. 2005. Document Clarification Letter from EPA dated August 19, 2005. U.S. Environmental Protection Agency, Atlanta, Georgia.

USEPA 2012. Letter from USEPA on the Constituent of Potential Concern (COPC) Evaluation White Paper, Anniston PCB Site, Anniston, Alabama dated June 26, 2012. U.S. Environmental Protection Agency, Atlanta, Georgia.

Table 2-16. Assessment and Measurement Endpoints Summary
Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
1) Survival, Growth, and Reproduction of Aquatic/Terrestrial Plant Communities	Are the levels of COPCs in soils (including floodplain soils), surface water, and sediments from OU-4 greater than toxicity benchmarks for the survival, growth, or reproduction of aquatic/terrestrial plants?	1a) Concentrations of COPCs in OU-4 soils (including floodplain soils), surface water, and sediments relative to benchmarks for survival, growth, or reproduction.
	Are the levels of COPCs in plant tissue from OU-4 greater than reference concentrations or CTCs protective of survival, growth, or reproduction of aquatic/terrestrial plants?	1b) Measured body burdens of COPCs in OU-4 plant tissue as compared to reference area(s) plant tissue and literature-derived CTCs, as available.
	Is the health of aquatic/terrestrial plant species collected in OU-4 outside the normal range for aquatic/terrestrial plant communities in the reference area(s)?	1c) Qualitative observations of plant condition and discoloration in OU-4 as compared to the reference area(s).
	Is the structure of aquatic/terrestrial plant communities in OU-4 outside the normal range for aquatic/terrestrial plant communities in the reference area(s)?	1d) Comparison of aquatic/terrestrial plant community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, for each habitat type in OU-4 to the reference area(s) or among OU-4 assessment areas.
2) Survival, Growth, and Reproduction of Benthic Invertebrate Communities	Are the levels of COPCs in sediments (including pore water) from OU-4 greater than benchmarks or toxicity thresholds for survival, growth, or reproduction of benthic invertebrates?	2a) Concentration of COPCs in OU-4 sediments (including pore water) compared to literature-derived toxicity benchmarks and site-specific toxicity thresholds.
	Are the levels of COPCs in benthic invertebrate tissue from OU-4 greater than reference concentrations or CTCs for survival, growth, or reproduction of benthic invertebrates?	2b) Measured body burdens of COPCs in OU-4 benthic invertebrate tissue as compared to reference area(s) benthic invertebrate tissue and literature-derived CTCs, as available.
	Is the survival, growth, or reproduction of laboratory-cultured benthic invertebrates exposed to sediments (including pore water and overlying water) from OU-4 significantly lower than those exposed to reference area(s) sediments?	2c) Survival, growth, and reproduction of Hyalella azteca and Chironomus dilutus.
	Is the structure of benthic macroinvertebrate communities in OU-4 outside the normal range for benthic invertebrate communities in the reference area(s)?	2d) Comparison of benthic invertebrate community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s) or among OU-4 assessment areas.
3) Survival, Growth, and Reproduction of Terrestrial Invertebrate Communities	Are the levels of COPCs in soil (including floodplain soils) from OU-4 greater than toxicity benchmarks for survival, growth, or reproduction of terrestrial invertebrates?	3a) Concentrations of COPCs in OU-4 surface soils compared to literature-derived toxicity benchmarks.
	Are the levels of COPCs in terrestrial invertebrate tissue from OU-4 greater than CTCs for survival, growth, or reproduction of terrestrial invertebrates?	3b) Measured body burdens of COPCs in OU-4 terrestrial invertebrate tissue as compared to reference area(s) terrestrial invertebrate tissue and literature-derived tissue-based CTCs, as available.
	Is the structure of terrestrial invertebrate communities in OU-4 outside the normal range for terrestrial invertebrate communities in the reference area(s)?	3c) Comparison of terrestrial invertebrate community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s).

Table 2-16. Assessment and Measurement Endpoints Summary
Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
4) Survival, Growth, and Reproduction of Fish Communities	Are the levels of COPCs in surface water and/or sediments from OU-4 greater than literature-derived toxicity benchmarks for survival, growth, or reproduction of fish?	4a) Concentration of COPCs in OU-4 surface water and sediment compared to literature-derived toxicity benchmarks.
	Are the levels of COPCs in fish tissue from OU-4 greater than CTCs for survival, growth, or reproduction of fish?	4b) Body burdens of COPCs in selected fish species from OU-4 as compared to those in the reference area(s) and CTCs, as available.
	Is the structure of fish communities in OU-4 outside the normal range for fish communities in the reference area(s)?	4c) Comparison of fish community structure metrics, including species diversity, total abundance, number of taxa, and taxa dominance, from OU-4 to the reference area(s).
	Are fish health assessment results (e.g., external parasites, fish erosion, lesions, sex ration, age structure) comparable between OU-4 and the reference area(s)?	4d) Fish health assessment using anomaly codes similar to those in the Rapid Bioassessment Protocol (Barbour et al. 1999). Observations may include disease, deformities, external parasites, fin erosion, lesions, tumors, sex ratio, and age structure.
5) Survival, Growth, and Reproduction of Birds	Do daily doses of COPCs received by aquatic-dependent and terrestrial birds (including piscivorous birds, sediment-probing birds, invertivorous birds, carnivorous birds, and omnivorous birds) from consumption of/exposure to food and other media from OU-4 exceed toxicity reference values (TRVs) for survival, growth, or reproduction?	5a) Compare an estimated dietary daily dose of COPCs in prey based in OU-4 to relevant literature-based dietary TRVs. Daily dose estimated using modeled and measured prey tissue concentrations.
	What is avian community structure and habitat use in OU-4 and the reference area(s)?	5b) Comparison of avian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to reference area(s) or among OU-4 assessment areas.
	Do the predicted concentrations of COPCs in bird eggs exceed CTCs for bird eggs?	5c) Comparisons of predicted OU-4 egg COPC concentrations to literature-derived egg-based CTCs, as available.
6) Survival, Growth, and Reproduction of Mammals	Do daily doses of COPCs received by aquatic-dependent and terrestrial mammals (including carnivorous mammals, piscivorous mammals, invertivorous mammals [including shrews and bats], omnivorous mammals, and herbivorous mammals) from consumption of/exposure to food and other media from OU-4 exceed TRVs for survival, growth, or reproduction?	6a) Compare an estimated dietary daily dose of COPCs in prey based in OU-4 to relevant literature-based dietary TRVs. Daily dose estimated using modeled and measured prey tissue concentrations.
	Are levels of COPCs in tissues of small mammals from OU-4 greater than tissue-based TRVs protective of survival, growth, or reproduction or reference area(s) tissue concentrations?	6b) Measured body burdens of COPCs in selected mammal species in OU-4 as compared to those in mammals from the reference area(s) and CTCs, as available.
	What is the mammalian community structure and habitat use in OU-4 and the reference area(s)?	6c) Comparison of mammalian species community structure, including total abundance and number of taxa, and habitat use in OU-4 to the reference area(s) or among OU-4 assessment areas.
	What is the habitat suitability of OU-4 and the reference area(s) for mink and river otter?	6d) Evaluate habitat suitability for the mink and river otter using habitat suitability index models or other methods as available.

Table 2-16. Assessment and Measurement Endpoints Summary
Anniston PCB Site, Anniston, Alabama

Assessment Endpoint	Risk Questions	Measurement Endpoints
7) Survival, Growth, and Reproduction of Amphibians or Reptiles	Are the levels of COPCs in surface water, sediment, and/or soil (including floodplain soil) from OU-4 greater than toxicity thresholds for survival, growth, or reproduction of amphibians and reptiles?	7a) Concentration of COPCs in surface water, sediment, and/or soil in OU-4 compared to literature-derived toxicity benchmarks, as available.
	Are the levels of COPCs in amphibian or reptile tissue from OU-4 greater than CTCs for survival, growth, or reproduction or reference area(s) tissue concentrations?	7b) Measured body burden of COPCs in selected herptile receptor tissue in OU-4 as compared to those in the reference area(s) and to tissue-based CTCs, as available.

Notes:

COPCs: constituents of potential concern

CTC: critical tissue concentration

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

TRV: toxicity reference value

USEPA: United States Environmental Protection Agency

References:

Barbour, MT, J Gerritsen, BD Snyder, and JB Stribling. 1999. Rapid bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C..

Table 3-1. Sample Counts for Total Polychlorinated Biphenyls in Abiotic and Biotic Media
Anniston PCB Site, Anniston, Alabama

Assessment Area	Reach	Abiotic Media				Terrestrial Tissue				Aquatic Tissue									
		Soil	Riparian Soil	Sediment[a]	Surface Water[b]	Terrestrial Plants	Grasshopper/Cricket	Worm	Small Mammals	Aquatic Plants	Emergent Insects	Odonata	Crayfish	Mollusc	Snake	Frog	Forage Fish	Bottom Fish	Predator Fish
C1 Total	C1	100	0	16	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	95	17	39	6	6	0	3	6	3	3	3	3	3	1	2	9	3	3
	C3	152	22	14	6	8	3	3	6	3	3	3	3	3	1	2	9	3	3
	C4	292	52	25	3	4	3	3	4	3	3	3	1	3	0	3	9	3	3
Upper Total		**539**	**91**	**78**	**15**	**18**	**6**	**9**	**16**	**9**	**9**	**9**	**7**	**9**	**2**	**7**	**27**	**9**	**9**
Middle	C5	228	57	48	12	18	6	9	11	9	9	9	7	9	2	7	27	9	9
	C6	47	29	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**275**	**86**	**52**	**12**	**18**	**6**	**9**	**11**	**9**	**9**	**9**	**7**	**9**	**2**	**7**	**27**	**9**	**9**
Lower	C7	194	37	36	13	18	6	9	17	9	9	9	9	9	7	2	27	9	9
	C8	44	19	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	41	14	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	9	9	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**288**	**79**	**122**	**13**	**18**	**6**	**9**	**17**	**9**	**9**	**9**	**9**	**9**	**7**	**2**	**27**	**9**	**9**
OU-4 Total		**1202**	**256**	**268**	**43**	**54**	**18**	**27**	**44**	**27**	**27**	**27**	**23**	**27**	**11**	**16**	**81**	**27**	**27**
Reference		14	0	21	12	14	6	9	10	9	9	9	3	9	6	4	27	9	9

Notes:

[a] The sample count for sediment presented in this table includes two composite sediment samples, one in Reach C5 (HHFL-05), and one in Reach C7 (HHFL-07) which were not included as part of the sediment exposure point concentration or the individual sediment sample comparisons.

[b] PCB homologs were preferentially used when homolog and aroclor results were both available for a sample.

Counts represent total samples after field duplicates were processed.

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

Table 3-2. Sample Counts for Mercury in Abiotic and Biotic Media
Anniston PCB Site, Anniston, Alabama

Assessment Area	Reach	Abiotic Media				Terrestrial Tissue				Aquatic Tissue									
		Soil	Riparian Soil	Sediment	Surface Water	Terrestrial Plants	Grasshopper/Cricket	Worm	Small Mammals	Aquatic Plants	Emergent Insects	Odonata	Crayfish	Mollusc	Snake	Frog	Forage Fish	Bottom Fish	Predator Fish
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	72	16	7	6	6	1	3	6	3	3	3	3	3	1	2	9	3	3
	C3	140	13	10	6	8	3	3	6	3	3	3	3	3	1	2	9	3	3
	C4	234	36	7	3	4	3	3	4	3	3	3	1	3	0	3	9	3	3
Upper Total		**446**	**65**	**24**	**15**	**18**	**7**	**9**	**16**	**9**	**9**	**9**	**7**	**9**	**2**	**7**	**27**	**9**	**9**
Middle	C5	212	44	25	12	18	6	9	11	9	9	9	7	9	2	7	27	9	9
	C6	47	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**259**	**73**	**25**	**12**	**18**	**6**	**9**	**11**	**9**	**9**	**9**	**7**	**9**	**2**	**7**	**27**	**9**	**9**
Lower	C7	92	13	21	13	18	7	9	17	9	9	9	9	9	7	2	27	9	9
	C8	8	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	40	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**140**	**30**	**40**	**13**	**18**	**7**	**9**	**17**	**9**	**9**	**9**	**9**	**9**	**7**	**2**	**27**	**9**	**9**
OU-4 Total		**845**	**168**	**91**	**44**	**54**	**20**	**27**	**44**	**27**	**27**	**27**	**23**	**27**	**11**	**16**	**81**	**27**	**27**
Reference		14	0	21	12	14	6	9	10	9	9	9	3	9	6	4	27	9	9

Notes:

Counts represent total samples after field duplicates were processed.

Blank cells indicate no data was collected from the exposure area for the applicable medium.

OU-4: Operable Unit-4

PCB: polychlorinated biphenyl

Table 3-3. Sample Counts for Non-Mercury Metals in Abiotic and Biotic Media
Anniston PCB Site, Anniston, Alabama

Assessment Area	Reach	Abiotic Media				Terrestrial Tissue				Aquatic Tissue									
		Soil	Riparian Soil	Sediment[a]	Surface Water	Terrestrial Plants	Grasshopper/Cricket	Worm	Small Mammals	Aquatic Plants	Emergent Insects	Odonata	Crayfish	Mollusc	Snake	Frog	Forage Fish	Bottom Fish	Predator Fish
Barium																			
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	7	3	4	4	0	0	1	1	0	0	0	0	1	0	2	3	0	0
	C3	13	1	2	0	2	0	0	1	1	1	1	1	0	0	0	0	1	0
	C4	20	4	2	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Upper Total		**40**	**8**	**8**	**4**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**0**	**2**	**4**	**1**	**0**
Middle	C5	18	2	4	2	1	0	2	1	1	1	1	0	1	0	0	0	1	1
	C6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**22**	**3**	**4**	**2**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Lower	C7	17	5	3	1	3	1	1	1	1	1	1	1	1	1	0	2	2	3
	C8	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**26**	**10**	**14**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**2**	**2**	**3**
Barium Total		**88**	**21**	**28**	**11**	**6**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**6**	**4**	**4**
Reference		0	0	5	1	1	0	1	1	1	1	1	0	1	1	0	0	2	2
Chromium																			
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	7	3	4	4	0	0	1	1	0	0	0	0	1	0	2	3	0	0
	C3	13	1	2	0	2	0	0	1	1	1	1	1	0	0	0	0	1	0
	C4	20	4	2	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Upper Total		**40**	**8**	**8**	**4**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**0**	**2**	**4**	**1**	**0**
Middle	C5	18	2	4	2	1	0	2	1	1	1	1	0	1	0	0	0	1	1
	C6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**22**	**3**	**4**	**2**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Lower	C7	17	5	3	1	3	1	1	1	1	1	1	1	1	1	0	2	2	3
	C8	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**26**	**10**	**14**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**2**	**2**	**3**
Chromium Total		**88**	**21**	**28**	**11**	**6**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**6**	**4**	**4**
Reference		1	0	5	1	1	0	1	1	1	1	1	0	1	1	0	0	2	2

Table 3-3. Sample Counts for Non-Mercury Metals in Abiotic and Biotic Media
Anniston PCB Site, Anniston, Alabama

Assessment Area	Reach	Abiotic Media				Terrestrial Tissue				Aquatic Tissue									
		Soil	Riparian Soil	Sediment[a]	Surface Water	Terrestrial Plants	Grasshopper/Cricket	Worm	Small Mammals	Aquatic Plants	Emergent Insects	Odonata	Crayfish	Mollusc	Snake	Frog	Forage Fish	Bottom Fish	Predator Fish
Cobalt																			
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	7	3	4	4	0	0	1	1	0	0	0	0	1	0	2	3	0	0
	C3	13	1	2	0	2	0	0	1	1	1	1	1	0	0	0	0	1	0
	C4	20	4	2	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Upper Total		**40**	**8**	**8**	**4**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**0**	**2**	**4**	**1**	**0**
Middle	C5	18	2	4	2	1	0	2	1	1	1	1	0	1	0	0	0	1	1
	C6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**22**	**3**	**4**	**2**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Lower	C7	17	5	3	1	3	1	1	1	1	1	1	1	1	1	0	2	2	3
	C8	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**26**	**10**	**14**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**2**	**2**	**3**
Cobalt Total		**88**	**21**	**28**	**11**	**6**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**6**	**4**	**4**
Reference		0	0	5	1	1	0	1	1	1	1	1	0	1	1	0	0	2	2
Lead																			
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	7	3	4	4	0	0	1	1	0	0	0	0	1	0	2	3	0	0
	C3	13	1	2	0	2	0	0	1	1	1	1	1	0	0	0	0	1	0
	C4	20	4	2	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Upper Total		**40**	**8**	**8**	**4**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**0**	**2**	**4**	**1**	**0**
Middle	C5	18	2	4	2	1	0	2	1	1	1	1	0	1	0	0	0	1	1
	C6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**22**	**3**	**4**	**2**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Lower	C7	17	5	3	1	3	1	1	1	1	1	1	1	1	1	0	2	2	3
	C8	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**26**	**10**	**14**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**2**	**2**	**3**
Lead Total		**88**	**21**	**28**	**11**	**6**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**6**	**4**	**4**
Reference		1	0	5	1	1	0	1	1	1	1	1	0	1	1	0	0	2	2

Table 3-3. Sample Counts for Non-Mercury Metals in Abiotic and Biotic Media
Anniston PCB Site, Anniston, Alabama

Assessment Area	Reach	Abiotic Media				Terrestrial Tissue				Aquatic Tissue									
		Soil	Riparian Soil	Sediment[a]	Surface Water	Terrestrial Plants	Grasshopper/Cricket	Worm	Small Mammals	Aquatic Plants	Emergent Insects	Odonata	Crayfish	Mollusc	Snake	Frog	Forage Fish	Bottom Fish	Predator Fish
Vanadium																			
C1 Total	C1	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper	C2	7	3	4	4	0	0	1	1	0	0	0	0	1	0	2	3	0	0
	C3	13	1	2	0	2	0	0	1	1	1	1	1	0	0	0	0	1	0
	C4	20	4	2	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Upper Total		**40**	**8**	**8**	**4**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**0**	**2**	**4**	**1**	**0**
Middle	C5	18	2	4	2	1	0	2	1	1	1	1	0	1	0	0	0	1	1
	C6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Total		**22**	**3**	**4**	**2**	**1**	**0**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**
Lower	C7	17	5	3	1	3	1	1	1	1	1	1	1	1	1	0	2	2	3
	C8	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C9	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower Total		**26**	**10**	**14**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**2**	**2**	**3**
Vanadium Total		**88**	**21**	**28**	**11**	**6**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**6**	**4**	**4**
Reference		1	0	5	1	1	0	1	1	1	1	1	0	1	1	0	0	2	2

Notes:

[a] Sediment was not collected in reaches C6 and C8 for metals. The reach directly upstream of reach C6 and reach C8 was used to estimate exposure to ecological receptors.

Counts represent total samples after field duplicates were processed.

Blank cells indicate no data was collected from the exposure area for the applicable medium.

PCB: polychlorinated biphenyl

Table 3-4. Fish Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Total PCBs (mg/kg wet weight)[1]		
	Forage Fish	Bottom Fish	Predator Fish
OU-4			
EUA-01	4.9	10	17
	1.7	13	18
	2.4	13	5.6
	4.6	-	-
	4.4	-	-
	4.5	-	-
	5.8	-	-
	3.4	-	-
	5.0	-	-
EUA-02	5.3	16	26
	7.6	12	18
	2.7	16	24
	4.6	-	-
	4.5	-	-
	6.0	-	-
	4.6	-	-
	4.6	-	-
	3.7	-	-
EUA-03	8.0	19	31
	4.0	19	41
	2.1	19	24
	10	-	-
	5.4	-	-
	7.9	-	-
	8.6	-	-
	4.2	-	-
	7.3	-	-
EMA-01	6.7	17	17
	5.7	6.3	14
	5.4	5.8	11
	8.3	-	-
	9.0	-	-
	8.3	-	-
	14	-	-
	14	-	-
	12	-	-

Table 3-4. Fish Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Total PCBs (mg/kg wet weight)[1]		
	Forage Fish	Bottom Fish	Predator Fish
OU-4, Continued			
EMA-02	7.3	10	32
	7.4	13	15
	5.5	10	13
	9.7	-	-
	9.8	-	-
	9.9	-	-
	13	-	-
	15	-	-
	7.3	-	-
EMA-03	5.5	13	21
	6.2	7.7	29
	4.9	9.0	32
	13	-	-
	10	-	-
	9.8	-	-
	8.0	-	-
	5.1	-	-
	8.1	-	-
ELA-01	5.8	18	22
	8.5	18	26
	9.9	11	35
	8.6	-	-
	8.4	-	-
	8.9	-	-
	6.9	-	-
	5.7	-	-
	8.0	-	-
ELA-02	5.8	13	13
	5.9	7.3	19
	5.1	9.3	16
	7.1	-	-
	13	-	-
	9.2	-	-
	7.9	-	-
	7.5	-	-
	4.2	-	-

Table 3-4. Fish Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Total PCBs (mg/kg wet weight)[1]		
	Forage Fish	Bottom Fish	Predator Fish
OU-4, Continued			
ELA-03	6.4	21	24
	5.7	15	31
	4.2	17	14
	12	-	-
	12	-	-
	8.2	-	-
	8.3	-	-
	9.7	-	-
	11	-	-
Reference			
ERA-01	2.8	0.18	4.9
	0.94	0.18	1.6
	0.40	0.16	3.3
	0.20	-	-
	0.22	-	-
	0.42	-	-
	1.0	-	-
	0.29	-	-
	4.6	-	-
ERA-02	0.058	**0.010**	0.28
	0.073	**0.010**	0.36
	0.010	**0.010**	0.044
	0.010	-	-
	0.021	-	-
	0.011	-	-
	0.10	-	-
	0.010	-	-
	0.010	-	-
ERA-03	0.023	**0.010**	0.31
	0.27	0.15	0.32
	0.22	0.10	0.12
	0.028	-	-
	0.062	-	-
	0.12	-	-
	0.064	-	-
	0.41	-	-
	0.19	-	-

Notes:

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

[1] Total PCBs calculated as the sum of detected Aroclors.

Bold values are one half the highest reporting limit for an individual Aroclor for samples in which all Aroclors were nondetect.

-: not sampled; collected three samples for bottom and predator fish and nine samples for forage fish

ELA: Ecological Lower Aquatic

EMA: Ecological Middle Aquatic

ERA: Ecological Reference Aquatic

EUA: Ecological Upper Aquatic

mg/kg: milligrams per kilogram

OU-4: Operable Unit 4

PCBs: polychlorinated biphenyls

Table 3-5. Fish Tissue Summary for Mercury
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Mercury (mg/kg wet weight)		
	Forage Fish	Bottom Fish	Predator Fish
OU-4			
EUA-01	0.040	0.080	0.27
	0.017	0.15	0.27
	0.015	0.084	0.22
	0.052	-	
	0.040	-	-
	0.041	-	-
	0.057	-	-
	0.022	-	-
	0.029	-	-
EUA-02	0.055	0.24	0.31
	0.046	0.094	0.59
	0.049	0.11	0.25
	0.049	-	
	0.038	-	-
	0.033	-	-
	0.054	-	-
	0.025	-	-
	0.048	-	-
EUA-03	0.062	0.14	0.53
	0.022	0.19	0.33
	0.021	0.12	0.36
	0.066	-	
	0.043	-	-
	0.033	-	-
	0.064	-	-
	0.030	-	-
	0.011	-	-
EMA-01	0.089	0.14	0.29
	0.091	0.055	0.39
	0.059	0.066	0.36
	0.089	-	
	0.096	-	-
	0.097	-	-
	0.16	-	-
	0.15	-	-
	0.15	-	-

Table 3-5. Fish Tissue Summary for Mercury
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Mercury (mg/kg wet weight)		
	Forage Fish	Bottom Fish	Predator Fish
OU-4, Continued			
EMA-02	0.11	0.050	0.45
	0.089	0.15	0.53
	0.089	0.11	0.37
	0.17	-	
	0.14	-	-
	0.17	-	-
	0.22	-	-
	0.18	-	-
	0.15	-	-
EMA-03	0.072	0.13	0.51
	0.11	0.12	0.25
	0.070	0.10	0.41
	0.14	-	
	0.15	-	-
	0.13	-	-
	0.18	-	-
	0.14	-	-
	0.15	-	-
ELA-01	0.10	0.093	0.59
	0.11	0.28	0.41
	0.16	0.16	0.60
	0.20	-	
	0.16	-	-
	0.21	-	-
	0.11	-	-
	0.090	-	-
	0.12	-	-
ELA-02	0.066	0.12	0.50
	0.052	0.10	0.40
	0.075	0.17	0.51
	0.14	-	
	0.18	-	-
	0.15	-	-
	0.12	-	-
	0.12	-	-
	0.11	-	-

Table 3-5. Fish Tissue Summary for Mercury
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Mercury (mg/kg wet weight)		
	Forage Fish	Bottom Fish	Predator Fish
OU-4, Continued			
ELA-03	0.13	0.35	0.59
	0.10	0.19	0.50
	0.12	0.18	0.83
	0.20	-	
	0.24	-	-
	0.18	-	-
	0.20	-	-
	0.28	-	-
	0.24	-	-
Reference			
ERA-01	0.10	0.10	0.18
	0.12	0.10	0.17
	0.088	0.15	0.28
	0.076	-	
	0.11	-	-
	0.10	-	-
	0.090	-	-
	0.082	-	-
	0.094	-	-
ERA-02	0.077	0.18	0.41
	0.059	0.13	0.63
	0.070	0.13	0.27
	0.062	-	
	0.088	-	-
	0.077	-	-
	0.073	-	-
	0.046	-	-
	0.075	-	-
ERA-03	0.031	0.059	0.31
	0.024	0.078	0.30
	0.030	0.075	0.20
	0.053	-	
	0.031	-	-
	0.021	-	-
	0.064	-	-
	0.035	-	-
	0.022	-	-

Notes:
Bold text indicates value is shown at half the reporting limit.

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

[1] All fish tissue mercury measured as total mercury.

ELA: Ecological Lower Aquatic
EMA: Ecological Middle Aquatic
ERA: Ecological Reference Aquatic
EUA: Ecological Upper Aquatic
mg/kg: milligrams per kilogram
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl

Table 3-6. Fish Tissue Summary for Metals
Anniston PCB Site, Anniston, Alabama

Sample ID	Metals Results (mg/kg wet weight)				
	Barium	Chromium	Cobalt	Lead	Vanadium
Forage Fish					
EUA-01-FF5	2.4	1.3	**5.0**	**1.0**	**2.0**
EUA-01-FF6	2.1	0.93	**5.0**	**1.0**	**2.0**
EUA-01-FF7	3.0	0.32	**0.35**	0.047	**0.15**
EUA-03-FF7	8.6	2.9	**5.0**	0.54	0.31
ELA-01-FF8	**50**	1.4	**5.0**	0.046	**2.0**
ELA-01-FF9	**50**	1.7	**5.0**	0.041	**2.0**
OU-4 Average	19	1.4	**4.2**	0.45	1.4
Bottom Fish					
EUA-02-BF1	3.2	0.21	**0.40**	0.12	**0.15**
EMA-02-BF2	0.76	0.10	**0.0055**	0.10	**0.006**
ELA-01-BF1	**4.3**	**0.15**	**0.45**	**0.085**	**0.15**
ELA-02-BF1	3.2	0.24	0.10	0.072	0.086
OU-4 Average	2.9	0.17	0.24	0.094	0.10
ERA-01-BF2	4.1	0.29	0.10	0.045	0.10
ERA-03-BF2	9.1	3.9	0.23	0.038	0.084
Predator Fish					
EMA-02-PR1	1.0	0.15	**0.01**	0.028	**0.006**
ELA-01-PR2	**4.3**	0.53	**0.45**	**0.085**	**0.15**
ELA-02-PR3	2.0	0.39	0.065	0.068	0.047
ELA-03-PR1	3.7	**2.0**	0.11	**1.0**	**2.0**
OU-4 Average	2.7	0.77	0.16	0.30	0.55
ERA-01-PR1	1.5	0.17	0.036	**1.0**	0.031
ERA-02-PR1	2.5	0.17	0.063	0.037	0.038

Notes:

Bold text indicates value is shown at half the reporting limit.

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

ELA: Ecological Lower Aquatic

EMA: Ecological Middle Aquatic

ERA: Ecological Reference Aquatic

EUA: Ecological Upper Aquatic

ID: identification

mg/kg: milligrams per kilogram

OU-4: Operable Unit-4

PCB: polychlorinated biphenyl

Table 3-7. Terrestrial Biota Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	PCB Results (mg/kg wet weight)[1]			
	Terrestrial Plants	Worm	Terrestrial Insects	Small Mammals
OU-4				
EUT-01-FF	**0.027**	**0.013**	ns	**0.0085**
	0.0085	**0.026**	ns	0.15
	ns	**0.013**	ns	ns
EUT-02-FF	**0.013**	ns	ns	0.10
	0.013	ns	ns	0.12
EUT-03-SF	**0.026**	ns	ns	0.16
	0.013	ns	ns	**0.0085**
	ns	ns	ns	ns
EUT-04-MF	**0.0085**	ns	ns	0.95
	0.0085	ns	ns	0.39
EUT-05-MF	**0.0085**	ns	ns	ns
	0.0085	ns	ns	ns
EUT-06-MF	**0.0085**	3.5	**0.024**	0.48
	0.0085	4.8	**0.014**	0.32
	ns	6.0	**0.026**	ns
EUT-07-SF	**0.026**	ns	ns	0.15
	0.0085	ns	ns	0.14
EUT-08-SF	**0.026**	16	**0.026**	2.6
	0.0085	11	**0.025**	1.8
	ns	23	**0.026**	ns
EUT-09-FF	**0.0085**	ns	ns	4.3
	0.033	ns	ns	2.8
EUT Average	**0.014**	**7.1**	**0.023**	**0.90**
EMT-01-SF	**0.013**	**0.025**	**0.024**	0.042
	0.013	**0.013**	**0.026**	**0.0085**
	ns	**0.014**	**0.026**	ns
EMT-02-MF	**0.013**	ns	ns	ns
	0.013	ns	ns	ns
	ns	ns	ns	ns
EMT-03-MF	**0.013**	ns	ns	**0.012**
	0.0085	ns	ns	ns
EMT-04-MF	**0.013**	0.33	**0.026**	ns
	0.0085	0.30	**0.027**	ns
	ns	0.21	**0.027**	ns
EMT-05-FF	**0.0085**	ns	ns	1.4
	0.013	ns	ns	0.92
EMT-06-SF	**0.0085**	ns	ns	0.10
	0.0085	ns	ns	0.043
EMT-07-FF	0.049	ns	ns	**0.013**
	0.078	ns	ns	6.5
EMT-08-FF	**0.013**	2.5	ns	0.39
	0.024	**0.026**	ns	0.60
	ns	1.3	ns	ns
EMT-09-SF	**0.0085**	ns	ns	ns
	0.0085	ns	ns	ns
EMT Average	**0.017**	**0.52**	**0.026**	**0.92**

Table 3-7. Terrestrial Biota Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	PCB Results (mg/kg wet weight)[1]			
	Terrestrial Plants	Worm	Terrestrial Insects	Small Mammals
ELT-01-SF	**0.0085**	ns	ns	**0.024**
	0.025	ns	ns	**0.023**
	ns	ns	ns	ns
ELT-02-SF	**0.025**	**0.013**	**0.026**	**0.023**
	0.0085	**0.025**	**0.013**	**0.0085**
	ns	**0.024**	**0.013**	ns
ELT-03-MF	**0.0080**	ns	ns	**0.028**
	0.0085	ns	ns	**0.013**
ELT-04-SF	**0.013**	ns	ns	**0.012**
	0.012	ns	ns	ns
ELT-05-FF	**0.0085**	ns	ns	2.0
	0.014	ns	ns	1.3
ELT-06-FF	**0.0085**	1.3	ns	2.2
	0.024	2.3	ns	12
	ns	1.6	ns	ns
ELT-07-FF	**0.0085**	ns	ns	1.8
	0.0090	ns	ns	**0.0080**
ELT-08-MF	**0.013**	**0.026**	**0.027**	0.19
	0.0085	1.1	**0.025**	0.063
	ns	2.0	**0.025**	ns
ELT-09-MF	**0.0085**	ns	ns	0.25
	0.0085	ns	ns	**0.0085**
ELT Average	**0.012**	**0.94**	**0.021**	**1.2**
Reference				
ERT-01-SF	**0.013**	**0.024**	**0.026**	**0.025**
	0.0080	**0.024**	**0.027**	4.6
	na	**0.025**	**0.025**	ns
ERT-01-MF	**0.013**	na	na	**0.023**
	0.013	na	na	ns
ERT-02-MF	**0.0085**	**0.023**	**0.025**	**0.025**
	0.0085	**0.024**	**0.025**	**0.0080**
	na	**0.025**	**0.027**	ns
	na	na	ns	ns
ERT-02-SF	**0.0085**	na	ns	**0.0080**
	0.0085	na	ns	**0.0080**
ERT-02-FF	**0.012**	na	ns	**0.0080**
	0.0085	na	ns	**0.0085**
ERT-03-FF	**0.014**	**0.024**	ns	**0.013**
	0.0085	**0.026**	ns	na
	na	**0.025**	ns	na
ERT-03-SF	**0.013**	na	ns	na
	0.0085	na	ns	na
ERT Average	**0.010**	**0.024**	**0.026**	**0.47**

Table 3-7. Terrestrial Biota Tissue Summary for PCBs
Anniston PCB Site, Anniston, Alabama

Notes:

Tissue concentrations reported in wet weight; see Appendix B for converted dry weight concentrations.

[1]Total PCBs calculated as the sum of detected homologs.

Bold values are one half the highest reporting limit for an individual homolog for samples in which all homologs were nondetect.

EUT: Ecological Upper Terrestrial
EMT: Ecological Middle Terrestrial
ELT: Ecological Lower Terrestrial
ERT: Ecological Reference Terrestrial
mg/kg: milligrams per kilogram
na: not analyzed
ns: no sample acquired in specified area
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl

Table 3-8. Aquatic Biota (non-fish) Tissue Summary for PCBs[1] (mg/kg wet weight)
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Sampling Location	Aquatic Plants	Emergent Insects	Benthic Invertebrates	Crayfish	Mollusks	Frog	Snake
OU-4								
EUA-01	EUA-01-19	0.13	0.83	0.65	0.45	0.80	3.5	7.7
	EUA-01-20	0.070	0.11	0.19	0.84	0.54	4.0	ns
	EUA-01-21	0.15	0.10	0.18	0.43	0.49	ns	ns
EUA-02	EUA-02-43	0.16	7.4	0.21	1.0	1.1	1.9	38
	EUA-02-44	0.15	6.9	0.26	1.0	1.4	0.57	ns
	EUA-02-45	0.18	5.8	0.23	0.49	1.0	ns	ns
EUA-03	EUA-03-25	0.15	7.8	0.22	0.35	1.4	4.2	ns
	EUA-03-26	0.20	7.7	0.43	ns	1.2	7.5	ns
	EUA-03-27	0.20	6.3	0.32	ns	1.0	1.1	ns
EUA Average		0.15	4.8	0.30	0.65	0.99	3.3	23
EMA-01	EMA-01-01	**0.0090**	0.10	0.37	0.70	0.50	0.58	32
	EMA-01-02	0.15	0.18	0.30	0.70	0.40	1.2	ns
	EMA-01-03	0.090	0.22	0.22	ns	0.60	ns	ns
EMA-02	EMA-02-07	0.21	0.20	0.44	0.49	0.60	0.65	5.0
	EMA-02-08	0.17	0.24	0.33	ns	0.50	0.58	ns
	EMA-02-09	**0.0090**	0.23	0.39	0.22	0.60	ns	ns
EMA-03	EMA-03-31	**0.0090**	0.26	0.27	0.66	1.0	1.1	ns
	EMA-03-32	0.070	0.28	0.30	0.53	0.90	0.74	ns
	EMA-03-33	0.060	0.36	0.21	0.45	1.2	0.53	ns
EMA Average		0.086	0.23	0.31	0.54	0.70	0.77	19
ELA-01	ELA-01-55	0.10	0.20	0.22	0.35	0.60	ns	10
	ELA-01-56	0.070	0.30	0.14	0.23	0.60	ns	8.9
	ELA-01-57	0.090	0.30	0.17	0.31	0.48	ns	8.9
ELA-02	ELA-02-61	0.060	0.28	0.14	0.06	1.0	1.3	6.9
	ELA-02-62	**0.0090**	0.29	0.15	0.14	0.68	1.0	ns
	ELA-02-63	**0.0090**	0.43	0.19	0.31	1.0	ns	ns
ELA-03	ELA-03-67	0.060	0.20	0.13	0.20	0.90	ns	6.7
	ELA-03-68	0.050	0.18	0.15	0.21	0.80	ns	13
	ELA-03-69	**0.0090**	0.35	0.12	0.27	0.90	ns	14
ELA Average		**0.051**	**0.28**	**0.16**	**0.23**	**0.77**	**1.2**	**9.8**
Reference								
ERA-01	ERA-01-49	**0.0090**	**0.050**	**0.030**	ns	**0.030**	ns	0.35
	ERA-01-50	**0.0090**	**0.050**	**0.030**	ns	**0.030**	ns	0.30
	ERA-01-51	**0.0090**	**0.050**	**0.020**	ns	**0.010**	ns	0.050
ERA-02	ERA-02-13	1.0	**0.030**	**0.010**	**0.020**	**0.010**	**0.010**	0.020
	ERA-02-14	**0.0090**	**0.020**	**0.030**	**0.020**	**0.010**	**0.030**	ns
	ERA-02-15	**0.0090**	**0.020**	**0.030**	**0.020**	**0.010**	ns	ns
ERA-03	ERA-03-37	**0.0090**	**0.070**	**0.030**	ns	**0.010**	**0.010**	**0.010**
	ERA-03-38	**0.0090**	**0.050**	**0.030**	ns	**0.010**	0.020	1.3
	ERA-03-39	**0.0090**	**0.050**	**0.030**	ns	**0.010**	ns	ns
ERA Average		**0.12**	**0.043**	**0.027**	**0.020**	**0.014**	**0.018**	**0.34**

Table 3-8. Aquatic Biota (non-fish) Tissue Summary for PCBs[1] (mg/kg wet weight)
Anniston PCB Site, Anniston, Alabama

Notes:

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

[1]Total PCBs calculated as the sum of detected Aroclors (crayfish and mollusk) or homologs (plants, insects, invertebrates, frogs and snakes).

Bold values are one half the highest reporting limit for an individual Aroclor or homolog for samples in which all Aroclors or homologs were nondetect.

ELA: Ecological Lower Aquatic

EMA: Ecological Middle Aquatic

ERA: Ecological Reference Aquatic

EUA: Ecological Upper Aquatic

mg/kg: milligrams per kilogram

ns: no sample acquired in specified area

OU-4: Operable Unit 4

PCBs: polychlorinated biphenyls

Table 3-9. Terrestrial Biota Tissue Summary for Mercury
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Mercury Results (mg/kg wet weight)			
	Terrestrial Plants	Worm	Terrestrial Insects	Small Mammals
OU-4				
EUT-01-FF	**0.0036**	0.050	ns	**0.0030**
	0.0036	0.041	ns	0.0087
	ns	0.020	ns	ns
EUT-02-FF	**0.0033**	ns	ns	**0.0030**
	0.0038	ns	ns	**0.0033**
EUT-03-SF	**0.0034**	ns	ns	**0.0031**
	0.0037	ns	ns	**0.0030**
	ns	ns	ns	ns
EUT-04-MF	**0.0037**	ns	ns	**0.0031**
	0.0034	ns	ns	0.0065
EUT-05-MF	**0.0036**	ns	ns	ns
	0.0036	ns	ns	ns
EUT-06-MF	**0.0035**	1.0	0.010	**0.0027**
	0.0034	1.0	0.011	**0.0034**
	ns	1.4	0.011	ns
EUT-07-SF	**0.0035**	ns	ns	0.017
	0.0034	ns	ns	0.029
EUT-08-SF	**0.0034**	2.4	**0.0036**	0.010
	0.0036	1.3	0.0067	0.013
	ns	1.9	**0.0034**	ns
EUT-09-FF	**0.0036**	ns	ns	0.022
	0.0034	ns	ns	0.029
EUT Average	**0.0035**	**1.0**	**0.0076**	**0.010**
EMT-01-SF	**0.0033**	0.35	**0.0033**	**0.0030**
	0.0035	0.34	**0.0033**	**0.0030**
	ns	0.42	**0.0035**	ns
EMT-02-MF	**0.0036**	ns	ns	ns
	0.0034	ns	ns	ns
	ns	ns	ns	ns
EMT-03-MF	**0.0036**	ns	ns	**0.0021**
	0.0032	ns	ns	ns
EMT-04-MF	**0.0034**	0.21	**0.0033**	ns
	0.0034	0.20	**0.0034**	ns
	ns	0.22	**0.0034**	ns
EMT-05-FF	**0.0036**	ns	ns	0.0071
	0.0034	ns	ns	0.022
EMT-06-SF	**0.0035**	ns	ns	**0.0030**
	0.0036	ns	ns	**0.0024**
EMT-07-FF	**0.0037**	ns	ns	**0.0033**
	0.015	ns	ns	0.089
EMT-08-FF	**0.0036**	0.98	ns	0.061
	0.011	0.20	ns	0.025
	ns	0.55	ns	ns
EMT-09-SF	**0.0036**	ns	ns	ns
	0.0037	ns	ns	ns
EMT Average	**0.0045**	**0.39**	**0.0033**	**0.020**

Table 3-9. Terrestrial Biota Tissue Summary for Mercury
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Mercury Results (mg/kg wet weight)			
	Terrestrial Plants	Worm	Terrestrial Insects	Small Mammals
ELT-01-SF	**0.0036**	ns	ns	**0.0025**
	0.0036	ns	ns	**0.0028**
	ns	ns	ns	ns
ELT-02-SF	**0.0036**	0.030	**0.0038**	**0.0036**
	0.0034	0.062	**0.0038**	**0.0028**
	ns	0.29	**0.0036**	ns
ELT-03-MF	**0.0036**	ns	ns	**0.0028**
	0.0034	ns	ns	**0.0027**
ELT-04-SF	**0.0036**	ns	ns	**0.0028**
	0.0036	ns	ns	ns
ELT-05-FF	**0.0034**	ns	ns	0.016
	0.0035	ns	ns	0.24
ELT-06-FF	**0.0036**	0.39	ns	0.068
	0.0039	1.1	ns	0.043
	ns	0.52	ns	ns
ELT-07-FF	**0.0033**	ns	ns	0.020
	0.0033	ns	ns	**0.0032**
ELT-08-MF	**0.0034**	0.24	**0.0036**	**0.0028**
	0.0037	0.74	**0.0036**	**0.0026**
	ns	0.96	**0.0033**	ns
ELT-09-MF	**0.0033**	ns	ns	**0.0029**
	0.0039	ns	ns	**0.0026**
ELT Average	**0.0035**	**0.48**	**0.0036**	**0.025**
Reference				
ERT-01-SF	**0.0038**	0.052	**0.0034**	**0.0029**
	0.0038	0.064	**0.0036**	**0.0034**
	ns	0.085	**0.0034**	ns
ERT-01-MF	**0.0035**	ns	ns	**0.0028**
	0.0039	ns	ns	ns
ERT-02-MF	**0.0036**	0.074	**0.0037**	**0.0026**
	0.0039	0.10	**0.0038**	**0.0026**
	ns	0.058	**0.0036**	ns
	ns	ns	ns	ns
ERT-02-SF	**0.0037**	ns	ns	0.013
	0.0037	ns	ns	**0.0028**
ERT-02-FF	0.025	ns	ns	**0.0028**
	0.015	ns	ns	**0.0035**
ERT-03-FF	**0.0040**	0.11	ns	**0.0027**
	0.0036	0.090	ns	ns
	ns	0.13	ns	ns
ERT-03-SF	**0.0037**	ns	ns	ns
	0.0034	ns	ns	ns
ERT Average	**0.0060**	**0.084**	**0.0036**	**0.0039**

Notes:
Bold text indicates value is half of the reporting limit.
Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.
ELT: Ecological Lower Terrestrial
EMT: Ecological Middle Terrestrial
ERT: Ecological Reference Terrestrial
EUT: Ecological Upper Terrestrial
mg/kg: milligrams per kilogram
ns: no sample acquired in specified area
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl

Table 3-10. Aquatic Biota (non-fish) Tissue Summary for Mercury (mg/kg wet weight)
Anniston PCB Site, Anniston, Alabama

Biological Sampling Area	Sampling Location	Aquatic Plants	Emergent Insects	Benthic Invertebrates	Crayfish	Mollusks	Frog	Snake
OU-4								
EUA-01	EUA-01-19	**0.0040**	0.040	0.020	0.030	0.010	0.15	0.26
	EUA-01-20	**0.0040**	0.030	0.040	0.030	0.010	0.20	ns
	EUA-01-21	0.0080	0.040	0.030	0.030	0.010	ns	ns
EUA-02	EUA-02-43	0.018	0.070	0.030	**0.10**	0.020	0.020	0.14
	EUA-02-44	0.019	0.070	0.030	0.040	0.030	0.030	ns
	EUA-02-45	0.015	0.10	0.030	0.030	0.020	ns	ns
EUA-03	EUA-03-25	0.017	0.13	0.040	0.050	0.030	0.18	ns
	EUA-03-26	0.015	0.12	0.050	ns	0.030	0.20	ns
	EUA-03-27	0.020	0.10	0.040	ns	0.020	0.16	ns
EUA Average		0.013	0.078	0.034	0.044	0.020	0.13	0.20
EMA-01	EMA-01-01	0.013	0.050	0.050	0.050	0.020	0.16	0.14
	EMA-01-02	**0.0040**	0.060	0.050	0.050	0.030	0.080	ns
	EMA-01-03	0.018	0.10	0.060	ns	0.010	ns	ns
EMA-02	EMA-02-07	0.0090	0.020	0.10	0.050	0.020	0.060	0.45
	EMA-02-08	0.011	0.010	0.040	ns	0.020	0.050	ns
	EMA-02-09	0.060	0.020	0.050	0.040	0.030	ns	ns
EMA-03	EMA-03-31	**0.0040**	0.050	0.060	0.040	0.040	0.070	ns
	EMA-03-32	**0.0040**	0.040	0.060	0.050	0.030	0.090	ns
	EMA-03-33	**0.0040**	0.040	0.050	0.080	0.040	0.30	ns
EMA Average		**0.014**	0.043	0.058	0.051	0.027	0.12	0.30
ELA-01	ELA-01-55	**0.0040**	0.050	0.050	**0.10**	0.030	ns	0.18
	ELA-01-56	0.0090	0.070	0.060	0.070	0.040	ns	0.29
	ELA-01-57	**0.0040**	0.080	0.060	0.050	0.040	ns	0.24
ELA-02	ELA-02-61	0.023	0.050	0.050	0.080	0.060	0.13	0.50
	ELA-02-62	0.016	0.060	0.11	0.060	0.070	0.060	ns
	ELA-02-63	0.0070	0.070	0.050	0.050	0.070	ns	ns
ELA-03	ELA-03-67	0.014	0.020	0.050	0.030	0.060	ns	0.47
	ELA-03-68	0.014	0.020	0.11	0.040	0.060	ns	0.39
	ELA-03-69	0.012	0.050	0.060	0.050	0.060	ns	0.11
ELA Average		0.011	0.052	0.067	0.059	0.054	0.095	0.31
Reference								
ERA-01	ERA-01-49	0.013	0.020	0.020	ns	0.020	ns	0.30
	ERA-01-50	**0.0040**	0.020	0.020	ns	0.020	ns	0.13
	ERA-01-51	0.010	0.010	0.020	ns	0.020	ns	0.10
ERA-02	ERA-02-13	**0.0040**	0.020	0.020	0.02	0.050	0.020	0.12
	ERA-02-14	0.0080	0.010	0.040	0.03	0.040	0.020	ns
	ERA-02-15	**0.0030**	0.020	0.040	0.02	0.060	ns	ns
ERA-03	ERA-03-37	**0.0040**	0.050	0.010	ns	0.020	0.020	0.10
	ERA-03-38	**0.0040**	0.050	0.010	ns	0.020	0.065	0.17
	ERA-03-39	**0.0040**	0.080	0.010	ns	0.010	ns	ns
ERA Average		**0.0060**	0.031	0.021	0.023	0.029	0.031	0.15

Notes:
Bold text indicates value is shown at half the reporting limit.
Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.
ELA: Ecological Lower Aquatic
EMA: Ecological Middle Aquatic
ERA: Ecological Reference Aquatic
EUA: Ecological Upper Aquatic
mg/kg: milligrams per kilogram
ns: no sample acquired in specified area
OU-4: Operable Unit 4
PCB: polychlorinated biphenyl

Table 3-11. Terrestrial Biota Tissue Summary for Metals
Anniston PCB Site, Anniston, Alabama

	Measured Concentrations (mg/kg) (wet weight)		
Sample ID	**Chromium**	**Lead**	**Vanadium**
Terrestrial Plants			
EUT-04-MF1	0.70	**1.0**	0.022
EUT-07-SF4	0.10	**1.0**	0.019
EMT-05-FF1	**2.0**	**0.0018**	0.026
ELT-02-SF2	0.30	0.036	0.028
ELT-03-MF2	0.12	**1.0**	0.028
ELT-08-MF4	0.16	**1.0**	0.031
OU-4 Average	**0.56**	**0.67**	**0.026**
ERT-02-MF2	**2.0**	**1.0**	4.0
Terrestrial Insects (Grasshopper)			
EUT-08-SF1	**2.0**	0.070	0.027
ELT-02-SF4	**2.0**	**1.0**	0.058
OU-4 Average	**2.0**	**0.54**	**0.043**
Soil Invertebrates (Worm)			
EUT-01-FF2	3.7	5.8	2.7
EMT-01-SF2	11	66	3.4
EMT-04-MF2	2.7	4.4	2.3
ELT-06-FF3	4.1	4.7	1.8
OU-4 Average	5.4	20	2.6
ERT-01-SF1	1.1	1.4	1.3
Small Mammals			
EUT-02-FF3 (mouse)	1.5	**1.0**	**2.0**
EUT-07-SF4	0.68	1.2	**2.0**
EMT-06-SF4	0.72	1.7	**2.0**
ELT-07-FF6 (mouse)	1.3	0.19	**2.0**
OU-4 Average	1.1	1.0	2.0
ERT-01-SF2	1.4	0.25	0.28

Notes:

Bold text indicates value is half of the reporting limit.

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

ELT: Ecological Lower Terrestrial

EMT: Ecological Middle Terrestrial

ERT: Ecological Reference Terrestrial

EUT: Ecological Upper Terrestrial

mg/kg: milligrams per kilogram

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

Table 3-12. Aquatic Biota (non-fish) Tissue Summary for Metals
Anniston PCB Site, Anniston, Alabama

Sample ID	Measured Concentrations (mg/kg wet weight)				
	Barium	Chromium	Cobalt	Lead	Vanadium
Aquatic Plants					
EUA-02	17	0.62	**5.0**	1.7	0.36
EMA-03	7.2	0.45	**5.0**	0.57	0.28
ELA-01	10	**0.18**	**0.45**	0.28	**0.18**
Average	12	0.42	3.5	0.85	0.27
ERA-03	26	1.0	1.1	0.42	1.5
Emergent Insects					
EUA-02	1.3	**2.0**	**5.0**	0.084	**2.0**
EMA-02	3.7	3.8	**5.0**	0.22	0.19
ELA-03	1.5	3.9	0.08	0.13	**0.10**
Average	2.2	3.2	3.4	0.14	0.76
ERA-01	2.6	0.87	0.023	0.080	0.088
Benthic Invertebrates					
EUA-02	5.4	0.30	0.40	0.54	0.23
EMA-03	5.6	0.58	0.64	0.75	0.37
ELA-03	5.9	0.51	**5.0**	0.57	0.35
Average	5.6	0.46	2.0	0.62	0.32
ERA-01	4.9	0.26	0.40	0.26	0.28
Crayfish					
EUA-02	40	**2.0**	**5.0**	0.45	**2.0**
EUA-03	55	0.38	**5.0**	0.90	0.38
ELA-01	30	**2.0**	**5.0**	0.26	**2.0**
Average	42	1.5	5.0	0.54	1.5
Mollusks					
EUA-01	2.8	0.76	0.28	0.29	0.15
EMA-03	2.3	0.82	0.33	0.38	0.16
ELA-03	2.7	1.1	0.29	0.30	0.12
Average	2.6	0.89	0.30	0.32	0.14
ERA-03	3.2	0.47	0.45	0.13	0.42
Frog					
EUA-01	10	1.7	0.37	0.63	0.24
EUA-01a	9.5	3.9	0.31	0.89	0.35
Average	10	2.8	0.34	0.76	0.30
Snake					
ELA-03	2.2	**2.0**	**5.0**	0.17	**2.0**
ERA-01	2.3	0.38	0.10	0.070	0.15

Notes:

Bold text indicates value is shown at half the reporting limit.

Tissue concentrations reported in wet weight; see Appendix B for the converted dry weight concentrations.

ELA: Ecological Lower Aquatic

EMA: Ecological Middle Aquatic

ERA: Ecological Reference Aquatic

EUA: Ecological Upper Aquatic

mg/kg: milligrams per kilogram

PCB: polychlorinated biphenyl

Table 3-13. Targeted and Actual Aquatic Community Tissue Sampling
Anniston PCB Site, Anniston, Alabama

Sample Matrix	Targeted Organisms/Species/Community	Collected Organisms/Species/Community		
		Species	Sample Fraction	Habitat
Plants	Composites of edible portions utilized by aquatic receptors from the dominant emergent plant species found; primarily alligator weed.	Alligator weed (*Alternanthera philoxeroides*)	Stems/Leaves	Emergent Aquatic Vegetation
		Unknown	Stems/Leaves	Emergent Aquatic Vegetation
Aquatic Mollusks and Crustaceans	Composites of Asiatic clam, rock snails, and crayfish from riffles, runs, and emergent vegetation.	Asiatic clam *(Corbicula fluminea)*	Muscle	Riffle, Run, Emergent Aquatic Vegetation
		Crayfish *(Astacoidea and Parastacoidea)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
Benthic Macroinvertebrates	Composites of Ephemeroptera, Plecoptera, and Trichoptera larval insects from riffles, runs, and emergent vegetation.	Odonata (Damselfly, Dragonfly)	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
Emergent and Flying Insects	Composites of Ephemeroptera, Plecoptera, and Trichoptera adult winged insects from riffles, runs, and emergent vegetation.	Cranefly *(Nephrotomoa appendiculata)*	Whole Body	Reach-wide in Riparian Corridor
		Damselfly *(Zygoptera)*	Whole Body	Reach-wide in Riparian Corridor
		Dragonfly *(Anisoptera)*	Whole Body	Reach-wide in Riparian Corridor
		Miscellaneous Winged Species	Whole Body	Reach-wide in Riparian Corridor
Fish (Forage, Bottom Feeder, Predator)	Forage - composites of largescale stoneroller and shiner species; Bottom Feeder - individual catfish species; Predator - individual spotted bass.	Forage Species:		
		Alabama hog sucker *(Hypentelium etowanum)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Alabama shiner *(Cyprinella callistia)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Black redhorse *(Moxostoma duquesni)*	Whole Body	Emergent Aquatic Vegetation, Run
		Blackspotted topminnow *(Fundulus olivaceus)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Blacktail redhorse *(Moxostoma poecilurum)*	Whole Body	Emergent Aquatic Vegetation, Run
		Blacktail shiner *(Cyprinella venusta)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Coosa shiner *(Notropis xaenocephalus)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Emerald shiner *(Notropis atherinoides)*	Whole Body	Riffle
		Largescale stoneroller *(Campostoma oligolepis)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Riffle minnow *(Phenocobius catostomus)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Silverstripe shiner *(Notropis stibius)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Southern studfish *(Fundulus stellifer)*	Whole Body	Riffle, Emergent Aquatic Vegetation
		Striped shiner *(Luxilus chrysocephalus)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Tricolor shiner *(Cyprinella trichroistia)*	Whole Body	Riffle, Run, Emergent Aquatic Vegetation
		Bottom Feeder Species:		
		Black redhorse *(Moxostoma duquesni)*	Whole Body	Reach-wide
		Blacktail redhorse (Moxostoma poecilurum)	Whole Body	Reach-wide
		Predator Species:		
		Largemouth bass *(Micropterus salmoides)*	Whole Body	Reach-wide
		Redeye bass *(Micropterus coosae)*	Whole Body	Reach-wide
		Spotted bass *(Micropterus punctulatus)*	Whole Body	Reach-wide

Table 3-13. Targeted and Actual Aquatic Community Tissue Sampling
Anniston PCB Site, Anniston, Alabama

Sample Matrix	Targeted Organisms/Species/Community	Collected Organisms/Species/Community		
		Species	Sample Fraction	Habitat
Reptiles and Amphibians	Individuals of green frogs, spring peepers, northern slimy salamanders, cooters, and turtle species.	American toad *(Anaxyrus americanus)*	Whole Body	Other Floodplain Waterbody
		Bronze or green frog *(Lithobates clamitans clamitans)*	Whole Body	Other Floodplain Waterbody
		Bullfrog *(Lithobates catesbeiana)*	Whole Body	Mainstem Creek, Other Floodplain Waterbody
		Northern cricket frog *(Acris crepitans)*	Whole Body	Mainstem Creek
		Southern leopard frog *(Lithobates sphenocephalus)*	Whole Body	Mainstem Creek
	Individuals queen snakes	Cottonmouth *(Agkistrodon piscivorous)*	Whole Body	Mainstem Creek
		Midland water snake *(Nerodia sipedon)*	Whole Body	Mainstem Creek, Other Floodplain Waterbody
		Queen snake *(Regina septemvittata)*	Whole Body	Mainstem Creek
		Yellow-bellied water snake *(Nerodia erythrogaster flavigaster)*	Whole Body	Mainstem Creek

Notes:
Targeted tissue data collection developed as a part of the Phase 2 Field Sampling Plan (Arcadis 2009)

Table 3-14. Targeted and Actual Terrestrial Community Tissue Sampling
Anniston PCB Site, Anniston, Alabama

Sample Matrix	Targeted Organisms/Species/ Community	Collected Organisms/Species/Community		
		Species	**Sample Fraction**	**Habitat**
Plants	Composites of edible portions utilized by terrestrial receptors from the dominant plant species found.	Bahia grass (*Paspalum notatum*)	Seeds	Maintained Field
		Box elder (*Acer negundo*)	Leaves	Forest/Wooded
		Buttonbush *(Cephalanthus occidentalis)*	Seeds	Forest/Wooded
		Catbriar *(Smilax)*	Leaves	Forest/Wooded
		Clear weed *(Pilea pumila)*	Stems/Leaves	Forest/Wooded
		Cotton *(Gossypium sp.)*	Leaves	Successional Field
		Crabgrass *(Digitaria sanguinalis)*	Stems/Leaves	Maintained Field, Successional Field
		Dallis grass *(Plaspalum dilatatum)*	Seeds	Maintained Field
		Elderberry *(Sambucus)*	Fruit	Successional Field
		Florida parsley *(Apiaceae)*	Entire Plant	Maintained Field
		Johnson grass *(Sorghum halepense)*	Seeds	Successional Field
		Late goldenrod *(Solidago)*	Leaves/Flowers	Successional Field
		Little bluestem *(Schizachyrium scoparium)*	Stems/Leaves	Successional Field
		Partridge pea *(Chamaecrista fasciculata)*	Seeds	Successional Field
		Poa spp.	Leaves	Maintained Field
		Pokeberry *(Phytolacca americana)*	Fruit	Forest/Wooded, Maintained Field, Successional Field
		Prickly mallow *(Sida spinosa)*	Stems/Leaves	Forest/Wooded, Maintained Field
		Red maple *(Acer rubrum)*	Leaves	Forest/Wooded
		Southern crabgrass *(Digitaria ciliaris)*	Entire Plant	Maintained Field
		Soy bean *(Glycine max)*	Seeds/Pods, Stems/Leaves	Maintained Field
		Stinging nettle *(Urtica dioica)*	Stems/Seeds	Forest/Wooded
		Variable panicgrass *(Panicum)*	Stems/Leaves	Forest/Wooded
		Water pepper *(Persicaria hydropiper)*	Seeds	Successional Field
		Yellow foxtail *(Setaria glauca)*	Seeds	Successional Field
Soil Macroinvertebrates	Composites of spiders, springtails (*Colembola* sp.), ground beetles (*Carabidae* sp.), and earthworms	Grasshoppers/Crickets	Whole Body	Maintained Field, Successional Field
		Grubs	Whole Body	Forest/Wooded, Maintained Field
	Earthworms	Earthworm *(Annelida)*	Whole Body	Forest/Wooded, Maintained Field, Successional Field
Small Mammals	Individuals of deer mouse, cotton mouse, harvest mouse, and hispid cotton rat	Cotton mouse *(Peromyscus gossypinus)*	Whole Body	Forest/Wooded, Successional Field
		Eastern harvest mouse *(Reithrodontomys h*	Whole Body	Forest/Wooded, Maintained Field, Successional Field
		Hispid cotton rat *(Sigmodon hispidus)*	Whole Body	Forest/Wooded, Maintained Field, Successional Field
		Deer mouse (*Peromyscus spp.*)	Whole Body	Forest/Wooded, Successional Field
		Short-tailed shrew *(Blarina brevicauda)*	Whole Body	Forest/Wooded
		Woodland/pine vole *(Microtus pinetorum)*	Whole Body	Maintained Field, Successional Field

Notes:
Targeted tissue data collection developed as a part of the Phase 2 Field Sampling Plan (Arcadis 2009)

Table 4-1a. Avian Exposure Parameters
Anniston PCB Site, Anniston, Alabama

Parameter	Aerial-feeding Insectivore		Ground-feeding Invertivore		Aquatic Ground-feeding		Omnivore		Herbivore		Piscivore		Piscivore		Raptor (Carnivore)		Wading Carnivore	
	Tree Swallow		Carolina Wren		Spotted Sandpiper		Blue Jay		Mourning Dove		Belted Kingfisher		American Osprey		Red-tailed Hawk		Great Blue Heron	
	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source
Composition of Diet (%)																		
Riparian Soil	0%	--	0%	--	9%	Half of assumed incidential ingested percent of soil/sediment	0%	--	0%	--	0%	--	0%	--	6%	Riparian soil assumed when sediment EPC also used.	0%	--
Soil/Sediment	0%	Assumed to be negligible based on feeding strategy.	14%	Beyer et al. (1994), as cited in USEPA (2007), based on mourning dove	18%	Beyer et al. (1994) [average of four sandpiper values]	14%	Beyer et al. (1994), as cited in USEPA (2007), based on mourning dove	14%	Beyer et al. (1994), as cited in USEPA (2007)	2%	Assumed to be low but possible for wading carnivores, as they stir sediment to flush prey	0%	Assumed to be negligible for piscivores	6%	Beyer et al. (1994), as cited in USEPA (2007)	2%	Assumed to be low but possible for wading carnivores, as they stir sediment to flush prey
Terrestrial Invertebrates (Worms)	0%	--	See Table 1b for values for each scenario	--	See Table 1b for values for each scenario	--	0%	--	0%	--	See Table 1b for values for each scenario	--	0%	--	0%	--	0%	--
Terrestrial Invertebrates (grasshoppers)	0%	--		--		--	11%	Smith et al. 2013	0%	--		--	0%	--	0%	--	0%	--
Terrestrial Invertebrates, Spiders, Detritivores	0%	--		--		--	11%	Smith et al. 2013	0%	--		--	0%	--				
Aquatic Emergent and Flying Insects	100%	Robertson et al. (1992)		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Aquatic Invertebrates, Spiders, Detritivores	0%	--		--		--	0%	--					0%	--				
Terrestrial Plants	0%	--		--		--	78%	Beal (1922), as cited in Tarvin and Woolfenden (1999)	100%	Mirarchi (1993)		--	0%	--	0%	--	0%	--
Aquatic Plants	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Mammals	0%	--		--		--	0%	--	0%	--		--	0%	--	87%	Janes (1984), as cited in USEPA (1993)	1%	Alexander (1977), as cited in USEPA (1993)
Reptiles	0%	--		--		--	0%	--	0%	--		--	0%	--	13%	Janes (1984), as cited in USEPA (1993)	0%	--
Amphibians	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	4%	Alexander (1977), as cited in USEPA (1993) - frogs
All Fish	0%	--		--		--	0%	--	0%	--		--	100%	USEPA (1993); McLean and Byrd 1991 for fish size - all size classes	0%	--	94%	Alexander (1977), as cited in USEPA (1993); Butler 1992 and DeGraaf and Yamasaki (2001) for fish size
Predator Fish Only	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Forage Fish (4-15cm)	0%			--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Aquatic Invertebrates	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Aquatic Oligochaetes (Lumbriculus)	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	--
Crayfish	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	1%	Alexander (1977), as cited in USEPA (1993) - crayfish
Mollusc	0%	--		--		--	0%	--	0%	--		--	0%	--	0%	--	0%	
Body Weight (kg)	0.021	Robertson et al. (1992)	0.020	Haggerty and Morton (1995)	0.043	USEPA (1993) [average of reported values]	0.087	Frysinger (2001)	0.12	USEPA (2007)	0.15	Dunning (1984), as cited in Sample and Suter (1994)	1.6	USEPA (1993) [based on average of adult values]	1.1	USEPA (1993) [based on average of all adult values]	2.3	USEPA (1993) [based on average of all adult values)
Food Ingestion Rate (kg/kg bw-d)																		
Food Ingestion Rate (kg/kg bw-d dw)	0.24	Nagy (2001), allometric equation for passerines.	0.24	Nagy (2001), allometric equation for passerines	0.18	Nagy (2001), allometric equation for insectivores.	0.15	Nagy (2001), allometric equation for passerines	0.14	Nagy (2001), allometric equation for all birds	0.16	Nagy (2001), allometric equation for carnivorous birds	0.07	Nagy (2001), allometric equation for carnivorous birds	0.08	Nagy (2001), allometric equation for carnivorous birds	0.18	Kushlan (1978), as cited in USEPA (1993)
Drinking Water Ingestion (kg/kg bw-d)	0.21	Calder and Braun (1983), as cited in USEPA (1993)	0.27	Calder and Braun (1983), as cited in USEPA (1993)	0.17	Calder and Braun (1983), as cited in USEPA (1993)	0.13	Calder and Braun (1983), as cited in USEPA (1993)	0.12	Calder and Braun (1983), as cited in USEPA (1993)	0.11	Calder and Braun (1983), as cited in USEPA (1993)	0.051	Calder and Braun (1983), as cited in USEPA (1993)	0.057	Calder and Braun (1983), as cited in USEPA (1993)	0.045	Calder and Braun (1983), as cited in USEPA (1993)
Home Range (acres)																		
Lower Bound	0.1 Km	McCarty and Winkler (1999); Hudson River BERA	0.42	Verner (1965), as cited in USEPA (1993), based on the marsh wren	2.5	Hays (1972)	--	--	247	Basket et al. 1993	0.7 Km	Davis (1982)	1.7 Km	Dunstan (1973), as cited in USEPA (1993)	148	Fitch et al. (1946), as cited in USEPA (1993)	1.8 Km	Mathisen and Richards (1978), as cited in USEPA (1993)
Central Tendency	225 m	Stapleton and Robertson (2006)	1.7	Haggerty and Morton (1975)	8.00	Hays (1972)	1746	Darley-Hill and Johnson (1981), as cited in Tarvin and Woolfenden (1999)	1800	Basket et al. 1993	1.61 Km	Brooks and Davis (1987)	3-8 km	Koplin (1981) as cited in USEPA (1993)	1659	USEPA (1993)	3.1 Km	Dowd and Flake (1985), as cited in USEPA (1993)
Upper Bound	0.3 ha	Poole and Gill 1992	5.40	DeGraff et al. (1975)	12	Zeiner et al. 1986-1990	--	--	10,600	Poole and Gill (1992)	4.8 Km	Salyer and Lagler (1949)	10 Km	Greene et al (1983) and Van Daele and Van Daele (1982), as cited in USEPA (1993)	6089	Andersen and Rongstad (1989), as cited in USEPA (1993)	7-8 Km	Parnell and Soots (1978), as cited in USEPA (1993)

Notes:

Full references provided in Table 4-2c.
%: percent
--: not applicable
BERA: Baseline Ecological Risk Assessment
cm: centimeters
EPC: exposure point concentration
ha: hectares
kg: kilograms
kg/kg bw-d: kilograms per kilogram of body weight per day
kg/kg bw-d dw: kilograms per kilogram of body weight per day dry weight
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency

Table 4-1b. Avian Exposure Parameter Scenarios
Anniston PCB Site, Anniston, Alabama

Parameter	Aquatic Ground-feeding Invertivore				Piscivore				Ground-feeding Invertivore			
	Spotted Sandpiper				Belted Kingfisher				Carolina Wren			
	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source
	Scenario 1		Scenario 2		Scenario 1		Scenario 2		Scenario 1		Scenario 2	
Composition of Diet (%)												
Soil Invertebrates (Worms)	50%	Assumed, based on Oring et al. (1997)	0%	--	0%	--	0%	--	15%	Cristol et al. 2008; Walters et al. 2010	15%	Cristol et al. 2008; Walters et al. 2010
Terrestrial Invertebrates (grasshoppers)	0%	--	0%	--	0%	--	0%	--	45%	Cristol et al. 2008; Walters et al. 2010	45%	Cristol et al. 2008; Walters et al. 2010
Terrestrial Invertebrates, Spiders, Detritivores	0%	--	0%	--	0%	--	0%	--	31%	Cristol et al. 2008; Walters et al. 2010	0%	--
Aquatic Emergent and Flying Insects	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Aquatic Invertebrates, Spiders, Detritivores	0%	--	0%	--	0%	--	0%	--	0%	--	31%	Cristol et al. 2008; Walters et al. 2010
Terrestrial Plants	0%	--	0%	--	0%	--	0%	--	9%	Cristol et al. 2008; Walters et al. 2010	0%	--
Aquatic Plants	0%	--	0%	--	0%	--	0%	--	0%	--	9%	Cristol et al. 2008; Walters et al. 2010
Mammals	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Reptiles	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Amphibians	0%	--	0%	--	0%	--	5%	Alexander (1977), Salyer and Lagler (1946) and Davis (1982) as cited in USEPA (1993)	0%	--	0%	--
All Fish	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Predator Fish Only	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Forage Fish (4-15 cm)	0%	--	0%	--	100%	Consume primarily fish (Hamas 2009); Prose (1985) fish size	76%	Alexander (1977), Salyer and Lagler (1946) and Davis (1982) as cited in USEPA (1993); Prose (1985) fish size	0%	--	0%	--
Aquatic Invertebrates (Odonata Larvae)	50%	Rubbelke (1976)	50%	Rubbelke (1976)	0%	--	0%	--	0%	--	0%	--
Aquatic Oligochaetes (Lumbriculus)	0%	--	50%	Assumed	0%	--	0%	--	0%	--	0%	--
Crayfish	0%	--	0%	--	0%	--	19%	Alexander (1977), Salyer and Lagler (1946) and Davis (1982) as cited in USEPA (1993) - crayfish	0%	--	0%	--
Mollusc	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--

Notes:
Full references provided in Table 4-2c.
%: percent
--: not applicable
cm: centimeters
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency

Table 4-2a. Mammalian Exposure Parameters
Anniston PCB Site, Anniston, Alabama

Parameter	Mammalian Aerial-feeding Insectivore		Mammalian Ground-feeding Invertivore		Mammalian Omnivore		Herbivore		Piscivore		Piscivore		Aquatic-dependent Carnivore		Mammalian Terrestrial-dependent Carnivore	
	Little Brown Bat		Short-tailed Shrew		Raccoon		White-tailed Deer		Mink		River Otter		Long-tailed Weasel		Red Fox	
	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source
Composition of Diet (%)																
Riparian Soil	0%	--	3%	riparian soil assumed whensed EPC also used.	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Soil/Sediment	0%	Assumed to be negligible for aerial-feeding insectivores	3%	Beyer et al. (1994), as cited in USEPA (2007)	9.4%	Beyer et al. (1994)	2%	Sample and Suter (1994)	0%	Hamilton (1940), as cited in Sample and Suter (1994)	0%	Assumed to be negligible for piscivores	4.3%	Beyer et al. (1994), as cited in USEPA (2007)	2.8%	Beyer et al. (1994)
Soil Invertebrates (Worms)	0%	--	See Table 2b for values for each scenario	--	See Table 2b for values for each scenario	--	0%	--	See Table 2b for values for each scenario	--	0%	--	0%	--	See Table 2b for values for each scenario	--
Terrestrial Insects (Grasshoppers)	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Terrestrial Invertebrates, Spiders, Detritivores	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Aquatic Emergent and Flying Insects	100%	Belwood and Fenton (1976), as cited in Sample and Suter (1994)		--		--	0%	--		--	0%	--	0%	--		--
Aquatic Invertebrates, Spiders, Detritivores	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Terrestrial Plants	0%	--		--		--	100%	Smith 1991, as cited in Sample and Suter (1994)		--	0%	--	0%	--		--
Aquatic Plants	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Mammals	0%	--		--		--	0%	--		--	0%	--	100%	Sheffield and Thomas (1997)		--
Reptiles	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Amphibians	0%	--		--		--	0%	--		--	0%	--	0%	--		--
All Fish	0%	--		--		--	0%	--		--	48%	1-(%forage fish+%predator fish)	0%	--		--
Predator Fish Only	0%	--		--		--	0%	--		--	22%	Stearns and Serfassi 2011	0%	--		--
Forage Fish Only (4-15cm)	0%	--		--		--	0%	--		--	30%	Stearns and Serfassi 2011	0%	--		--
Aquatic Invertebrates	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Aquatic Oligochaetes (Lumbriculus)	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Crayfish	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Mollusc	0%	--		--		--	0%	--		--	0%	--	0%	--		--
Body Weight (kg)	0.009	Nagy (2001), allometric equation for little brown bat.	0.017	USEPA (1993) [Average of all mean values]	5.6	USEPA (1993) [average of adult and juvenile means values]	57	Smith (1991), as cited in Sample and Suter (1994) [average of male and female values]	0.90	USEPA (1993) [average of all adult and juvenile values]	7.4	USEPA (1993) [average of all adult and yearling values]	0.30	USEPA (2007)	4.5	USEPA (1993) [mean of all adult values]
Food Ingestion Rate (kg/kg bw-d)																
Food Ingestion Rate (kg/kw bw-d dw)	0.18	Nagy (2001), allometric equation for little brown bat.	0.1278	Nagy (2001), allometric equation for insectivores	0.0268	Nagy (2001), allometric equation for Omnivores.	0.0147	Nagy (2001), allometric equation for herbivores	0.05	Nagy (2001), allometric equation for carnivores	0.03	Nagy (2001), allometric equation for carnivores	0.06	Nagy (2001), allometric equation for carnivores	0.04	Nagy (2001), allometric equation for carnivores
Drinking Water Ingestion (kg/kg bw-d)	0.16	Calder and Braun (1983), as cited in USEPA (1993)	0.15	Calder and Braun (1983), as cited in USEPA (1993)	0.083	Calder and Braun (1983), as cited in USEPA (1993)	0.066	Calder and Braun (1983), as cited in USEPA (1993)	0.10	Calder and Braun (1983), as cited in USEPA (1993)	0.081	Calder and Braun (1983), as cited in USEPA (1993)	0.11	Calder and Braun (1983), as cited in USEPA (1993)	0.085	Calder and Braun (1983), as cited in USEPA (1993)
Home Range (acres)																
Lower Bound	0.1 Km	Bulcher (1976); Hudson River BE	0.25	Blair (1940), as cited in USEPA (1993)	48	Urban (1970); Hudson River BERA	146	Marchinton and Hirth (1984), as cited in Sample and Suter (1994)	1.9 Km	Gerell (1970) and Mitchell (1961) as cited in USEPA (1993)	10 Km	Spinola et al (1999); Hudson River BERA	30-40	Svendsen 1982	141	Ables (1969), as cited in USEPA (1993)
Central Tendency	42	Henry et al. (2002)	0.96	Buckner (1966) as cited in USEPA (1993)	270	Prange et al. (2004)	715	Marchinton and Hirth (1984), as cited in Sample and Suter (1994)	2.15 Km	in USEPA (1993)	31 Km	Melquist and Hornocker (1983) , as cited in USEPA (1993)	96-338	Gehring and Swihart (2004)	2563	USEPA (1993) [mean of all reported values]
Upper Bound	74	Henry et al. (2002)	4.4	Blair (1940), as cited in USEPA (1993)	12217	Fritzell (1978), as cited in USEPA (1993)	1284	Marchinton and Hirth (1984), as cited in Sample and Suter (1994)	3.4	Gerell (1970) and Mitchell (1961) as cited in USEPA (1993)			79-395	Quick 1944-1951	8447	Jones and Theberge (1982), as cited in USEPA (1993)

Notes:
Full references provided in Table 4-2c.
%: percent
--: not applicable
BERA: Baseline Ecological Risk Assessment
cm: centimeters
dw: dry weight
EPC: exposure point concentration
kg: kilograms
kg/kg bw-d: kilograms per kilogram of body weight per day
kg/kg bw-d dw: kilograms per kilogram of body weight be day dry weight
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency

Table 4-2b. Mammalian Exposure Parameters Scenarios
Anniston PCB Site, Anniston, Alabama

Parameter	Mammalian Ground-feeding Invertivore				Mammalian Omnivore				Piscivore				Mammalian Terrestrial-dependent Carnivore			
	Short-tailed Shrew				Raccoon				Mink				Red Fox			
	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source	Data	Source
	Scenario 1		Scenario 2		Scenario 1		Scenario 2		Scenario 1		Scenario 2		Scenario 1		Scenario 2	
Composition of Diet (%)																
Terrestrial Invertebrates (Worms)	37%	Average diet composition of two studies (Whitaker and Ferraro 1963; Hamilton 1941), as cited in USEPA (1993)	41%	Hamilton (1941) as cited in USEPA (1993)	10%	Value of 30% from Llewellyn and Uhler (1952), as cited in USEPA (1993) *33%	0%	Alexander (1977), riverine as cited in USEPA 1993	0%	--	0%	--	4%	Knable et al. (1974), as cited in USEPA (1993) - insects	0%	--
Terrestrial Insects (Grasshoppers)	26%	Non-worm and non-plant average diet composition of two studies (Whitaker and Ferraro 1963; Hamilton 1941), as cited in USEPA (1993)*50%	17.5%	Non-worm, non-plant, non-vertebrate diet composition from Hamilton (1941), as cited in USEPA (1993)*50%	10%	Value of 30% from Llewellyn and Uhler (1952), as cited in USEPA (1993) *33%	0%	--	0%	--	0%	--	0%	--	0%	--
Terrestrial Invertebrates, Spiders, Detritivores	26%	Non-worm and non-plant average diet composition of two studies (Whitaker and Ferraro 1963; Hamilton 1941), as cited in USEPA (1993)*50%	17.5%	Non-worm, non-plant, non-vertebrate diet composition from Hamilton (1941), as cited in USEPA (1993)*50%	10%	Value of 30% from Llewellyn and Uhler (1952), as cited in USEPA (1993) *33%	0%	--	0%	--	0%	--	0%	--	0%	--
Aquatic Emergent and Flying Insects	0%	--	0%	--	0%	--	0%		0%	--	0%	--	0%	--	0%	--
Aquatic Invertebrates, Spiders, Detritivores	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Terrestrial Plants	12%	Average diet composition of two studies (Whitaker and Ferraro 1963; Hamilton 1941), as cited in USEPA (1993)	17%	Hamilton (1941) as cited in USEPA (1993)	44%	Llewellyn and Uhler (1952), as cited in USEPA (1993)	0%	--	0%	--	0%	--	17%	Knable et al. (1974), as cited in USEPA (1993)	5%	Korschgen (1959) as cited in USEPA (1993)
Aquatic Plants	0%	--	0%	--	0%	--	17%	Alexander (1977), riverine as cited in USEPA 1993	0%	--	1%	Alexander (1977), riverine as cited in USEPA 1993	0%	--	0%	--
Mammals/Birds	0%	--	5%	Hamilton (1941) as cited in USEPA (1993)	5%	Llewellyn and Uhler (1952), as cited in USEPA (1993)	19%	Alexander (1977), riverine as cited in USEPA 1993	44%	Korschgen (1958), as cited in USEPA (1993)	6%	Alexander (1977), riverine as cited in USEPA 1993	79%	Knable et al. (1974), as cited in USEPA (1993)	95%	Korschgen (1959) as cited in USEPA (1993)
Reptiles	0%	--	1%	Hamilton 1930	2%	Assumed, from average for reptiles/amphibians in Llewellyn and Uhler (1952), as cited in USEPA (1993)	0%	--	0%	--	0%	--	0%	--	0%	--
Amphibians	0%	--	1%	Hamilton 1930	3%	Assumed, from average for reptiles/amphibians in Llewellyn and Uhler (1952), as cited in USEPA (1993)	12%	Alexander (1977), riverine as cited in USEPA 1993	26%	Korschgen (1958), as cited in USEPA (1993)	3%	Alexander (1977), riverine as cited in USEPA 1993	0%	--	0%	--
All Fish	0%	--	0%	--	2%	Llewellyn and Uhler (1952), as cited in USEPA (1993) - all size classes	23%	Alexander (1977), riverine as cited in USEPA 1993 - all size classes	0%	--	0%	--	0%	--	0%	--
Predator Fish Only	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Forage Fish Only (4-15cm)	0%	--	0%	--	0%	--	0%	--	21%	Korschgen (1958), as cited in USEPA (1993) - forage fish	86%	Alexander (1977), riverine as cited in USEPA 1993 - forage fish	0%	--	0%	--
Crayfish	0%	--	0%	--	13%	Llewellyn and Uhler (1952), as cited in USEPA (1993) - crayfish	13%	Alexander (1977), riverine as cited in USEPA 1993 - crayfish	9%	Korschgen (1958), as cited in USEPA (1993) - crayfish	4%	Alexander (1977), riverine as cited in USEPA 1993 - crayfish	0%	--	0%	--
Aquatic Invertebrates (Odonata larvae)	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--	0%	--
Aquatic Oligochaetes (Lumbriculus)	0%	--	0%	--	0%	--	3%	--	0%	--	0%	--	0%	--	0%	--
Mollusc	0%	--	0%	--	0%	--	13%	--	0%	--	0%	--	0%	--	0%	--

Notes:
Full references provided in Table 4-2c.
%: percent
--: not applicable
cm: centimeters
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency

Tables 4-2c. Literature Cited in Tables 4-1a,b and 4-2a,b - Avian and Mammalian Exposure Parameters
Anniston PCB Site, Anniston, Alabama

Ables, ED. 1969. Home range studies of red foxes (Vulpes vulpes). J. Mammal. 50: 108-120.

Alexander, GR. 1977. Food of vertebrate predators on trout waters in north central lower Michigan. The Michigan Academician 10:181-195.

Andersen, DE and OJ Rongstad. 1989. Home-range estimates of red-tailed hawks based on random and systematic relocations. J. Wildl. Manage. 53: 802-807.

Anthony, ELP, and TH Kunz. 1977. Feeding strategies of the little brown bat, Myotis lucifugus, in southern New Hampshire. Ecology: 58:775-786.

Arnold, TW and EK Fritzell. 1987. Food habits of prairie mink during the waterfowl breeding season. Can. J. Zool. 65: 2322-2324.

Bayer, RD. 1978. Aspects of an Oregon estuarine great blue heron population. In: Sprunt, A.; Ogden, J.; Winckler, S., eds. Wading birds. Natl. Audubon Soc. Res. Rep. 7; pp. 213-217.

Beal, F. E. L., W. L. McAtee, and E. R. Kalmbach. 1916. Common birds of southeastern United States in relation to agriculture. U.S. Dept. Agric. Farmers' Bull. 755.

Beal, FEL. 1922. Some common birds useful to the farmer. USDA Farmers' Bulletin 630.

Belwood, JJ and MB Fenton. 1976. Variation in the diet of Myotis lucifugus (Chiroptera: Vespertilionidae). Can. J. Zool. 54:1674-1678.

Beyer, WN, EE Connor, and S Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management, vol. 58, no. 2, pp. 375-382.

Blair, WF. 1940. Notes on home ranges and populations of the short-tailed shrew. Ecology 21: 284-288.

Brooks, RP and WJ Davis. 1987. Habitat selection by breeding belted kingfishers (Ceryle alcyon). American Midland Naturalist 117:63-70.

Bulcher, ER. 1976. Prey selection by *Myotis lucifugus* . Amer. Nat. 100: 619-628.

Buckner, CH. 1966. Populations and ecological relationships of shrews in tamarack bogs of southeastern Manitoba. J. Mammal. 47: 181-194.

Butler, Robert W.. 1992 . Great Blue Heron (*Ardea herodias*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology.

Calder, WA and EJ Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 244: R601-R606.

Cristol, DA, RL Brasso, AM Condon, RE Fovargue, SL Friedman, KK Hallinger, AP Monroe, AE White. The movement of aquatic mercury through terrestrial food webs. Science 2008, 320, 335.

Darley-Hill, S and WC Johnson. 1981. Acorn dispersal by the blue Jay (Cyanocitta cristata). Oecologia 50:231:232.

Davis, WJ. 1982. Territory size in Megaceryle alcyon along a stream habitat. Auk 99:353-362.

DeGraaf, RM and M Yamasaki. 2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England, Hanover, NH.

DeVan, R. 1982. The ecology and life history of the long-tailed weasel (Mustela frenata). Unpublished Ph.D. dissertation, University of Cincinnati, Cincinnati, Ohio.

Dowd, EM and LD Flake. 1985. Foraging habitats and movements of nesting Great Blue Herons in a prairie river ecosystem, South Dakota. Journal of Field Ornithology 56: 379–87.

Dunning, JB. 1984. Body weights of 686 species of North American Birds. West. Bird Banding Assoc. Monogr. No. 1. Eldon Publ. Company, Cave Creek, Arizona. 38 pp.

Dunstan, TC. 1973. The biology of ospreys in Minnesota. Loon 45: 108-113.

Erickson, DW, CR McCullough, and WR Porath. 1984. River otter investigations in Missouri. Missouri Dept. Conserv.; Pittman-Robertson Proj. W-13-R-38, Final Report.

Fitch, HS, F Swenson, and DF Tillotson. 1946. Behavior and food habits of the red-tailed hawk. Condor 48: 205-237.

Fritzell, EK. 1978. Habitat use by prairie raccoons during the waterfowl breeding season. J. Wildl. Manage. 42: 118-127.

Frysinger, J. 2001. Cyanocitta cristata (On-line), Animal Diversity Web Accessed October 25, 2010 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Cyanocitta_cristata.html.

Gehring, T. M. and Swihart, R. K. 2004. Home range and movements of long-tailed weasels in a landscape fragmented by agriculture. Journal of Mammalogy 85: 79-86.

Gerelll, R. 1970. Home ranges and movements of the mink Mustala vision Schreber in southern Sweden - Oikos 21: 160 - 173. Copenhagen.

Gould, ED. 1955. The feeding efficiency of insectivorous bats. J. Mammal. 36:399-407.

Greene, EP, AE Greene, B Freedman. 1983. Foraging behavior and prey selection by ospreys in coastal habitats in Nova Scotia, Canada. In: Bird, D. M.; Seymour, N. R.; Gerrard, J. M., eds. Biology and management of bald eagles and ospreys. St. Anne de Bellvue, Quebec: Harpell Press; pp. 257-267.

Haggerty, T.M. and E.S. Morton. 1995. The Carolina wren (Thyrothorus ludovicianus). In: The Birds of North America, No. 188. Poole, A. and F. Gill (Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Hamas, MJ, J Kelly, ES Bridge. 2009. Belted Kingfisher Megaceryle alcyon. In: Birds of North America.P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America:

Hamilton, WJ, Jr. 1940. The summer food of minks and raccoons on the Montezuma Marsh, New York. J. Wildl. Manage. 4: 80-84.

Hamilton, WJ, Jr. 1941. The foods of small forest mammals in eastern United States. J. Mammal. 22: 250-263.

Henry, M, DW Thomas, R Vaudry, M Carrier. Foraging Distances and Home Range of Pregnant and Lactating Little Brown Bats (*Myotis Lucifugus*) in Journal of Mammology.

Janes, SW. 1984. Influences of territory composition and interspecific competition on red-tailed hawk reproductive success. Ecology 65: 862-870.

Jones, DM and JB Theberge. 1982. Summer home range and habitat utilization of the red fox (Vulpes vulpes) and gray foxes (Urocyon cinereoargentus) in Maryland. Am. Midl. Nat. 110: 276-285.

Kale, HW, II. 1965. Ecology and bioenergetics of the long-billed marsh wren Telmatoidytes palustris griseus (Brewster) in Georgia salt marshes. Publ. Nuttall Ornith. Club No. 5.

Tables 4-2c. Literature Cited in Tables 4-1a,b and 4-2a,b - Avian and Mammalian Exposure Parameters
Anniston PCB Site, Anniston, Alabama

Knable, AE. 1974. Seasonal trends in the utilization of major food groups by the red fox (Vulpes fulva) in Union County, Illinois. Trans. Ill. State Acad. Sci. 66: 113-115.

Korschgen, LJ. 1958. December food habits of mink in Missouri. J. Mammal. 39: 521-527.

Korschgen, L. J. 1959. Food habits of the red fox in Missouri. J. Wildl. Manage. 23:168 176. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Kushlan, JA. 1978. Feeding ecology of wading birds. In: Sprunt, A.; Ogden, J.; Winckler,S., eds. Wading birds. Natl. Audubon Soc. Res. Rep. 7; pp. 249-296.

Llewellyn, LM and FM Uhler. 1952. The foods of fur animals of the Patuxent Research Refuge, Maryland. Am. Midl. Nat. 48: 193-203.

Mack, CM. 1985. River otter restoration in Grand County, Colorado [master's thesis]. Fort Collins, CO: Colorado State University.

Marchinton, RL and DH Hirth. 1984. Behavior in Halls, LK, ed. White-tailed Deer: Ecology and Management. Stackpole Books, Harrisburg, Pennsylvania.

Mautz, WW, H Silver, JB Hayes, and WE Urban. 1976. Digestibility and related nutritional data for seven northern deer browse species. J. Wildl. Manage. 40:630-638.

Maxson, SJ and LW Oring. 1980. Breeding season time and energy budgets of the polyandrous spotted sandpiper. Behaviour 74: 200-263.

Mclean, PK and MA Byrd. 1991. Feeding ecology of Chesapeake Bay Ospreys and growth and behavior of their young. Wilson Bull. no. 103:105-111.

Melquist, WE and MG Hornocker. 1983. Ecology of river otters in west central Idaho. Wildlife Monographs 83: 1-60.

Mirarchi, RE. 1993. Energetics, metabolism, and reproductive physiology. Pages 143-160 in Ecology and Management of the Mourning Dove (Baskett, TS, MW Sayre, RE Tomlinson, and RE Mirarchi, Eds.) Stackpole Books, Harrisburg, PA.

Mitchell, JL. 1961. Mink movements and populations on a Montana river J. Wildl. Manage., 25 (1) (1961), pp. 48–54.

Nagy, KA. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B: Livestock Feeds and Feeding, vol. 71, no. 10, pp. 1R-12R.

Oring, LW, EM Gray, and JM Reed. 1997. Spotted Sandpiper (Actitis macularius), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/289 doi:10.2173/bna.289.

Parnell, JF and RF Soots. 1978. The use of dredge islands by wading birds. Wading Birds. Nat. Audubon Soc. Res. Rep. 7:105-111.

Poole, AF. 1983. Courtship feeding, clutch size, and egg size in ospreys: a preliminary report. In: Bird, D. M.; Seymour, N. R.; Gerrard, J. M., eds. Biology and management of bald eagles and ospreys. St. Anne de Bellvue, Quebec: Harpell Press; pp. 243-256.

Prange, S and SD Gehrt. 2004. Changes in mesopredator-community structure in response to urbanization. Canadian Journal of Zoology 82:1804-1817.

Prose, B. L. 1985. Habitat suitability index models: belted kingfisher. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.87).

Robertson, RJ, BJ Stutchbury, and RR Cohen. 1992. Tree Swallow (Tachycineta bicolor). P. 1-26. In A Poole, P Stettenheim and F Gill (ed.) The Birds of North America, No. 11. The Birds of North America, Inc, Philadelphia, PA, USA.

Rubbelke, Donald Lewis. (1976). Distribution and relative abundance of potential prey of spotted sandpipers (Actitis macularia L.) on Little Pelican Island, Leech Lake, Cass County, Minnesota.

Salyer, JC and KF Lagler. 1946. The eastern belted kingfisher, Megaceryle alcyon alcyon (Linnaeus), in relation to fish management. Trans. Am. Fish. Soc. 76: 97-117.

Sample, BE and GW Suter, II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. ES/ER/TM-125.

Sheffield, SR, and HH Thomas. 1997. Mammalian Species: Mustela frenata. American Society of Mammalogists.

Smith, WP. 1991. Odocoileus virginianus. Mammal. Species 388:1-163.

Stearns CR, Serfassi TL. 2011. Food habits and fish prey size selection of a newly colonizing population of river otters (*Lontra canadensis*) in eastern North Dakota. Am Midl Nat. 165:169–184

Spinola, RM. 2003. Spatiotemporal ecology of river otter translocated to western New York. Ph.D. Dissertation. The Pennsylvania State University. State College, PA. 125. pp.

Stuewer, FW. 1943. Raccoons: their habits and management in Michigan. Ecol. Monogr. 13: 203-257.

Svendsen G. E. 1982. Weasels: Mustela species. Pp. 613–628 in Wild mammals of North America: biology, management, and economics (Chapman J. A., Feldhamer G. A., eds.). The Johns Hopkins University Press, Baltimore, Maryland.

Tarvin, KA, and GE Woolfenden. 1999. Blue Jay (Cyanocitta cristatta), The Birds of North American Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North American Online: http://bna.birds.cornell.edu/bna/species/469 doi:10.2173/bna.469.

Urban. 1970. Raccoon populations, movement patterns, and predations on a managed waterfowl marsh. Journal of Wildlife Management 34:372-382.

USEPA. 1993. Wildlife Exposure Factors Handbook, EPA/600/R-93/187a. Office of Research and Development, Washington, D.C., December.

USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs): Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OWSER Directive 9285.7-55. Issued November 2003, Revised February 2005, Revised April 2007).

Van Daele, LJ and HA Van Daele. 1982. Factors affecting the productivity of ospreys nesting in west central Idaho. Condor 84: 292 299. As cited in USEPA (1993) Wildlife Exposure Factors Handbook.

Verner, J. 1965. Breeding biology of the long-billed marsh wren. Condor 67: 6-30.

Walters, DM, MA Mills, KM Fritz, DF Raikow. 2010. Spider-mediated flux of PCBs from contaminated sediments to terrestrial ecosystems and potential risks to arachnivorous birds. Environ Sci Tech 44: 2849-2856.

Tables 4-2c. Literature Cited in Tables 4-1a,b and 4-2a,b - Avian and Mammalian Exposure Parameters
Anniston PCB Site, Anniston, Alabama

Whitaker, JO, Jr and MG Ferraro. 1963. Summer food of 220 short-tailed shrews from Ithaca, New York. J. Mammal. 44: 419.

Zeiner, D, WF Laudenslayer, Jr., KE Mayer, and M White (eds). 1990. California's Wildlife. Volume I, Mammals. Volume II, Birds. Sacramento, California: State of California Department of Fish and Game.

Table 4-4. EPC Calculation Details Table for PCBs in Surface Sediments
Anniston PCB Site, Anniston, Alabama

Data Groups			Descriptive Statistics						MCA (Fine + Coarse + Gravel)				
Assessment Area	**Reach**	**Sediment Texture**	**Core Locations (n)**	**Surface Area (ac)**	**PCB Samples (n)**	**Detected Samples (n)**	**Mean Surface PCB (mg/kg)**	**Max Surface PCB (mg/kg)**	**Reach Sample Weighting Factor**	**Reach Bootstrap Mean**	**Reach 95%tile of Bootstrap Means**	**Assessment Area Bootsrap Mean**	**Assessment Area 95%tile of Bootstrap Means**
C1	C1[a]	Snow Creek[a]	16	NA	16	15	5.26	41.00	NA	NA	NA	NA	NA
Upper	C2	Coarse	14	2.5	15	3	0.37	3.08	0.01				
		Fine	24	6.5	22	13	8.83	95.00	0.03				
		Gravel	8	2.4	2	2	0.55	0.81	0.10	5.13	9.95		
		No Recovery	2	0.7	0	0	0.05	NA					
	C3	Coarse	14	6.0	5	5	0.75	1.96	0.09				
		Fine	5	2.2	9	9	1.29	2.83	0.02				
		Gravel[b]	9	5.3	0	0	**0.75**	NA	0.39	0.83	1.10	1.69	4.09
		No Recovery	4	1.7	0	0	0.05	NA					
	C4	Coarse	79	28.8	16	16	1.07	8.90	0.05				
		Fine	7	2.2	5	5	5.32	23.20	0.01				
		Gravel	18	6.8	4	4	0.58	1.45	0.05	1.24	2.42		
		No Recovery	8	3.1	0	0	0.05	NA					
Middle	C5	Coarse	75	47.2	31	26	0.52	5.15	0.03				
		Fine	6	3.6	14	14	1.62	3.90	0.005				
		Gravel	9	5.5	2	1	0.07	0.08	0.05	0.55	0.83		
		No Recovery	34	19.5	0	0	0.05	NA				0.49	0.76
	C6[c]	Coarse	37	28.4	3	2	0.10	0.14	0.29				
		Fine	1	0.7	1	1	1.20	1.20	0.02	< 8 Samples			
		Gravel[b]	6	4.0	0	0	**0.10**	NA	0.12				
		No Recovery	40	24.6	0	0	0.05	NA					
Lower	C7	Coarse	56	35.4	17	11	0.56	3.17	0.04				
		Fine	8	5.0	17	16	1.87	4.20	0.01				
		Gravel	14	8.3	1	1	0.09	0.09	0.17	0.61	0.90		
		No Recovery	22	12.7	0	0	0.05	NA					
	C8	Coarse	30	27.1	14	13	0.57	2.64	0.04				
		Fine	25	24.1	18	18	1.09	2.13	0.03				
		Gravel[b]	2	1.4	0	0	**0.57**	NA	0.03	0.81	1.02		
		No Recovery	35	30.4	0	0	0.05	NA				0.83	1.11
	C9	Coarse	7	7.9	7	6	0.18	0.49	0.04				
		Fine	9	11.2	8	5	0.23	0.84	0.05				
		Gravel	9	11.0	2	1	0.11	0.16	0.18	0.17	0.25		
		No Recovery	31	37.1	0	0	0.05	NA					
	C10	Coarse	13	27.6	6	6	0.37	0.64	0.01				
		Fine	95	347.1	31	25	0.57	2.72	0.03				
		Gravel[b]	0	0.0	0	0	**0.37**	NA	0	0.56	0.74		
		No Recovery	13	26.6	0	0	0.05	NA					

Table 4-4. EPC Calculation Details Table for PCBs in Surface Sediments
Anniston PCB Site, Anniston, Alabama

Notes:
Areas of no sediment recovery were not included in the assessment or spatial weighting
a. Snow Creek values are representive of 16 samples collected from individual deposits and are not spatially weighted. A standard 95% UCL of 16.0 mg/kg was selected as the reach and AA EPC.
b. Gravel areas without samples in a given reach were assumed to have a gravel PCB concentration equal to mean Coarse Sediment for that reach.
c. Dataset is small; weighted maximum EPC of 0.17 mg/kg calculated for reach C6.
Blue shading indicates selected EPC value
AA: assessment area
ac: acres
EPC: exposure point concentration
MCA: Monte-Carlo analysis
mg/kg: milligrams per kilogram
NA: not applicable or not calculated
PCB: polychlorinated biphenyl
UCL: 95% upper confidence limit

Table 4-5a. EPC Calculation Details Table for Mercury in Surface Sediments by Reach
Anniston PCB Site, Anniston, Alabama

Data Groups		Descriptive Statistics						MCA (Fine and Coarse)			MCA (Fine + Coarse + Gravel)		
Hg Reach	Sediment Texture	Core Locations (n)	Surface Area (ac)	Hg Samples (n)	Detected Samples (n)	Mean Surface Hg (mg/kg)	Max Surface Hg (mg/kg)	Sample Weighting Factor	Mean	95% of Bootstrap Means	Reach Sample Weighting Factor	Reach Bootstrap Mean	Reach 95%tile of Bootstrap Means
C1[a]	Snow Creek[a]	16	NA	2	2	0.55	0.58				NA	NA	NA
C2	Coarse	14	2.5	4	3	0.87	2.60	0.0694			0.05		
	Fine	24	6.5	2	2	23.32	46.60	0.361	6.5	11.7	0.29	14.1	27.4
	Gravel	8	2.4	1	1	2.90	2.90				0.21		
	No Recovery	2	0.7	0	0	No samples	No samples						
C3 to C4	Coarse	93	34.7	5	5	0.94	1.30	0.178			0.14		
	Fine	12	4.4	9	9	0.54	1.00	0.0124	0.89	1.25	0.01	0.801	0.96
	Gravel	27	12.1	3	3	0.51	0.91				0.08		
	No Recovery	12	4.7	0	0	No samples	No samples						
C5 to C8	Coarse	coarse	138.1	22	22	0.57	1.40	0.0366			0.03		
	Fine	fine	33.5	25	25	0.97	6.30	0.00780			0.01	0.640	0.82
	Gravel**	gravel	19.2	0	0	**0.49**	No samples				0.10		
	No Recovery	NR	87.2	0	0	No samples	No samples						
C9 to C10	Coarse	coarse	35.4	1	1	0.57	0.57	0.0900			0.09		
	Fine	fine	358.3	15	15	0.64	1.70	0.0607			0.06	0.615	0.822
	Gravel[b]	gravel	11.0	0	0	**0.57**	No samples				0.03		
	No Recovery	NR	63.7	0	0	No samples	No samples						

Notes:
Non-weighted UCLs calculation used. No substitutions were made for gravel and no recovery samples
Areas of no sediment recovery were not included in the assessment or spatial weighting

a. Snow Creek values are representive of 16 samples collected from individual deposits and are not spatially weighted. A reach EPC of 0.58 mg/kg based on the maximum concentration was selected.
b. Gravel areas without samples in a given reach were assumed to have a gravel PCB concentration equal to mean Coarse Sediment for that reach
*** Dataset is small; UCL may be unreliable
Blue shading indicates selected EPC value
AA: assessment area
ac: acres
EPC: exposure point concentration
Hg: mercury
mg/kg: milligrams per kilogram
NA: not applicable or not calculated
NR: no recovery
PCB: polychlorinated biphenyl
UCL: Upper Confidence Limit

Table 4-5b. EPC Calculation Details Table for Mercury in Surface Sediments by Assessment Area
Anniston PCB Site, Anniston, Alabama

Data Groups		Descriptive Statistics						MCA (Fine and Coarse)			MCA (Fine + Coarse + Gravel)		
Hg Reach	**Sediment Texture**	**Core Locations (n)**	**Surface Area (ac)**	**Hg Samples (n)**	**Detected Samples (n)**	**Mean Surface Hg (mg/kg)**	**Max Surface Hg (mg/kg)**	**Sample Weighting Factor**	**Mean**	**95% of Bootstrap Means**	**Reach Sample Weighting Factor**	**Reach Bootstrap Mean**	**Reach 95%tile of Bootstrap Means**
C1[a]	Snow Creek[a]	16	NA	2	2	0.55	0.58				NA	NA	NA
Upper	Coarse	107	37.2	9	9	0.91	2.60	0.0861			0.07		
	Fine	36	10.8	11	11	4.68	46.60	0.0205	6.46	11.7	0.02	1.61	4.48
	Gravel	35	14.5	4	4	1.11	2.90				0.06		
	No Recovery	14	5.5	0	0	No samples	No samples						
Middle	Coarse	112	75.6	13	13	0.74	1.40	0.0727			0.07		
	Fine	7	4.4	11	11	0.70	1.20	0.0050	0.894	1.25	0.004	0.736	0.85
	Gravel**	15	9.5	0	NA	**0.62**	No samples				0.11		
	No Recovery	74	44.1	0	NA	No samples	No samples						
Lower	Coarse	106	97.9	10	10	0.35	0.57	0.0202			0.02		
	Fine	137	387.4	29	29	0.90	6.30	0.0275			0.03	0.769	1.07
	Gravel[b]	25	20.7	0	0	**0.35**	No samples				0.04		
	No Recovery	101	106.8	0	0	No samples	No samples						

Notes:

Areas of no sediment recovery were not included in the assessment or spatial weighting

a. Snow Creek values are representive of 16 samples collected from individual deposits and are not spatially weighted. An AA EPC of 0.58 mg/kg based on the maximum concentration was selected.

b. Gravel areas without samples in a given reach were assumed to have a gravel PCB concentration equal to mean Coarse Sediment for that reac

Blue shading indicates selected EPC value

AA: assessment area

ac: acres

EPC: exposure point concentration

Hg: mercury

MCA: Monte-Carlo analysis

mg/kg: milligrams per kilogram

NA: not applicable or not calculated

PCB: polychlorinated bipheny

Table 4-6. Summary Statistics for Non-Mercury Metals in OU-4 Sediments
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	COPC	Total Sample Size (n)	Number of Detects	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)	Median	SD	CV	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
C1	barium	2	2	160.00	220.00	190.00	190.00	42.43	0.22	NA	220	Maximum
C1	chromium	2	2	42.00	46.00	44.00	44.00	2.83	0.06	NA	46	Maximum
C1	cobalt	2	2	16.00	21.00	18.50	18.50	3.54	0.19	NA	21	Maximum
C1	lead	2	2	57.00	110.00	83.50	83.50	37.48	0.45	NA	110	Maximum
C1	vanadium	2	2	52.00	53.00	52.50	52.50	0.71	0.01	NA	53	Maximum
C2	barium	4	4	15.90	172.00	86.23	78.50	68.43	0.79	NA	172	Maximum
C2	chromium	4	4	6.00	16.00	9.85	8.70	4.46	0.45	NA	16	Maximum
C2	cobalt	4	4	2.70	7.80	5.45	5.65	2.21	0.41	NA	7.8	Maximum
C2	lead	4	3	9.10	50.30	25.03	15.70	22.13	0.88	NA	50	Maximum
C2	vanadium	4	4	4.70	13.70	9.63	10.05	4.47	0.46	NA	14	Maximum
C3	barium	2	2	47.50	82.90	65.20	65.20	25.03	0.38	NA	83	Maximum
C3	chromium	2	2	16.90	20.80	18.85	18.85	2.76	0.15	NA	21	Maximum
C3	cobalt	2	2	7.00	10.50	8.75	8.75	2.48	0.28	NA	11	Maximum
C3	lead	2	2	10.20	13.90	12.05	12.05	2.62	0.22	NA	14	Maximum
C3	vanadium	2	2	9.40	17.20	13.30	13.30	5.52	0.42	NA	17	Maximum
C4	barium	2	2	35.10	47.50	41.30	41.30	8.77	0.21	NA	48	Maximum
C4	chromium	2	2	9.30	18.10	13.70	13.70	6.22	0.45	NA	18	Maximum
C4	cobalt	2	2	4.10	4.20	4.15	4.15	0.07	0.02	NA	4.2	Maximum
C4	lead	2	2	10.40	12.90	11.65	11.65	1.77	0.15	NA	13	Maximum
C4	vanadium	2	2	6.90	7.40	7.15	7.15	0.35	0.05	NA	7.4	Maximum
UAA	barium	8	8	15.90	172.00	69.74	48.75	49.99	0.72	103.2	103	UCL
UAA	chromium	8	8	6.00	20.80	13.06	13.10	5.55	0.42	16.78	17	UCL
UAA	cobalt	8	8	2.70	10.50	5.95	5.65	2.50	0.42	7.627	8	UCL
UAA	lead	8	7	9.10	50.30	17.50	12.90	14.65	0.84	30.28	30	UCL
UAA	vanadium	8	8	4.70	17.20	9.93	8.40	4.29	0.43	12.8	13	UCL
C5	barium	4	4	24.10	251.00	85.50	33.45	110.40	1.29	NA	251	Maximum
C5	chromium	4	4	6.30	54.70	19.05	7.60	23.77	1.25	NA	55	Maximum
C5	cobalt	4	4	2.30	34.30	10.66	3.03	15.77	1.48	NA	34	Maximum
C5	lead	4	4	4.30	71.00	22.31	6.98	32.49	1.46	NA	71	Maximum
C5	vanadium	4	4	3.15	43.10	13.66	4.20	19.64	1.44	NA	43	Maximum

Table 4-6. Summary Statistics for Non-Mercury Metals in OU-4 Sediments
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	COPC	Total Sample Size (n)	Number of Detects	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)	Median	SD	CV	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
C6	barium	4	4	24.10	251.00	85.50	33.45	110.40	1.29	NA	251	Maximum[5]
C6	chromium	4	4	6.30	54.70	19.05	7.60	23.77	1.25	NA	55	Maximum[5]
C6	cobalt	4	4	2.30	34.30	10.66	3.03	15.77	1.48	NA	34	Maximum[5]
C6	lead	4	4	4.30	71.00	22.31	6.98	32.49	1.46	NA	71	Maximum[5]
C6	vanadium	4	4	3.15	43.10	13.66	4.20	19.64	1.44	NA	43	Maximum[5]
MAA	barium	4	4	24.10	251.00	85.50	33.45	110.40	1.29	NA	251	Maximum
MAA	chromium	4	4	6.30	54.70	19.05	7.60	23.77	1.25	NA	55	Maximum
MAA	cobalt	4	4	2.30	34.30	10.66	3.03	15.77	1.48	NA	34	Maximum
MAA	lead	4	4	4.30	71.00	22.31	6.98	32.49	1.46	NA	71	Maximum
MAA	vanadium	4	4	3.15	43.10	13.66	4.20	19.64	1.44	NA	43	Maximum
C7	barium	3	3	14.30	26.90	20.05	18.95	6.37	0.32	NA	27	Maximum
C7	chromium	3	3	8.15	13.60	10.08	8.50	3.05	0.30	NA	14	Maximum
C7	cobalt	3	3	2.45	3.90	3.25	3.40	0.74	0.23	NA	4	Maximum
C7	lead	3	3	7.05	9.20	8.22	8.40	1.09	0.13	NA	9	Maximum
C7	vanadium	3	3	5.05	7.60	5.98	5.30	1.41	0.24	NA	8	Maximum
C8	barium	3	3	14.30	26.90	20.05	18.95	6.37	0.32	NA	27	Maximum[5]
C8	chromium	3	3	8.15	13.60	10.08	8.50	3.05	0.30	NA	14	Maximum[5]
C8	cobalt	3	3	2.45	3.90	3.25	3.40	0.74	0.23	NA	4	Maximum[5]
C8	lead	3	3	7.05	9.20	8.22	8.40	1.09	0.13	NA	9	Maximum[5]
C8	vanadium	3	3	5.05	7.60	5.98	5.30	1.41	0.24	NA	8	Maximum[5]
C9	barium	1	1	88.80	88.80	88.80	88.80	NA	NA	NA	89	Maximum
C9	chromium	1	1	23.10	23.10	23.10	23.10	NA	NA	NA	23	Maximum
C9	cobalt	1	1	9.30	9.30	9.30	9.30	NA	NA	NA	9.3	Maximum
C9	lead	1	1	23.90	23.90	23.90	23.90	NA	NA	NA	24	Maximum
C9	vanadium	1	1	16.20	16.20	16.20	16.20	NA	NA	NA	16	Maximum
C10	barium	10	10	39.20	134.00	89.46	100.30	35.03	0.39	110	110	UCL
C10	chromium	10	10	7.50	41.20	21.71	20.25	10.92	0.50	28	28	UCL
C10	cobalt	10	10	4.00	13.30	8.03	7.73	2.93	0.37	10	9.7	UCL
C10	lead	10	10	6.30	36.10	20.10	19.45	11.13	0.55	27	27	UCL
C10	vanadium	10	10	7.50	30.90	17.51	17.55	7.99	0.46	22	22	UCL

Table 4-6. Summary Statistics for Non-Mercury Metals in OU-4 Sediments
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	COPC	Total Sample Size (n)	Number of Detects	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)	Median	SD	CV	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
LAA	barium	14	14	14.30	134.00	74.54	82.15	41.57	0.56	94	94	UCL
LAA	chromium	14	14	7.50	41.20	19.32	16.80	10.45	0.54	24	24	UCL
LAA	cobalt	14	14	2.45	13.30	7.09	7.28	3.24	0.46	9	9	UCL
LAA	lead	14	14	6.30	36.10	17.82	13.43	10.68	0.60	23	23	UCL
LAA	vanadium	14	14	5.05	30.90	14.94	15.88	8.26	0.55	19	19	UCL

Notes:

[1] See Figure 4-1 for locations of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

[5] Data for the reach directly upstream was used as a surrogate for C6 and C8.

AA: assessment area

COPC: constituent of potential concern

CV: coefficient of variation

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

MAD: median absolute deviation

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

SD: standard deviation

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-7. Summary Statistics for Polychlorinated Biphenyls in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected PCB Concentration (mg/kg)	Maximum of Detected PCB Concentration (mg/kg)	Standard Deviation of Detected PCB Concentration (mg/kg)	UCL [2,3] (mg/kg)	EPC [4] (mg/kg)	EPC Basis
C1	Oxford Lake Park	east	94	75	11.03	59.00	12.91	11.4	11.4	UCL
C1	Oxford Lake Park	west	6	6	52.90	206.50	80.30	NA	206.5	Maximum
C2	Backwater Area	central	35	4	0.59	1.76	0.81	NA	1.8	Maximum
C2	Backwater Area	south	22	3	0.26	0.38	0.10	NA	0.4	Maximum
C2	Backwater Area	riparian	17	4	8.58	32.00	15.63	NA	32.0	Maximum
C2	Backwater Area	north	38	29	3.56	32.00	6.56	5.5	5.5	UCL
C3	Friendship Road to Highway 21	north	82	78	11.06	75.00	13.72	13.6	13.6	UCL
C3	Friendship Road to Highway 21	riparian	22	21	13.14	79.40	18.23	24	24.0	UCL
C3	Friendship Road to Highway 21	south	70	45	12.97	79.40	19.41	28.3	28.3	UCL
C4	Highway 21 to Silver Run Road	north	147	115	4.36	38.00	7.21	9.4	9.4	UCL
C4	Highway 21 to Silver Run Road	south	145	118	6.18	51.50	7.93	6.3	6.3	UCL
C4	Highway 21 to Silver Run Road	riparian	52	49	8.01	31.30	7.97	9.8	9.8	UCL
UAA	Floodplain Soil and Riparian Soil	floodplain	539	392	7.10	79.40	11.30	9.5	9.5	UCL
UAA	Riparian Soil Only	riparian	91	74	9.49	79.40	12.17	10	10.2	UCL
C5	Silver Run Road to Mitchell Matson Road	south	101	52	1.95	15.50	2.47	1.5	1.5	UCL
C5	Silver Run Road to Mitchell Matson Road	north	127	68	1.38	9.39	1.95	1.0	1.0	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	57	51	2.37	15.50	2.76	2.9	2.9	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	23	16	1.75	5.20	1.75	1.8	1.8	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	24	15	1.87	9.95	2.65	2.7	2.7	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	29	24	1.84	9.95	2.24	2.6	2.6	UCL
MAA	Floodplain Soil and Riparian Soil	floodplain	275	151	1.66	15.50	2.19	1.4	1.4	UCL
MAA	Riparian Soil	riparian	86	75	2.20	15.50	2.60	2.5	2.5	UCL
C7	upstream of Curry Station Road to Eastaboga Creek	north	91	39	0.64	8.39	1.42	0.7	0.7	UCL
C7	upstream of Curry Station Road to Eastaboga Creek	south	103	40	1.57	9.90	2.37	1.3	1.3	UCL
C7	upstream of Curry Station Road to Eastaboga Creek	riparian	37	33	1.95	9.90	2.28	2.6	2.6	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	south	20	10	0.72	3.08	1.22	1.3	1.3	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	north	24	18	1.39	5.46	1.58	1.9	1.9	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	19	18	1.72	5.46	1.58	2.3	2.3	UCL
C9	Jackson Shoals Dam to Highway 77	south	20	11	0.41	0.58	0.13	0.3	0.3	UCL
C9	Jackson Shoals Dam to Highway 77	north	21	8	1.22	5.10	1.75	1.6	1.6	UCL
C9	Jackson Shoals Dam to Highway 77	riparian	14	13	0.98	5.10	1.36	2.3	2.3	UCL
LAA	Floodplain Soil and Riparian Soil	floodplain	288	132	1.04	9.90	1.75	0.8	0.8	UCL
LAA	Riparian Soil	riparian	79	70	1.58	9.90	1.90	1.8	1.8	UCL

Table 4-7. Summary Statistics for Polychlorinated Biphenyls in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for locations of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-8. Summary Statistics for Mercury in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Mercury Concentration (mg/kg)	Maximum of Detected Mercury Concentration (mg/kg)	Standard Deviation of Detected Mercury Concentration (mg/kg)	UCL [2,3] (mg/kg)	EPC [4] (mg/kg)	EPC Basis
C2	Backwater Area	south	22	22	0.05	0.21	0.04	0.07	0.07	UCL
C2	Backwater Area	central	34	34	0.08	0.70	0.11	0.2	0.2	UCL
C2	Backwater Area	riparian	16	16	0.17	1.10	0.30	0.5	0.5	UCL
C2	Backwater Area	north	16	15	0.42	2.40	0.67	1.4	1.4	UCL
C3	Friendship Road to Highway 21	north	77	77	2.56	16.50	2.78	3.2	3.2	UCL
C3	Friendship Road to Highway 21	south	63	62	1.79	13.00	2.93	3.4	3.4	UCL
C3	Friendship Road to Highway 21	riparian	13	13	3.22	13.00	3.58	5.9	5.9	UCL
C4	Highway 21 to Silver Run Road	riparian	36	36	2.51	17.40	3.36	3.6	3.6	UCL
C4	Highway 21 to Silver Run Road	north	103	103	1.51	21.70	3.13	2.2	2.2	UCL
C4	Highway 21 to Silver Run Road	south	131	131	1.95	16.30	2.55	2.4	2.4	UCL
UAA	Floodplain Soil and Riparian Soil	floodplain	446	444	1.64	21.70	2.69	2.2	2.2	UCL
UAA	Riparian Soil	riparian	65	65	2.08	17.40	3.14	2.8	2.8	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	44	44	1.02	3.90	1.12	1.4	1.4	UCL
C5	Silver Run Road to Mitchell Matson Road	north	120	120	0.44	3.70	0.74	0.7	0.7	UCL
C5	Silver Run Road to Mitchell Matson Road	south	92	92	0.53	3.90	0.82	0.9	0.9	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	29	29	1.27	8.40	1.83	2.0	2.0	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	23	23	0.88	3.40	1.13	1.6	1.6	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	24	24	1.03	8.40	1.94	2.8	2.8	UCL
MAA	Floodplain Soil and Riparian Soil	floodplain	259	259	0.57	8.40	0.99	0.8	0.8	UCL
MAA	Riparian Soil	riparian	73	73	1.12	8.40	1.44	1.4	1.4	UCL
C7	Upstream of Curry Station Road to Eastaboga Creek	north	40	38	0.25	2.20	0.45	0.5	0.5	UCL
C7	Upstream of Curry Station Road to Eastaboga Creek	south	52	52	0.69	8.40	1.76	1.8	1.8	UCL
C7	Upstream of Curry Station Road to Eastaboga Creek	riparian	13	12	2.01	7.60	2.38	3.0	3.0	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	0.70	0.75	0.07	NA	0.8	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	1.75	4.65	1.94	NA	4.7	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	north	6	6	0.95	4.65	1.85	NA	4.7	Maximum
C9	Jackson Shoals Dam to Highway 77	south	20	20	0.33	0.86	0.28	0.5	0.5	UCL
C9	Jackson Shoals Dam to Highway 77	riparian	13	13	0.88	5.10	1.30	1.7	1.7	UCL
C9	Jackson Shoals Dam to Highway 77	north	20	12	0.67	5.10	1.43	1.7	1.7	UCL
LAA	Floodplain Soil and Riparian Soil	floodplain	140	130	0.52	8.40	1.28	0.9	0.9	UCL
LAA	Riparian Soil	riparian	30	29	1.47	7.60	1.91	3.9	3.9	UCL

Table 4-8. Summary Statistics for Mercury in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for locations of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-9. Summary Statistics for Chromium in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Chromium Concentration (mg/kg)	Maximum of Detected Chromium Concentration (mg/kg)	Standard Deviation of Detected Chromium Concentration[1] (mg/kg)	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
C2	Backwater Area	south	2	2	11.00	11.20	0.28	NA	11.2	Maximum
C2	Backwater Area	riparian	3	3	11.45	13.40	1.84	NA	13.4	Maximum
C2	Backwater Area	central	3	3	11.12	13.40	1.99	NA	13.4	Maximum
C2	Backwater Area	north	2	2	28.90	34.40	7.78	NA	34.4	Maximum
C3	Friendship Road to Highway 21	north	7	7	12.61	17.90	3.85	NA	17.9	Maximum
C3	Friendship Road to Highway 21	riparian	1	1	16.20	16.20	NA	NA	16.2	Maximum
C3	Friendship Road to Highway 21	south	6	6	24.52	55.20	18.49	NA	55.2	Maximum
C4	Highway 21 to Silver Run Road	south	11	11	18.80	35.30	9.49	26.2	26.2	UCL
C4	Highway 21 to Silver Run Road	north	9	9	24.34	53.10	17.18	43.8	43.8	UCL
C4	Highway 21 to Silver Run Road	riparian	4	4	26.43	46.00	14.00	NA	46.0	Maximum
UAA	Floodplain Soil and Riparian Soil	floodplain	40	40	19.36	55.20	12.77	28.2	28.2	UCL
UAA	Riparian Soil	riparian	8	8	19.53	46.00	11.90	27.5	27.5	UCL
C5	Silver Run Road to Mitchell Matson Road	north	10	10	14.47	35.80	9.35	19.9	19.9	UCL
C5	Silver Run Road to Mitchell Matson Road	south	8	8	16.68	41.90	12.44	25.0	25.0	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	2	2	24.50	41.90	24.61	NA	41.9	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	2	2	8.80	10.00	1.70	NA	10.0	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	2	2	15.85	18.40	3.61	NA	18.4	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	1	1	18.40	18.40	NA	NA	18.4	Maximum
MAA	Floodplain Soil and Riparian Soil	floodplain	22	22	14.88	41.90	9.73	19.0	19.0	UCL
MAA	Riparian Soil	riparian	3	3	22.47	41.90	17.75	NA	41.9	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	north	7	7	12.07	22.20	6.42	NA	22.2	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	riparian	5	5	13.54	27.80	8.52	NA	27.8	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	south	10	10	21.54	42.00	13.75	29.5	29.5	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	17.63	18.75	1.59	NA	18.8	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	north	3	3	18.33	23.70	4.87	NA	23.7	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	19.01	23.70	3.27	NA	23.7	Maximum
C9	Jackson Shoals Dam to Highway 77	south	2	2	13.15	14.10	1.34	NA	14.1	Maximum
C9	Jackson Shoals Dam to Highway 77	riparian	1	1	14.40	14.40	NA	NA	14.4	Maximum
C9	Jackson Shoals Dam to Highway 77	north	2	2	11.00	14.40	4.81	NA	14.4	Maximum
LAA	Floodplain Soil and Riparian Soil	floodplain	26	26	16.86	42.00	10.01	20.2	20.2	UCL
LAA	Riparian Soil	riparian	10	10	15.82	27.80	6.59	19.6	19.6	UCL

Table 4-9. Summary Statistics for Chromium in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for location of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-10. Summary Statistics for Lead in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Lead Concentration (mg/kg)	Maximum of Detected Lead Concentration (mg/kg)	Standard Deviation of Detected Lead Concentration[1] (mg/kg)	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
C2	Backwater Area	south	2	2	20.15	22.80	3.75	NA	22.8	Maximum
C2	Backwater Area	north	2	2	20.65	30.00	13.22	NA	30.0	Maximum
C2	Backwater Area	central	3	3	32.82	44.80	13.03	NA	44.8	Maximum
C2	Backwater Area	riparian	3	3	27.08	44.80	15.36	NA	44.8	Maximum
C3	Friendship Road to Highway 21	riparian	1	1	35.90	35.90	NA	NA	35.9	Maximum
C3	Friendship Road to Highway 21	north	7	7	32.10	43.10	8.67	NA	43.1	Maximum
C3	Friendship Road to Highway 21	south	6	6	53.40	106.00	33.79	NA	106.0	Maximum
C4	Highway 21 to Silver Run Road	south	11	11	37.18	85.70	22.56	49.5	49.5	UCL
C4	Highway 21 to Silver Run Road	north	9	9	44.30	89.10	30.05	62.9	62.9	UCL
C4	Highway 21 to Silver Run Road	riparian	4	4	52.88	89.10	26.31	NA	89.1	Maximum
UAA	Floodplain Soil and Riparian Soil	floodplain	40	40	38.32	106.00	23.94	45.3	45.3	UCL
UAA	Riparian Soil	riparian	8	8	41.08	89.10	23.05	56.5	56.5	UCL
C5	Silver Run Road to Mitchell Matson Road	north	10	10	17.04	39.20	8.23	21.8	21.8	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	2	2	39.65	52.70	18.46	NA	52.7	Maximum
C5	Silver Run Road to Mitchell Matson Road	south	8	8	34.08	95.60	29.60	53.9	53.9	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	2	2	13.75	14.30	0.78	NA	14.3	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	2	2	17.85	25.50	10.82	NA	25.5	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	1	1	25.50	25.50	NA	NA	25.5	Maximum
MAA	Floodplain Soil and Riparian Soil	floodplain	22	22	23.01	95.60	20.03	41.6	41.6	UCL
MAA	Riparian Soil	riparian	3	3	34.93	52.70	15.40	NA	52.7	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	south	10	10	20.22	32.10	7.92	24.8	24.8	UCL
C7	Upstream of Curry Station Road to Eastaboga Creek	riparian	5	5	18.94	32.10	8.87	NA	32.1	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	north	7	7	21.39	39.40	9.86	NA	39.4	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	north	3	3	24.98	29.50	5.69	NA	29.5	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	25.15	30.45	4.97	NA	30.5	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	27.57	30.45	4.07	NA	30.5	Maximum
C9	Jackson Shoals Dam to Highway 77	north	2	2	14.25	15.50	1.77	NA	15.5	Maximum
C9	Jackson Shoals Dam to Highway 77	riparian	1	1	15.50	15.50	NA	NA	15.5	Maximum
C9	Jackson Shoals Dam to Highway 77	south	2	2	16.45	18.60	3.04	NA	18.6	Maximum
LAA	Floodplain Soil and Riparian Soil	floodplain	26	26	20.90	39.40	7.78	23.5	23.5	UCL
LAA	Riparian Soil	riparian	10	10	21.08	32.10	7.52	25.4	25.4	UCL

Table 4-10. Summary Statistics for Lead in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for location of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-11. Summary Statistics for Vanadium in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Vanadium Concentration (mg/kg)	Maximum of Detected Vanadium Concentration (mg/kg)	Standard Deviation of Detected Vanadium Concentration[1] (mg/kg)	UCL[2,3] (mg/kg)	EPC[4] (mg/kg)	EPC Basis
C2	Backwater Area	central	3	3	16.22	19.40	2.76	NA	19.4	Maximum
C2	Backwater Area	riparian	3	3	18.88	22.80	4.20	NA	22.8	Maximum
C2	Backwater Area	south	2	2	20.05	22.80	3.89	NA	22.8	Maximum
C2	Backwater Area	north	2	2	21.75	22.90	1.63	NA	22.9	Maximum
C3	Friendship Road to Highway 21	riparian	1	1	15.80	15.80	NA	NA	15.8	Maximum
C3	Friendship Road to Highway 21	north	7	7	16.63	19.60	2.74	NA	19.6	Maximum
C3	Friendship Road to Highway 21	south	6	6	17.98	24.80	4.83	NA	24.8	Maximum
C4	Highway 21 to Silver Run Road	riparian	4	4	17.75	22.20	3.58	NA	22.2	Maximum
C4	Highway 21 to Silver Run Road	south	11	11	20.16	25.50	4.44	22.6	22.6	UCL
C4	Highway 21 to Silver Run Road	north	9	9	20.78	27.20	4.05	23.3	23.3	UCL
UAA	Floodplain Soil and Riparian Soil	floodplain	40	40	19.13	27.20	4.09	20.2	20.2	UCL
UAA	Riparian Soil	riparian	8	8	17.93	22.80	3.40	20.2	20.2	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	2	2	13.35	15.70	3.32	NA	15.7	Maximum
C5	Silver Run Road to Mitchell Matson Road	north	10	10	21.16	42.80	11.95	28.1	28.1	UCL
C5	Silver Run Road to Mitchell Matson Road	south	8	8	22.66	44.90	14.02	32.1	32.1	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	2	2	12.60	12.90	0.42	NA	12.9	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	1	1	13.30	13.30	NA	NA	13.3	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	2	2	20.25	27.20	9.83	NA	27.2	Maximum
MAA	Floodplain Soil and Riparian Soil	floodplain	22	22	20.85	44.90	11.80	25.2	25.2	UCL
MAA	Riparian Soil	riparian	3	3	13.33	15.70	2.35	NA	15.7	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	riparian	5	5	12.86	15.40	2.50	NA	15.4	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	north	7	7	16.96	28.80	7.45	NA	28.8	Maximum
C7	Upstream of Curry Station Road to Eastaboga Creek	south	10	10	21.89	45.40	13.78	29.9	29.9	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	north	3	3	15.72	22.80	6.33	NA	22.8	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	19.91	28.30	9.04	NA	28.3	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	27.65	28.30	0.92	NA	28.3	Maximum
C9	Jackson Shoals Dam to Highway 77	riparian	1	1	9.70	9.70	NA	NA	9.7	Maximum
C9	Jackson Shoals Dam to Highway 77	north	2	2	10.95	12.20	1.77	NA	12.2	Maximum
C9	Jackson Shoals Dam to Highway 77	south	2	2	24.25	27.00	3.89	NA	27.0	Maximum
LAA	Floodplain Soil and Riparian Soil	floodplain	26	26	19.63	45.40	10.22	23.7	23.7	UCL
LAA	Riparian Soil	riparian	10	10	15.37	28.30	6.80	20.7	20.7	UCL

Table 4-11. Summary Statistics for Vanadium in OU-4 Floodplain Soils
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for location of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-12. Summary Statistics for Barium in Soil [5]
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Barium Concentration (mg/kg)	Maximum of Detected Barium Concentration (mg/kg)	Standard Deviation of Detected Barium Concentration (mg/kg)	UCL [2,3] (mg/kg)	EPC [4] (mg/kg)	EPC Basis
C2	Backwater Area	central	3	3	124.00	138.00	15.72	NA	138	Maximum
C2	Backwater Area	north	2	2	77.80	86.10	11.74	NA	86.1	Maximum
C2	Backwater Area	riparian	3	3	114.50	138.00	20.75	NA	138	Maximum
C2	Backwater Area	south	2	2	117.30	136.00	26.45	NA	136	Maximum
C3	Friendship Road to Highway 21	north	7	7	101.50	137.00	32.64	NA	137	Maximum
C3	Friendship Road to Highway 21	riparian	1	1	117.00	117.00	NA	NA	117	Maximum
C3	Friendship Road to Highway 21	south	6	6	109.90	171.00	39.49	NA	171	Maximum
C4	Highway 21 to Silver Run Road	north	9	9	128.10	197.00	55.28	162.4	162.4	UCL
C4	Highway 21 to Silver Run Road	riparian	4	4	130.30	189.00	46.89	NA	189	Maximum
C4	Highway 21 to Silver Run Road	south	11	11	122.60	180.00	29.24	138.6	138.6	UCL
UAA	Floodplain Soil and Riparian Soil	floodplain	40	40	115.80	197.00	37.59	125.9	125.9	UCL
UAA	Riparian Soil Only	riparian	8	8	122.70	189.00	33.63	145.2	145.2	UCL
C5	Silver Run Road to Mitchell Matson Road	north	10	10	88.45	145.80	39.78	111.5	111.5	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	2	2	107.90	137.00	41.15	NA	137	Maximum
C5	Silver Run Road to Mitchell Matson Road	south	8	8	65.71	137.00	40.25	92.67	92.7	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	2	2	62.40	74.90	17.68	NA	74.9	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	1	1	74.90	74.90	NA	NA	74.9	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	2	2	66.25	85.40	27.08	NA	85.4	Maximum
MAA	Floodplain Soil and Riparian Soil	floodplain	22	22	75.79	145.80	37.54	89.56	89.6	UCL
MAA	Riparian Soil	riparian	3	3	96.90	137.00	34.78	NA	137	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	north	7	7	90.70	139.00	33.28	NA	139	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	riparian	5	5	77.84	107.00	19.99	NA	107	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	south	10	10	81.11	163.00	36.83	110.1	110.1	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	north	3	3	92.02	130.00	35.72	NA	130	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	104.40	142.50	38.36	NA	142.5	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	135.80	142.50	9.55	NA	142.5	Maximum
C9	Jackson Shoals Dam to Highway 77	north	2	2	55.40	57.60	3.11	NA	57.6	Maximum
C9	Jackson Shoals Dam to Highway 77	riparian	1	1	57.60	57.60	NA	NA	57.6	Maximum
C9	Jackson Shoals Dam to Highway 77	south	2	2	91.80	116.00	34.22	NA	116	Maximum
LAA	Floodplain Soil and Riparian Soil	floodplain	26	26	88.00	163.00	34.62	101.6	101.6	UCL
LAA	Riparian Soil	riparian	10	10	86.44	142.50	30.74	104.3	104.3	UCL

Table 4-12. Summary Statistics for Barium in Soil [5]
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for location of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

[5] Barium is not a COPC in soil. Data included for foodweb modeling for mixed-diet receptors.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-13. Summary Statistics for Cobalt in Soil [5]
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	Description	Subgroup	Total Sample Size (n)	Number of Detects	Mean of Detected Cobalt Concentration (mg/kg)	Maximum of Detected Cobalt Concentration (mg/kg)	Standard Deviation of Detected Cobalt Concentration (mg/kg)	UCL [2,3] (mg/kg)	EPC [4] (mg/kg)	EPC Based on
C2	Backwater Area	central	3	3	10.22	11.40	1.20	NA	11.4	Maximum
C2	Backwater Area	north	2	2	5.80	6.50	0.99	NA	6.5	Maximum
C2	Backwater Area	riparian	3	3	9.95	11.40	1.62	NA	11.4	Maximum
C2	Backwater Area	south	2	2	9.10	10.00	1.27	NA	10	Maximum
C3	Friendship Road to Highway 21	north	7	7	7.79	10.60	2.32	NA	10.6	Maximum
C3	Friendship Road to Highway 21	riparian	1	1	8.50	8.50	NA	NA	8.5	Maximum
C3	Friendship Road to Highway 21	south	6	6	8.40	13.80	3.55	NA	13.8	Maximum
C4	Highway 21 to Silver Run Road	north	9	9	9.21	12.60	2.89	11.0	11.0	UCL
C4	Highway 21 to Silver Run Road	riparian	4	4	9.20	11.70	1.75	NA	11.7	Maximum
C4	Highway 21 to Silver Run Road	south	11	11	8.96	12.60	2.39	10.3	10.3	UCL
UAA	Floodplain Soil and Riparian Soil	floodplain	40	40	8.67	13.80	2.57	9.4	9.4	UCL
UAA	Riparian Soil Only	riparian	8	8	9.39	11.70	1.53	10.4	10.4	UCL
C5	Silver Run Road to Mitchell Matson Road	north	10	10	7.89	15.25	3.86	10.1	10.1	UCL
C5	Silver Run Road to Mitchell Matson Road	riparian	2	2	7.70	8.60	1.27	NA	8.6	Maximum
C5	Silver Run Road to Mitchell Matson Road	south	8	8	5.91	10.00	2.58	7.6	7.6	UCL
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	north	2	2	6.65	7.10	0.64	NA	7.1	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	riparian	1	1	7.10	7.10	NA	NA	7.1	Maximum
C6	Mitchell Matson Road to 2,000 feet upstream of Curry Station Road	south	2	2	5.10	5.20	0.14	NA	5.2	Maximum
MAA	Floodplain Soil and Riparian Soil	floodplain	22	22	6.80	15.25	3.12	8.1	8.1	UCL
MAA	Riparian Soil	riparian	3	3	7.50	8.60	0.96	NA	8.6	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	north	7	7	10.14	25.20	6.91	NA	25.2	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	riparian	5	5	6.92	8.50	1.29	NA	8.5	Maximum
C7	upstream of Curry Station Road to Eastaboga Creek	south	10	10	8.68	15.40	3.59	10.8	10.8	UCL
C8	Eastaboga Creek to Jackson Shoals Dam	north	3	3	7.60	8.10	0.78	NA	8.1	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	riparian	4	4	10.30	13.60	3.46	NA	13.6	Maximum
C8	Eastaboga Creek to Jackson Shoals Dam	south	2	2	13.25	13.60	0.50	NA	13.6	Maximum
C9	Jackson Shoals Dam to Highway 77	north	2	2	5.40	5.50	0.14	NA	5.5	Maximum
C9	Jackson Shoals Dam to Highway 77	riparian	1	1	5.50	5.50	NA	NA	5.5	Maximum
C9	Jackson Shoals Dam to Highway 77	south	2	2	6.95	7.90	1.34	NA	7.9	Maximum
LAA	Floodplain Soil and Riparian Soil	floodplain	26	26	8.91	25.20	4.44	10.5	10.5	UCL
LAA	Riparian Soil	riparian	10	10	8.13	13.60	2.90	9.8	9.8	UCL

Table 4-13. Summary Statistics for Cobalt in Soil [5]
Anniston PCB Site, Anniston, Alabama

Notes:

[1] See Figure 4-1 for location of reaches.

[2] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[3] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[4] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

[5] Cobalt is not a COPC in soil. Data included for foodweb modeling for mixed-diet receptors.

AA: assessment area

EPC: exposure point concentration

LAA: lower assessment area

MAA: middle assessment area

mg/kg: milligram per kilogram

n: sample size

NA: value not available; too few samples for UCL calculation

PCB: polychlorinated biphenyl

UAA: upper assessment area

UCL: 95% upper confidence limit

USEPA: United States Environmental Protection Agency

Reference:

USEPA. 2016. ProUCL 5.1 A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-14. Summary Statistics for COPCs in OU-4 Surface Water
Anniston PCB Site, Anniston, Alabama

Reach or AA [1]	COPC	Total Sample Size (n)	Detects	NumNDs	% FOD	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median	SD	CV	UCL[1,2] (mg/L)	EPC[3] (mg/L)	EPC Basis
C1	Barium	4	4	0	100%	0.0241	0.201	0.086	0.059	0.083	0.97	--	0.20	Maximum
C1	Chromium	4	4	0	100%	0.002	0.0329	0.012	0.0065	0.015	1.2	--	0.033	Maximum
C1	Cobalt	4	2	2	50%	0.005	0.0122	0.0086	0.0086	0.0051	0.59	--	0.012	Maximum
C1	Lead	4	4	0	100%	0.0042	0.0964	0.034	0.017	0.043	1.3	--	0.096	Maximum
C1	Vanadium	4	4	0	100%	0.0041	0.0339	0.015	0.011	0.014	0.94	--	0.034	Maximum
C1	Mercury	4	2	2	50%	0.00015	0.00043	0.00029	0.00029	0.00020	0.68	--	0.00043	Maximum
C1	Total Homolog PCBs	3	3	0	100%	0.000175	0.000498	0.00036	0.00040	0.00017	0.46	--	0.00050	Maximum
UAA	Barium	4	4	0	100%	0.0251	0.0319	0.030	0.031	0.0030	0.10	--	0.032	Maximum
UAA	Chromium	4	4	0	100%	0.000575	0.0017	0.0011	0.0011	0.00046	0.42	--	0.0017	Maximum
UAA	Cobalt	4	0	4	0%	NA	NA	NA	NA	NA	NA	--	--	ND
UAA	Lead	4	4	0	100%	0.00048	0.00084	0.00063	0.00060	0.00016	0.26	--	0.00084	Maximum
UAA	Vanadium	4	4	0	100%	0.000495	0.0013	0.0010	0.0012	0.00036	0.35	--	0.0013	Maximum
UAA	Mercury	15	0	15	0%	NA	NA	NA	NA	NA	NA	--	--	ND
UAA	Total Homolog PCBs	15	11	4	73%	0.000016	0.000132	0.000068	0.000064	0.000036	0.53	0.000083	0.000083	UCL
MAA	Barium	2	2	0	100%	0.0248	0.0428	0.034	0.034	0.013	0.38	--	0.043	Maximum
MAA	Chromium	2	1	1	50%	0.004	0.004	0.0040	0.0040	NA	NA	--	0.0040	Maximum
MAA	Cobalt	2	1	1	50%	0.0022	0.0022	0.0022	0.0022	NA	NA	--	0.0022	Maximum
MAA	Lead	2	2	0	100%	0.00058	0.0048	0.0027	0.0027	0.0030	1.1	--	0.0048	Maximum
MAA	Vanadium	2	2	0	100%	0.00057	0.0031	0.0018	0.0018	0.0018	0.98	--	0.0031	Maximum
MAA	Mercury	12	0	12	0%	NA	NA	NA	NA	NA	NA	--	--	ND
MAA	Total Homolog PCBs	12	12	0	100%	0.0000476	0.000172	0.000087	0.000085	0.000032	0.37	0.00011	0.00011	UCL
LAA	Barium	1	1	0	100%	0.0244	0.0244	0.024	0.024	NA	NA	--	0.024	Maximum
LAA	Chromium	1	1	0	100%	0.00067	0.00067	0.00067	0.00067	NA	NA	--	0.00067	Maximum
LAA	Cobalt	1	0	1	0%	NA	NA	NA	NA	NA	NA	--	--	ND
LAA	Lead	1	1	0	100%	0.00034	0.00034	0.00034	0.00034	NA	NA	--	0.00034	Maximum
LAA	Vanadium	1	1	0	100%	0.00039	0.00039	0.00039	0.00039	NA	NA	--	0.00039	Maximum
LAA	Mercury	13	1	12	8%	0.000069	0.000069	0.000069	0.000069	NA	NA	--	0.000069	Maximum
LAA	Total Homolog PCBs	13	13	0	100%	0.000024	0.000309	0.000073	0.000054	0.000072	1.0	0.00016	0.00016	UCL
Sitewide	Barium	11	11	0	100%	0.0241	0.201	0.050	0.030	0.054	1.1	0.12	0.12	UCL
Sitewide	Chromium	11	10	1	91%	0.000575	0.0329	0.0057	0.0019	0.010	1.8	0.018	0.018	UCL
Sitewide	Cobalt	11	3	8	27%	0.0022	0.0122	0.0065	0.0050	0.0052	0.80	--	0.012	Maximum
Sitewide	Lead	11	11	0	100%	0.00034	0.0964	0.013	0.00084	0.029	2.2	0.067	0.067	UCL
Sitewide	Vanadium	11	11	0	100%	0.00039	0.0339	0.0061	0.0013	0.010	1.7	0.017	0.017	UCL
Sitewide	Mercury	44	3	41	7%	0.000069	0.00043	0.00022	0.00015	0.00019	0.88	--	0.00043	Maximum
Sitewide	Total Homolog PCBs	43	39	4	91%	0.000016	0.000498	0.00010	0.000069	0.00010	1.0	0.00016	0.00016	UCL

Table 4-14. Summary Statistics for COPCs in OU-4 Surface Water
Anniston PCB Site, Anniston, Alabama

Notes:

[1] Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.

[2] ProUCL 5.1 (USEPA 2016) was used to calculate summary statistics and UCL values.

[3] EPC based on the UCL when available, otherwise based on the maximum detected concentration.

Datasets with "NA" for UCL did not have enough samples for ProUCL to calculate a UCL.
ProUCL 4.1 (USEPA 2011) was used to calculate summary statistics and UCL values.
EPC based on the UCL when available, otherwise based on the maximum detected concentration.
COPC: constituent of potential concern
CV: coefficient of variation
EPC: exposure point concentration
LAA: lower assessment area
MAA: middle assessment area
MAD: median absolute deviation
MAD/0.675: Robust estimate of variability (standard deviation)
Maximum: Maximum value
Mean: Sample average value
Median: Median value
mg/L: milligram per liter
Minimum: Minimum value
n: sample size
NA: not available
ND: nondetect
Num Obs: Number of Observations
NumNDs: Number of Nondetects
SD: Classical sample standard deviation
UAA: upper assessment area
UCL: 95% upper confidence limit
USEPA: United States Environmental Protection Agency
% FOD: Frequency of Detection

Reference:

USEPA. 2016. ProUCL 5.1.A Statistical Software for Environmental Applications for Data Sets with and without non detect observations. National Exposure Research Lab, EPA, Las Vegas Nevada, May 2016. http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm

Table 4-15. Summary Statistics by Assessment Area - Aquatic Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Polychlorinated Biphenyls														
Aquatic Plants														
UAA	9 / 9	100	0.41	1.19	NA	NA	0.82	0.80	0.06	0.25	0.978	95% Student's-t UCL	0.978	UCL
MAA	6 / 9	67	0.39	1.69	0.08	0.12	0.87	0.75	0.29	0.54	0.978	95% KM (t) UCL	0.978	UCL
LAA	6 / 9	67	0.24	0.63	0.07	0.08	0.40	0.35	0.03	0.17	0.427	95% KM (t) UCL	0.427	UCL
Sitewide	21 / 27	78	0.24	1.69	0.07	0.12	0.72	0.65	0.15	0.38	0.715	95% KM (t) UCL	0.715	UCL
Emergent Insects														
UAA	9 / 9	100	0.31	27.22	NA	NA	15.63	20.49	125.80	11.21	22.58	95% Student's-t UCL	22.58	UCL
MAA	9 / 9	100	0.31	1.01	NA	NA	0.69	0.69	0.04	0.20	0.806	95% Student's-t UCL	0.806	UCL
LAA	9 / 9	100	0.67	1.38	NA	NA	0.96	0.95	0.06	0.25	1.109	95% Student's-t UCL	1.109	UCL
Sitewide	27 / 27	100	0.31	27.22	N/A	N/A	5.76	0.83	89.34	9.45	13.69	95% Chebyshev (Mean, Sd) UCL	13.69	UCL
Benthic Invertebrates (Odonata)														
UAA	9 / 9	100	0.86	3.51	NA	NA	1.70	1.25	0.96	0.98	2.653	95% Adjusted Gamma UCL	2.653	UCL
MAA	9 / 9	100	1.18	1.99	NA	NA	1.62	1.57	0.12	0.34	1.828	95% Student's-t UCL	1.828	UCL
LAA	9 / 9	100	0.61	1.57	NA	NA	0.92	0.90	0.07	0.27	1.089	95% Student's-t UCL	1.089	UCL
Sitewide	27 / 27	100	0.61	3.51	N/A	N/A	1.41	1.21	0.48	0.69	1.658	95% Adjusted Gamma UCL	1.658	UCL
Crayfish														
UAA	7 / 7	100	1.29	3.80	NA	NA	2.46	2.20	0.96	0.98	--	--	3.8	Maximum Detect
MAA	7 / 7	100	0.89	2.62	NA	NA	1.81	1.83	0.45	0.67	--	--	2.622	Maximum Detect
LAA	9 / 9	100	0.24	1.28	NA	NA	0.83	0.83	0.12	0.34	1.045	95% Student's-t UCL	1.045	UCL
Sitewide	23 / 23	100	0.24	3.80	N/A	N/A	1.63	1.29	0.92	0.96	1.97	95% Student's-t UCL	1.97	UCL
Mollusc														
UAA	9 / 9	100	5.91	16.89	NA	NA	11.72	11.59	17.42	4.17	14.3	95% Student's-t UCL	14.3	UCL
MAA	9 / 9	100	4.60	11.88	NA	NA	7.74	6.44	7.96	2.82	9.484	95% Student's-t UCL	9.484	UCL
LAA	9 / 9	100	6.08	13.77	NA	NA	10.58	11.01	4.94	2.22	11.96	95% Student's-t UCL	11.96	UCL
Sitewide	27 / 27	100	4.60	16.89	N/A	N/A	10.01	10.64	12.24	3.50	11.16	95% Student's-t UCL	11.16	UCL
Frogs														
UAA	7 / 7	100	2.53	38.45	NA	NA	15.15	14.58	139.80	11.82	--	--	38.45	Maximum Detect
MAA	7 / 7	100	2.42	4.58	NA	NA	3.39	3.09	0.70	0.84	--	--	4.582	Maximum Detect
LAA	2 / 2	100	5.29	5.43	NA	NA	5.36	5.36	0.01	0.10	--	--	5.431	Maximum Detect
Sitewide	16 / 16	100	2.42	38.45	N/A	N/A	8.78	4.93	90.22	9.50	14.41	95% H-UCL	14.41	UCL
Snakes														
UAA	2 / 2	100	25.89	166.50	NA	NA	96.21	96.21	9888.00	99.44	--	--	166.5	Maximum Detect
MAA	2 / 2	100	18.94	122.30	NA	NA	70.62	70.62	5342.00	73.09	--	--	122.3	Maximum Detect
LAA	7 / 7	100	26.08	55.17	NA	NA	39.16	34.75	110.60	10.52	--	--	55.17	Maximum Detect
Sitewide	11 / 11	100	18.94	166.50	N/A	N/A	55.25	34.75	2153.00	46.40	90.51	95% Adjusted Gamma UCL	90.51	UCL
Predator Fish														
UAA	9 / 9	100	21.79	175.20	NA	NA	84.03	88.74	1935.00	43.98	111.3	95% Student's-t UCL	111.3	UCL
MAA	9 / 9	100	36.99	126.50	NA	NA	74.03	71.67	1190.00	34.50	95.42	95% Student's-t UCL	95.42	UCL
LAA	9 / 9	100	42.47	126.80	NA	NA	83.20	88.00	904.70	30.08	101.8	95% Student's-t UCL	101.8	UCL
Sitewide	27 / 27	100	21.79	175.20	N/A	N/A	80.42	80.31	1261.00	35.51	92.08	95% Student's-t UCL	92.08	UCL
Forage Fish														
UAA	27 / 27	100	6.77	43.70	NA	NA	20.92	18.56	74.19	8.61	23.75	95% Student's-t UCL	23.75	UCL
MAA	27 / 27	100	18.41	51.09	NA	NA	32.83	32.33	93.49	9.67	36.01	95% Student's-t UCL	36.01	UCL
LAA	27 / 27	100	16.47	47.37	NA	NA	30.73	31.10	71.68	8.47	33.51	95% Student's-t UCL	33.51	UCL
Sitewide	81 / 81	100	6.77	51.09	N/A	N/A	28.16	28.17	105.10	10.25	30.06	95% Student's-t UCL	30.06	UCL
Bottom Fish														
UAA	9 / 9	100	33.77	67.51	NA	NA	52.69	48.44	169.10	13.00	60.75	95% Student's-t UCL	60.75	UCL
MAA	9 / 9	100	18.23	50.76	NA	NA	32.30	30.82	112.50	10.60	38.87	95% Student's-t UCL	38.87	UCL
LAA	9 / 9	100	22.41	84.27	NA	NA	53.47	56.11	422.00	20.54	66.2	95% Student's-t UCL	66.2	UCL
Sitewide	27 / 27	100	18.23	84.27	N/A	N/A	46.15	45.85	316.20	17.78	51.99	95% Student's-t UCL	51.99	UCL

Table 4-15. Summary Statistics by Assessment Area - Aquatic Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
All Fish														
UAA	45 / 45	100	6.77	175.20	NA	NA	39.90	30.67	1079.00	32.85	50.11	95% H-UCL	50.11	UCL
MAA	45 / 45	100	18.23	126.50	NA	NA	40.96	35.03	571.70	23.91	45.99	95% H-UCL	45.99	UCL
LAA	45 / 45	100	16.47	126.80	NA	NA	45.77	35.25	721.00	26.85	52.83	95% H-UCL	52.83	UCL
Sitewide	135 / 135	100	6.77	175.20	N/A	N/A	42.21	33.78	785.40	28.02	46.16	95% H-UCL	46.16	UCL
Mercury														
Aquatic Plants														
UAA	7 / 9	78	0.05	0.11	0.04	0.05	0.08	0.08	0.00	0.02	0.0859	95% KM (t) UCL	0.0859	UCL
MAA	5 / 9	56	0.06	0.38	0.05	0.05	0.13	0.08	0.02	0.14	0.258	95% KM (Chebyshev) UCL	0.258	UCL
LAA	7 / 9	78	0.03	0.09	0.05	0.05	0.06	0.07	0.00	0.02	0.0699	95% KM (t) UCL	0.0699	UCL
Emergent Insects														
UAA	9 / 9	100	0.11	0.42	NA	NA	0.25	0.27	0.01	0.12	0.321	95% Student's-t UCL	0.321	UCL
MAA	9 / 9	100	0.03	0.32	NA	NA	0.13	0.13	0.01	0.09	0.188	95% Student's-t UCL	0.188	UCL
LAA	9 / 9	100	0.08	0.25	NA	NA	0.17	0.17	0.00	0.06	0.206	95% Student's-t UCL	0.206	UCL
Benthic Invertebrates (Odonata)														
UAA	9 / 9	100	0.13	0.31	NA	NA	0.19	0.18	0.00	0.06	0.232	95% Student's-t UCL	0.232	UCL
MAA	9 / 9	100	0.22	0.44	NA	NA	0.30	0.28	0.01	0.08	0.35	95% Student's-t UCL	0.35	UCL
LAA	9 / 9	100	0.25	0.70	NA	NA	0.38	0.34	0.02	0.15	0.476	95% Student's-t UCL	0.476	UCL
Crayfish														
UAA	6 / 7	86	0.12	0.19	0.80	0.80	0.14	0.13	0.00	0.03	--	--	0.19	Maximum Detect
MAA	7 / 7	100	0.12	0.21	NA	NA	0.17	0.17	0.00	0.04	--	--	0.206	Maximum Detect
LAA	8 / 9	89	0.11	0.29	0.73	0.73	0.19	0.20	0.00	0.06	0.234	95% KM (t) UCL	0.234	UCL
Mollusc														
UAA	9 / 9	100	0.14	0.38	NA	NA	0.24	0.25	0.01	0.08	0.292	95% Student's-t UCL	0.292	UCL
MAA	9 / 9	100	0.14	0.42	NA	NA	0.30	0.33	0.01	0.10	0.36	95% Student's-t UCL	0.36	UCL
LAA	9 / 9	100	0.52	1.01	NA	NA	0.77	0.78	0.02	0.15	0.864	95% Student's-t UCL	0.864	UCL
Frogs														
UAA	7 / 7	100	0.12	1.03	NA	NA	0.65	0.73	0.15	0.38	--	--	1.031	Maximum Detect
MAA	7 / 7	100	0.24	1.76	NA	NA	0.57	0.33	0.30	0.54	--	--	1.755	Maximum Detect
LAA	2 / 2	100	0.32	0.56	NA	NA	0.44	0.44	0.03	0.17	--	--	0.56	Maximum Detect
Snakes														
UAA	2 / 2	100	0.61	0.88	NA	NA	0.74	0.74	0.04	0.19	--	--	0.875	Maximum Detect
MAA	2 / 2	100	0.54	1.71	NA	NA	1.12	1.12	0.68	0.82	--	--	1.705	Maximum Detect
LAA	7 / 7	100	0.42	2.12	NA	NA	1.24	1.13	0.37	0.61	--	--	2.117	Maximum Detect
Predator Fish														
UAA	9 / 9	100	0.86	1.95	NA	NA	1.24	1.06	0.14	0.37	1.468	95% Student's-t UCL	1.468	UCL
MAA	9 / 9	100	0.97	1.97	NA	NA	1.40	1.39	0.09	0.31	1.591	95% Student's-t UCL	1.591	UCL
LAA	9 / 9	100	1.47	3.04	NA	NA	2.04	1.92	0.26	0.51	2.353	95% Student's-t UCL	2.353	UCL
Forage Fish														
UAA	26 / 27	96	0.06	0.28	0.05	0.05	0.17	0.16	0.00	0.06	0.182	95% KM (t) UCL	0.182	UCL
MAA	27 / 27	100	0.24	0.76	NA	NA	0.47	0.48	0.02	0.13	0.512	95% Student's-t UCL	0.512	UCL
LAA	27 / 27	100	0.21	1.09	NA	NA	0.57	0.52	0.05	0.22	0.646	95% Student's-t UCL	0.646	UCL
Bottom Fish														
UAA	9 / 9	100	0.26	0.75	NA	NA	0.46	0.46	0.03	0.17	0.567	95% Student's-t UCL	0.567	UCL
MAA	9 / 9	100	0.16	0.47	NA	NA	0.33	0.37	0.01	0.12	0.399	95% Student's-t UCL	0.399	UCL
LAA	9 / 9	100	0.35	1.41	NA	NA	0.68	0.66	0.13	0.36	0.9	95% Student's-t UCL	0.9	UCL
All Fish														
UAA	44 / 45	98	0.06	1.95	0.05	0.05	0.45	0.24	0.21	0.46	0.736	95% KM (Chebyshev) UCL	0.736	UCL
MAA	45 / 45	100	0.16	1.97	NA	NA	0.63	0.48	0.19	0.43	0.741	95% H-UCL	0.741	UCL
LAA	45 / 45	100	0.21	3.04	NA	NA	0.89	0.66	0.44	0.66	1.07	95% H-UCL	1.07	UCL
Barium														
Aquatic Plants														
Sitewide	3 / 3	100	50.00	70.12	NA	NA	62.12	66.24	NA	NA	--	--	70.12	Maximum Detect

Table 4-15. Summary Statistics by Assessment Area - Aquatic Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Emergent Insects														
Sitewide	3 / 3	100	4.42	11.35	NA	NA	6.97	5.14	NA	NA	--	--	11.35	Maximum Detect
Benthic Invertebrates (Odonata)														
Sitewide	3 / 3	100	37.33	60.00	NA	NA	44.89	37.34	NA	NA	--	--	60	Maximum Detect
Crayfish														
Sitewide	3 / 3	100	107.20	199.30	NA	NA	156.00	161.60	NA	NA	--	--	199.3	Maximum Detect
Mollusc														
Sitewide	3 / 3	100	27.06	34.15	NA	NA	31.38	32.93	NA	NA	--	--	34.15	Maximum Detect
Frogs														
Sitewide	2 / 2	100	43.70	43.98	NA	NA	43.84	43.84	NA	NA	--	--	43.98	Maximum Detect
Snakes														
Sitewide	1 / 1	100	9.91	9.91	NA	NA	9.91	9.91	NA	NA	--	--	9.91	Maximum Detect
Predator Fish														
Sitewide	3 / 4	75	3.39	15.29	NA	NA	8.32	6.29	NA	NA	--	--	15.29	Maximum Detect
Forage Fish														
Sitewide	4 / 6	67	8.11	32.95	NA	NA	15.63	10.74	NA	NA	--	--	32.95	Maximum Detect
Bottom Fish														
Sitewide	3 / 4	75	2.03	10.00	NA	NA	7.21	9.61	NA	NA	--	--	10	Maximum Detect
All Fish														
Sitewide	10 / 14	71	2.03	32.95	NA	NA	10.91	9.32	NA	NA	14.78	95% KM (t) UCL	14.78	UCL
Cobalt														
Aquatic Plants														
Site-wide	0 / 3	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected
Emergent Insects														
Site-wide	1 / 3	33	0.28	0.28	NA	NA	0.28	0.28	NA	NA	--	--	0.284	Maximum Detect
Benthic Invertebrates (Odonata)														
Site-wide	2 / 3	67	4.27	4.44	NA	NA	4.36	4.36	NA	NA	--	--	4.444	Maximum Detect
Crayfish														
Site-wide	0 / 3	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected
Mollusc														
Site-wide	3 / 3	100	3.42	3.88	NA	NA	3.61	3.54	NA	NA	--	--	3.882	Maximum Detect
Frogs														
Site-wide	2 / 2	100	1.44	1.56	NA	NA	1.50	1.50	NA	NA	--	--	1.555	Maximum Detect
Snakes														
Site-wide	0 / 1	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected
Predator Fish														
Site-wide	2 / 4	50	0.20	0.46	NA	NA	0.33	0.33	NA	NA	--	--	0.455	Maximum Detect
Forage Fish														
Site-wide	0 / 6	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected
Bottom Fish														
Site-wide	1 / 4	25	0.30	0.30	NA	NA	0.30	0.30	NA	NA	--	--	0.3	Maximum Detect
All Fish														
Site-wide	3 / 14	21	0.20	0.46	NA	NA	0.32	0.30	NA	NA	--	--	0.455	Maximum Detect
Chromium														
Aquatic Plants														
Site-wide	2 / 3	67	2.57	3.13	NA	NA	2.85	2.85	NA	NA	--	--	3.125	Maximum Detect
Emergent Insects														
Site-wide	2 / 3	67	11.66	13.36	NA	NA	12.51	12.51	NA	NA	--	--	13.36	Maximum Detect
Benthic Invertebrates (Odonata)														
Site-wide	3 / 3	100	3.23	3.87	NA	NA	3.48	3.33	NA	NA	--	--	3.867	Maximum Detect
Crayfish														
Site-wide	1 / 3	33	1.39	1.39	NA	NA	1.39	1.39	NA	NA	--	--	1.387	Maximum Detect

Table 4-15. Summary Statistics by Assessment Area - Aquatic Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Mollusc														
Site-wide	3 / 3	100	9.27	13.41	NA	NA	10.78	9.65	NA	NA	--	--	13.41	Maximum Detect
Frogs														
Site-wide	2 / 2	100	7.14	18.06	NA	NA	12.60	12.60	NA	NA	--	--	18.06	Maximum Detect
Snakes														
Site-wide	0 / 1	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected
Predator Fish														
Site-wide	3 / 4	75	0.51	1.90	NA	NA	1.21	1.23	NA	NA	--	--	1.9	Maximum Detect
Forage Fish														
Site-wide	6 / 6	100	1.33	11.11	NA	NA	5.46	5.14	NA	NA	--	--	11.11	Maximum Detect
Bottom Fish														
Site-wide	3 / 4	75	0.26	0.72	NA	NA	0.55	0.66	NA	NA	--	--	0.721	Maximum Detect
All Fish														
Site-wide	12 / 14	86	0.26	11.11	NA	NA	3.17	1.61	NA	NA	4.556	95% KM (t) UCL	4.556	UCL
Lead														
Aquatic Plants														
Site-wide	3 / 3	100	1.78	7.05	NA	NA	4.27	3.96	NA	NA	--	--	7.054	Maximum Detect
Emergent Insects														
Site-wide	3 / 3	100	0.29	0.68	NA	NA	0.47	0.45	NA	NA	--	--	0.675	Maximum Detect
Benthic Invertebrates (Odonata)														
Site-wide	3 / 3	100	3.61	6.00	NA	NA	4.87	5.00	NA	NA	--	--	6	Maximum Detect
Crayfish														
Site-wide	3 / 3	100	0.94	3.29	NA	NA	2.01	1.80	NA	NA	--	--	3.285	Maximum Detect
Mollusc														
Site-wide	3 / 3	100	3.54	4.47	NA	NA	3.89	3.66	NA	NA	--	--	4.471	Maximum Detect
Frogs														
Site-wide	2 / 2	100	2.65	4.12	NA	NA	3.38	3.38	NA	NA	--	--	4.12	Maximum Detect
Snakes														
Site-wide	1 / 1	100	0.77	0.77	NA	NA	0.77	0.77	NA	NA	--	--	0.766	Maximum Detect
Predator Fish														
Site-wide	2 / 4	50	0.10	0.21	NA	NA	0.16	0.16	NA	NA	--	--	0.214	Maximum Detect
Forage Fish														
Site-wide	4 / 6	67	0.16	2.07	NA	NA	0.65	0.19	NA	NA	--	--	2.069	Maximum Detect
Bottom Fish														
Site-wide	3 / 4	75	0.22	0.38	NA	NA	0.29	0.27	NA	NA	--	--	0.375	Maximum Detect
All Fish														
Site-wide	9 / 14	64	0.10	2.07	NA	NA	0.42	0.21	NA	NA	0.547	KM H-UCL	0.547	UCL
Vanadium														
Aquatic Plants														
Site-wide	2 / 3	67	1.49	1.94	NA	NA	1.72	1.72	NA	NA	--	--	1.944	Maximum Detect
Emergent Insects														
Site-wide	1 / 3	33	0.58	0.58	NA	NA	0.58	0.58	NA	NA	--	--	0.583	Maximum Detect
Benthic Invertebrates (Odonata)														
Site-wide	3 / 3	100	2.22	2.56	NA	NA	2.41	2.47	NA	NA	--	--	2.556	Maximum Detect
Crayfish														
Site-wide	1 / 3	33	1.39	1.39	NA	NA	1.39	1.39	NA	NA	--	--	1.387	Maximum Detect
Mollusc														
Site-wide	3 / 3	100	1.46	1.88	NA	NA	1.73	1.83	NA	NA	--	--	1.882	Maximum Detect
Frogs														
Site-wide	2 / 2	100	1.01	1.62	NA	NA	1.31	1.31	NA	NA	--	--	1.62	Maximum Detect
Snakes														
Site-wide	0 / 1	0	N/A	N/A	NA	NA	N/A	N/A	NA	NA	--	--	Not Detected	Not Detected

Table 4-15. Summary Statistics by Assessment Area - Aquatic Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Predator Fish														
Site-wide	1 / 4	25	0.15	0.15	NA	NA	0.15	0.15	NA	NA	--	--	0.148	Maximum Detect
Forage Fish														
Site-wide	1 / 6	17	1.19	1.19	NA	NA	1.19	1.19	NA	NA	--	--	1.188	Maximum Detect
Bottom Fish														
Site-wide	1 / 4	25	0.26	0.26	NA	NA	0.26	0.26	NA	NA	--	--	0.258	Maximum Detect
All Fish														
Site-wide	3 / 14	21	0.15	1.19	NA	NA	0.53	0.26	NA	NA	--	--	1.188	Maximum Detect

Notes:
All units in milligrams per kilogram dry weight (mg/kg dw)
EPC: exposure point concentration
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
ND: nondetect
UAA: upper assessment area
UCL: 95% upper confidence limit
% FOD: Frequency of Detection

Table 4-16. Summary Statistics by Assessment Area - Terrestrial Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Total Polychlorinated Biphenyls														
Terrestrial Plants														
UAA	1 / 18	6	0.26	0.26	0.03	0.21	0.26	0.26	N/A	N/A	--	--	0.257	Maximum Detect
MAA	2 / 18	11	0.31	0.44	0.03	0.23	0.37	0.37	0.01	0.09	--	--	0.437	Maximum Detect
LAA	0 / 18	0	NA	NA	0.03	0.35	NA	NA	NA	NA	--	--	Not Detected	Not Detected
Sitewide	3 / 54	6	NA	NA	0.03	0.35	NA	NA	NA	NA	--	--	NA	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
UAA	0 / 6	0	NA	NA	0.09	0.18	NA	NA	NA	NA	--	--	Not Detected	Not Detected
MAA	0 / 6	0	NA	NA	0.14	0.18	NA	NA	NA	NA	--	--	Not Detected	Not Detected
LAA	0 / 6	0	NA	NA	0.08	0.19	NA	NA	NA	NA	--	--	Not Detected	Not Detected
Sitewide	0 / 18	0	NA	NA	0.08	0.19	NA	NA	NA	NA	--	--	Not Detected	Not Detected
Soil Invertebrates (Earthworms)														
UAA	6 / 9	67	13.98	84.64	0.07	0.18	39.89	34.86	706.60	26.58	45.15	95% KM (t) UCL	45.15	UCL
MAA	5 / 9	56	0.91	11.08	0.04	0.18	3.95	1.33	19.17	4.38	4.64	95% KM (t) UCL	4.64	UCL
LAA	5 / 9	56	3.30	7.90	0.11	0.18	5.59	5.37	3.42	1.85	5.225	95% KM (t) UCL	5.225	UCL
Sitewide	16 / 27	59	NA	NA	0.04	0.18	NA	NA	NA	NA	22.71	95% Gamma Adjusted KM-UCL	22.71	UCL
Small Mammals														
UAA	14 / 16	88	0.32	13.53	0.05	0.05	3.22	1.11	17.27	4.16	6.357	95% Gamma Adjusted KM-UCL	6.357	UCL
MAA	8 / 11	73	0.13	20.34	0.05	0.08	3.92	1.54	46.34	6.81	14.9	95% Gamma Adjusted KM-UCL	14.9	UCL
LAA	8 / 17	47	0.20	38.13	0.05	0.18	7.80	4.83	157.30	12.54	15.36	95% Gamma Adjusted KM-UCL	15.36	UCL
Sitewide	30 / 44	68	NA	NA	0.05	0.18	NA	NA	NA	NA	5.993	95% Gamma Adjusted KM-UCL	5.993	UCL
Mercury														
Terrestrial Plants														
UAA	0 / 18	0	N/A	N/A	0.01	0.06	N/A	N/A	N/A	N/A	--	--	Not Detected	Not Detected
MAA	2 / 18	11	0.02	0.06	0.01	0.07	0.04	0.04	0.00	0.03	--	--	0.0598	Maximum Detect
LAA	0 / 18	0	NA	NA	0.01	0.06	NA	NA	NA	NA	--	--	Not Detected	Not Detected
Sitewide	2 / 54	4	NA	NA	0.01	0.07	NA	NA	NA	NA	--	--	NA	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
UAA	4 / 7	57	NA	NA	0.02	0.02	NA	NA	NA	NA	--	--	NA	Maximum Detect
MAA	0 / 6	0	NA	NA	0.02	0.02	NA	NA	NA	NA	--	--	Not Detected	Not Detected
LAA	1 / 7	14	NA	NA	0.02	0.03	NA	NA	NA	NA	--	--	NA	Maximum Detect
Sitewide	5 / 20	25	NA	NA	0.02	0.03	NA	NA	NA	NA	0.0278	95% KM (t) UCL	0.0278	UCL
Soil Invertebrates (Earthworms)														
UAA	9 / 9	100	0.11	7.36	N/A	N/A	3.76	4.41	8.68	2.95	5.583	95% Student's-t UCL	5.583	UCL
MAA	9 / 9	100	0.53	4.40	N/A	N/A	1.31	0.76	1.62	1.27	3.159	95% Chebyshev (Mean, Sd) UCL	3.159	UCL
LAA	9 / 9	100	0.14	3.71	N/A	N/A	1.58	1.32	1.68	1.30	2.385	95% Student's-t UCL	2.385	UCL
Sitewide	27 / 27	100	NA	NA	N/A	N/A	NA	NA	NA	NA	3.339	95% Adjusted Gamma UCL	3.339	UCL
Small Mammals														
UAA	8 / 16	50	0.02	0.09	0.02	0.02	0.05	0.05	0.00	0.03	0.0468	95% KM (t) UCL	0.0468	UCL
MAA	5 / 11	45	0.02	0.28	0.01	0.02	0.13	0.08	0.01	0.10	0.117	95% KM (t) UCL	0.117	UCL
LAA	5 / 17	29	0.05	0.75	0.02	0.02	0.24	0.13	0.08	0.29	0.165	95% KM (t) UCL	0.165	UCL
Sitewide	18 / 44	41	NA	NA	0.01	0.02	NA	NA	NA	NA	0.0689	KM H-UCL	0.0689	UCL
Barium														
Terrestrial Plants														
Sitewide	5 / 6	83	1.78	250.80	1.36	1.36	78.14	43.97	9699.00	98.48	--	--	250.8	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
Sitewide	2 / 2	100	3.25	8.86	N/A	N/A	6.05	6.05	15.70	3.96	--	--	8.856	Maximum Detect
Soil Invertebrates (Earthworms)														
Sitewide	4 / 4	100	54.00	228.90	N/A	N/A	130.60	119.70	6102.00	78.12	--	--	228.9	Maximum Detect
Small Mammals														
Sitewide	4 / 4	100	9.38	43.44	N/A	N/A	18.91	11.41	270.30	16.44	--	--	43.44	Maximum Detect
Chromium														
Terrestrial Plants														
Sitewide	5 / 6	83	0.47	2.40	17.54	17.54	0.99	0.64	0.64	0.80	--	--	2.397	Maximum Detect

Table 4-16. Summary Statistics by Assessment Area - Terrestrial Tissue
Anniston PCB Site, Anniston, Alabama

Assessment Area	Summary Statistics											Exposure Point Concentration			
	Detects / Total	FOD (%)	Minimum Detect	Maximum Detect	Minimum ND	Maximum ND	Mean	Median	Variance	Standard Deviation	UCL	UCL Method	Selected EPC	Basis
Terrestrial Insects (Grasshoppers/Crickets)														
Sitewide	0 / 2	0	N/A	N/A	13.99	14.76	N/A	N/A	N/A	N/A	--	--	Not Detected	Not Detected
Soil Invertebrates (Earthworms)														
Sitewide	4 / 4	100	10.23	19.43	N/A	N/A	14.10	13.37	14.99	3.87	--	--	19.43	Maximum Detect
Small Mammals														
Sitewide	4 / 4	100	2.13	4.69	N/A	N/A	3.28	3.16	1.66	1.29	--	--	4.688	Maximum Detect
Cobalt														
Terrestrial Plants														
Sitewide	2 / 6	33	0.39	0.39	0.04	43.86	0.39	0.39	0.00	0.01	--	--	0.394	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
Sitewide	0 / 2	0	N/A	N/A	34.97	36.90	N/A	N/A	N/A	N/A	--	--	Not Detected	Not Detected
Soil Invertebrates (Earthworms)														
Sitewide	4 / 4	100	4.42	5.68	N/A	N/A	5.27	5.49	0.34	0.58	--	--	5.682	Maximum Detect
Small Mammals														
Sitewide	0 / 4	0	N/A	N/A	31.25	31.25	N/A	N/A	N/A	N/A	--	--	Not Detected	Not Detected
Lead														
Terrestrial Plants														
Sitewide	1 / 6	17	0.10	0.10	0.02	12.82	0.10	0.10	N/A	N/A	--	--	0.103	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
Sitewide	1 / 2	50	0.25	0.25	7.38	7.38	0.25	0.25	N/A	N/A	--	--	0.245	Maximum Detect
Soil Invertebrates (Earthworms)														
Sitewide	4 / 4	100	15.88	115.70	N/A	N/A	42.12	18.44	2411.00	49.11	--	--	115.7	Maximum Detect
Small Mammals														
Sitewide	3 / 4	75	0.59	5.31	6.25	6.25	3.22	3.75	5.78	2.40	--	--	5.313	Maximum Detect
Vanadium														
Terrestrial Plants														
Sitewide	6 / 6	100	0.08	0.12	N/A	N/A	0.10	0.11	0.00	0.02	--	--	0.122	Maximum Detect
Terrestrial Insects (Grasshoppers/Crickets)														
Sitewide	2 / 2	100	0.09	0.21	N/A	N/A	0.15	0.15	0.01	0.08	--	--	0.214	Maximum Detect
Soil Invertebrates (Earthworms)														
Sitewide	4 / 4	100	6.01	9.41	N/A	N/A	7.55	7.40	3.11	1.76	--	--	9.408	Maximum Detect
Small Mammals														
Sitewide	0 / 4	0	N/A	N/A	12.50	12.50	N/A	N/A	N/A	N/A	--	--	Not Detected	Not Detected

Notes:
All units in milligrams per kilogram dry weight (mg/kg dw)
EPC: exposure point concentration
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
ND: nondetect
UAA: upper assessment area
UCL: 95% upper confidence limit
% FOD: Frequency of Detection

Table 4-17. Assessment Area-Specific Exposure Scenarios Evaluated for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

	Exposure Inputs							HQs			
Media→	**Soil**	**Soil- Riparian**	**Sediment**	**Water**	**Tissue**	**Diet**	**BAFs**	**Lower Trophic Level HQs**	**Dietary HQs [a] (Modeled Tissue)**	**Dietary HQs [b] (Measured Tissue)**	**Tissue HQs [c]**
AA Scenario Exposure Units/EPCs→	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**Sitewide [g]**	**UAA / MAA / LAA**	**--**	**--**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**
EU Scenario Exposure Units/EPCs→	**Reaches C1 through C10 [h,i]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]**	**Reaches C1 through C10**	**Sitewide [g]**	**UAA / MAA / LAA [k]**	**--**	**--**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**UAA / MAA / LAA**	**--**
COPCs →	**EPCs for PCBs, Hg, Ba [j], Co [j], Cr, Pb, and V**	**EPCs for PCBs, Hg, Ba, Co, Cr, Pb, and V**	**SWACs for Hg & PCBs and EPCs for Ba, Co, Cr, Pb, and V**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**soil/sed + water + food (listed below)**	**media-to-food**	**Media-specific [d]**	**BAFs by reach or assessment area**	**EPCs for all COPCs**	**Bird eggs (PCBs and Hg), mammal whole body, benthic and terrestrial invertebrates (PCBs), and fish (PCBs, Hg, other metals)**
Receptors↓											
Aquatic (Choccolocco/Snow Creeks)											
Lower Trophic Level Receptors											
Aquatic Life				✓				✓			
Aquatic Plants				✓	✓			✓			
Benthic Invertebrates			✓	✓	✓			✓			✓
Fish				✓	✓			✓			✓
Wildlife											
Birds, Aerial-Feeding Insectivores (Tree Swallow)			0%	✓		100% aquatic emergent and flying insects	sediment-to-emergent insects		✓	✓	✓
Birds, Aquatic Ground-Feeding Insectivores (Spotted Sandpiper) - Scenario 2			100%	✓		50% aquatic Oligochaetes (Lumbriculus) and 50% benthic invertebrates (Odonata larvae)	sediment-to-Lumbriculus and sediment-to-benthic invertebrates		✓	✓	✓
Birds, Piscivores (Belted Kingfisher) - Scenario 1			100%	✓		100% forage fish	sediment-to-forage fish		✓	✓	✓
Birds, Piscivores (Belted Kingfisher) - Scenario 2			100%	✓		5% amphibians, 76% forage fish, and 19% crayfish	sediment-to-frogs, sediment-to-forage fish, and sediment-to-crayfish		✓	✓	✓
Birds, Wading Carnivores (Great Blue Heron)		0%	100%	✓		1% mammals, 4% amphibians, 94% all fish, and 1% crayfish	soil-to-small mammals, sediment-to-frogs, sediment-to-all fish, and sediment-to-crayfish		✓	✓	✓
Birds, Piscivores (American Osprey)			0%	✓		100% all fish	sediment-to-all fish		✓	✓	✓
Mammals, Aerial-Feeding Insectivores (Little Brown Bat)			0%	✓	small mammals	100% aquatic emergent and flying insects	sediment-to-emergent insects		✓	✓	
Mammals, Piscivores (Mink) - Scenario 2		0%	0%	✓	small mammals	1% aquatic plants, 6% mammals, 3% amphibians, 86% forage fish, and 4% crayfish	sediment-to-aquatic plants, soil-to-small mammals, sediment-to-frogs, sediment-to-forage fish, and sediment-to-crayfish		✓	✓	
Mammals, Piscivores (River Otter)			0%	✓	small mammals	48% all fish, 22% forage fish, 30% predator fish	sediment-to-all fish, sediment-to-forage fish, sediment-to-predator fish		✓	✓	

Table 4-17. Assessment Area-Specific Exposure Scenarios Evaluated for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

	Exposure Inputs							HQs			
Media→	**Soil**	**Soil- Riparian**	**Sediment**	**Water**	**Tissue**	**Diet**	**BAFs**	**Lower Trophic Level HQs**	**Dietary HQs [a] (Modeled Tissue)**	**Dietary HQs [b] (Measured Tissue)**	**Tissue HQs [c]**
AA Scenario Exposure Units/EPCs→	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**Sitewide [g]**	**UAA / MAA / LAA**	**--**	**--**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**
EU Scenario Exposure Units/EPCs→	**Reaches C1 through C10 [h,i]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]**	**Reaches C1 through C10**	**Sitewide [g]**	**UAA / MAA / LAA [k]**	**--**	**--**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**UAA / MAA / LAA**	**--**
COPCs →	**EPCs for PCBs, Hg, Ba [j], Co [j], Cr, Pb, and V**	**EPCs for PCBs, Hg, Ba, Co, Cr, Pb, and V**	**SWACs for Hg & PCBs and EPCs for Ba, Co, Cr, Pb, and V**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**soil/sed + water + food (listed below)**	**media-to-food**	**Media-specific [d]**	**BAFs by reach or assessment area**	**EPCs for all COPCs**	**Bird eggs (PCBs and Hg), mammal whole body, benthic and terrestrial invertebrates (PCBs), and fish (PCBs, Hg, other metals)**
Terrestrial (Floodplain)											
Lower Trophic Level Receptors											
Soil Invertebrates	✓	✓						✓			✓
Terrestrial Plants	✓	✓						✓			
Wildlife											
Birds, Herbivores (Mourning Dove)	100%			✓		100% terrestrial plants	soil-to-terrestrial plants		✓	✓	✓
Birds, Omnivores (Blue Jay)	100%			✓		11% terrestrial insects (grasshoppers), 11% terrestrial invertebrates (spiders, Detritivores), and 78% terrestrial plants	soil-to-terrestrial insects, soil-to-earthworm/spider, and soil-to-terrestrial plants		✓	✓	✓
Birds, Ground-Feeding Invertivores (Carolina Wren - Scenario 1)	100%			✓		45% terrestrial insects (grasshoppers), 15% soil invertebrates (worms), 31% terrestrial invertebrates (spiders, Detritivores), and 9% terrestrial plants	soil-to-terrestrial insects, soil-to-earthworm/spider, and soil-to-terrestrial plants		✓	✓	✓
Birds, Raptors (Carnivores) (Hawk)	50%		50%	✓		87% mammals and 13% reptile	soil-to-small mammals and sediment-to-snakes		✓	✓	✓
Mammals, Ground-Feeding Invertivores (Short-Tailed Shrew) - Scenario 1	100%			✓	small mammals	37% soil invertebrates (worms), 26% terrestrial invertebrates (spiders, Detritivores), 26% terrestrial invertebrates (grasshoppers), and 12% terrestrial plants	soil-to-earthworms/spiders, soil-to-grasshoppers, and soil-to-terrestrial plants		✓	✓	✓
Mammals, Ground-Feeding Invertivores (Short-Tailed Shrew) - Scenario 2	100%		0%	✓	small mammals	41% soil invertebrates (worms), 18% terrestrial invertebrates (spiders, Detritivores), 18% terrestrial insects (grasshoppers), 17% terrestrial plants, 5% mammals/birds, 1% reptiles, and 1% amphibians	soil-to-earthworms/spiders, soil-to-terrestrial insects, soil-to-terrestrial plants, soil-to-small mammals, sediment-to-snakes, and sediment-to-frogs		✓	✓	✓
Mammals, Herbivores (White-Tailed Deer)	100%			✓	small mammals	100% terrestrial plants	soil-to-terrestrial plants		✓	✓	
Mammals, Terrestrial-Dependent Carnivores (Long-Tailed Weasel)	100%			✓	small mammals	100% mammals/birds	soil-to-small mammals		✓	✓	
Mammals, Terrestrial-Dependent Carnivores (Red Fox) - Scenario 1	100%			✓	small mammals	4% soil invertebrates (worms), 17% terrestrial plants, and 79% mammals/birds	soil-to-earthworms, soil-to-terrestrial plants, and soil-to-small mammals		✓	✓	
Mammals, Terrestrial-Dependent Carnivores (Red Fox) - Scenario 2	100%			✓	small mammals	5% terrestrial plants and 95% mammals/birds	soil-to-terrestrial plants and soil-to-small mammals				

Table 4-17. Assessment Area-Specific Exposure Scenarios Evaluated for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

	Exposure Inputs							HQs			
Media→	**Soil**	**Soil- Riparian**	**Sediment**	**Water**	**Tissue**	**Diet**	**BAFs**	**Lower Trophic Level HQs**	**Dietary HQs [a] (Modeled Tissue)**	**Dietary HQs [b] (Measured Tissue)**	**Tissue HQs [c]**
AA Scenario Exposure Units/EPCs→	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**Sitewide [g]**	**UAA / MAA / LAA**	**--**	**--**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**	**UAA / MAA / LAA**
EU Scenario Exposure Units/EPCs→	**Reaches C1 through C10 [h,i]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]**	**Reaches C1 through C10**	**Sitewide [g]**	**UAA / MAA / LAA [k]**	**--**	**--**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**Reaches C1 through C10 [h]: North, South, Central [e], East [f], West [f] EUs**	**UAA / MAA / LAA**	**--**
COPCs →	**EPCs for PCBs, Hg, Ba [j], Co [j], Cr, Pb, and V**	**EPCs for PCBs, Hg, Ba, Co, Cr, Pb, and V**	**SWACs for Hg & PCBs and EPCs for Ba, Co, Cr, Pb, and V**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**EPCs for COPCs (Ba, Co, Cr, Pb, Hg, V, and PCBs)**	**soil/sed + water + food (listed below)**	**media-to-food**	**Media-specific [d]**	**BAFs by reach or assessment area**	**EPCs for all COPCs**	**Bird eggs (PCBs and Hg), mammal whole body, benthic and terrestrial invertebrates (PCBs), and fish (PCBs, Hg, other metals)**
Aquatic & Terrestrial											
Upper Trophic Level Receptors											
Reptiles/Amphibians											
Birds, Ground-Feeding Invertivores (Carolina Wren - Scenario 2)		100%	0%	✓		45% terrestrial insects (grasshoppers), 15% soil invertebrates (worms), 31% aquatic invertebrates (spiders, Detritivores), and 9% aquatic plants	soil-to-terrestrial insects soil-to-earthworm, sediment-to-earthworm/spider, and sediment-to-aquatic plants		✓	✓	✓
Birds, Aquatic Ground-Feeding Invertivores (Spotted Sandpiper) - Scenario 1		50%	50%	✓		50% aquatic benthic invertebrates and 50% soil invertebrates (worms)	sediment-to-benthic invertebrates and soil-to-earthworm		✓	✓	✓
Mammals, Piscivores (Mink) - Scenario 1		0%	0%	✓	small mammals	44% mammals/birds, 26% amphibians, 21% forage fish, and 9% crayfish	soil-to-small mammals, sediment-to-frogs, sediment-to-forage fish, and sediment-to-crayfish		✓	✓	
Mammals, Omnivores (Raccoon) - Scenario 1	100%	100%	0%	✓	small mammals	10% soil invertebrates (worms), 10% terrestrial invertebrates (spiders, Detritivores), 10% terrestrial insects (grasshoppers), 44% terrestrial plants, 5% mammal/birds, 2% reptiles, 3% amphibians, 2% all fish, and 13% crayfish	soil-to-earthworms/spiders, soil-to-terrestrial insects, soil-to-terrestrial plants, soil-to-small mammal, sediment-to-frogs, sediment-to-snakes sediment-to-all fish, and sediment-to-crayfish		✓	✓	
Mammals, Omnivores (Raccoon) - Scenario 2		0%	100%	✓	small mammals	3% aquatic Oligochaetes (Lumbriculus), 17% aquatic plants, 19% mammals/birds, 12% amphibians, 23% all fish, 13% crayfish, and 13% mollusk	sediment-to-Lumbriculus, sediment-to-aquatic plants, soil-to-small mammals, sediment-to-frogs, sediment-to-all fish, sediment-to-crayfish, and sediment-to-mollusk		✓	✓	

Table 4-17. Assessment Area-Specific Exposure Scenarios Evaluated for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

Notes:

Incomplete pathway, not quantitatively evaluated in the BERA

Evaluated qualitatively

%: percent	BERA: Baseline Ecological Risk Assessment	Cr: chromium	HQ: hazard quotient	Pb: lead	SWAC: surface-weighted average concentration
Ba: barium	Co: cobalt	EPC: exposure point concentration	NA: not available	PCBs: polychlorinated biphenyls	V: vanadium
BAF: bioaccumulation factor	COPC: constituent of potential concern	Hg: mercury	OU-4: Operable Unit 4	Sed: sediment	

a. Dietary HQs (Modeled Tissue) calculated based on prey ingestion (using prey tissue modeled from abiotic media EPCs and BAFs), incidental ingestion (using abiotic media EPCs), and dietary TRVs.
If no BAFs available for the reach, BAFs for the assessment area were used.

b. Dietary HQs (Measured Tissue) calculated based on prey ingestion (using measured prey tissue EPCs), incidental ingestion (using abiotic media EPCs), and dietary TRVs.
If no measured tissue data available, tissue EPCs for the assessment area were used.

c. Tissue HQs calculated based on measured tissue EPCs and tissue-based toxicity thresholds. For birds, egg concentrations were estimated using uptake models due to lack of egg data.

d. Calculated based on media-specific toxicity benchmarks and site-specific toxicity thresholds (benthic invertebrates only) for available abiotic media EPCs

e. Central Floodplain soil EU evaluated for reach C2 only.

f. Reach C1 was evaluated using east and west floodplain soil EUs only.

g. For surface water, wildlife exposure was evalauted using sitewide EPCs. Lower trophic levels were evaluated using sitewide and AA EPCs.

h. In the EU scenarios, some reaches do not contain floodplain soil or riparian habitat:
Reach C1 does not contain riparian habitat. UAA-wide riparian soil EPCs were used to evaluate exposure for wildlife receptors in C1.
Reach C10 does not contain floodplain soil or riparian habitat. Terrestrial receptors/floodplain soil EPCs were not evalauted in Reach C10. LAA-wide riparian soil EPCs were used to evaluate exposure.

i. Metals not measured in Reach C1 floodplain soil. Risks were estimated for PCBs in soil only.

j. Barium and cobalt are not soil COPCs. These metals are sediment COPCs and were evaluated for semi-aquatic and aquatic receptors consuming some dietary fraction from soil.

k. For tissue, only AA-wide EPCs were calculated due to small sample size. The AA EPCs were used in both the AA and EU HQ scenarios

Table 4-18. Sediment Samples Included in Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU/ Reach	BSA	Location ID	Date	Sample Type	Sediment Class	Analyses						
							PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Ba, Cr, Co, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Upper	C2	EUA-01	EUA-01-19	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EUA-01-20	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EUA-01-21	9/30/2009	DISCRETE	Gravel	1	1				1	1
			EUA-01-22	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EUA-01-23	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EUA-01-24	9/30/2009	DISCRETE	Fine	1	1	1		1	1	1
	C3	EUA-02	EUA-02-43	10/1/2009	DISCRETE	Fine	2	2	2		2	2	2
			EUA-02-44	10/1/2009	DISCRETE	Fine	1	1		1		1	1
			EUA-02-45	10/1/2009	DISCRETE	Fine	1	1				1	1
			EUA-02-46	10/1/2009	DISCRETE	Fine	1	1				1	1
			EUA-02-47	10/1/2009	DISCRETE	Fine	1	1				1	1
			EUA-02-48	10/1/2009	DISCRETE	Coarse	1	1				1	1
	C4	EUA-03	EUA-03-25	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EUA-03-26	9/30/2009	DISCRETE	Gravel	1	1				1	1
			EUA-03-27	9/30/2009	DISCRETE	Gravel	1	1				1	1
			EUA-03-28	9/30/2009	DISCRETE	Gravel	1	1				1	1
			EUA-03-29	9/30/2009	DISCRETE	Fine	1	1		1		1	1
			EUA-03-30	9/30/2009	DISCRETE	Coarse	1	1				1	1
Middle	C5	EMA-01	EMA-01-01	9/29/2009	DISCRETE	Coarse	1	1				1	1
			EMA-01-02	9/29/2009	DISCRETE	Coarse	1	1	1		1	1	1
			EMA-01-03	9/29/2009	DISCRETE	Coarse	2	2				2	2
			EMA-01-04	9/29/2009	DISCRETE	Coarse	1	1		1		1	1
			EMA-01-05	9/29/2009	DISCRETE	Fine	1	1				1	1
			EMA-01-06	9/29/2009	DISCRETE	Fine	1	1				1	1
			HHFL-05	4/4/2009	COMPOSITE	Coarse	2	2		2		2	2
		EMA-02	EMA-02-07	9/29/2009	DISCRETE	Fine	1	1				1	1
			EMA-02-08	9/29/2009	DISCRETE	Coarse	1	1				1	1
			EMA-02-09	9/29/2009	DISCRETE	Coarse	1	1	1		1	1	1
			EMA-02-10	9/29/2009	DISCRETE	Fine	1	1				1	1
			EMA-02-11	9/29/2009	DISCRETE	Fine	1	1				1	1
			EMA-02-12	9/29/2009	DISCRETE	Fine	1	1				1	1
		EMA-03	EMA-03-31	9/30/2009	DISCRETE	Coarse	1	1		1		1	1
			EMA-03-32	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EMA-03-33	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EMA-03-34	9/30/2009	DISCRETE	Coarse	1	1				1	1
			EMA-03-35	9/30/2009	DISCRETE	Fine	1	1	1		1	1	1
			EMA-03-36	9/30/2009	DISCRETE	Fine	1	1				1	1

Table 4-18. Sediment Samples Included in Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU/ Reach	BSA	Location ID	Date	Sample Type	Sediment Class	Analyses						
							PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Ba, Cr, Co, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Lower	C7	ELA-01	ELA-01-55	10/2/2009	DISCRETE	Coarse	2	2		2		2	2
			ELA-01-56	10/2/2009	DISCRETE	Coarse	1	1				1	1
			ELA-01-57	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-01-58	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-01-59	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-01-60	10/2/2009	DISCRETE	Fine	1	1				1	1
			HHFL-04	5/4/2009	COMPOSITE	Coarse	1	1		1		1	1
		ELA-02	ELA-02-61	10/2/2009	DISCRETE	Fine	1	1	1		1	1	1
			ELA-02-62	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-02-63	10/2/2009	DISCRETE	Coarse	1	1				1	1
			ELA-02-64	10/2/2009	DISCRETE	Coarse	1	1				1	1
			ELA-02-65	10/2/2009	DISCRETE	Coarse	1	1		1		1	1
			ELA-02-66	10/2/2009	DISCRETE	Fine	1	1	1		1	1	1
		ELA-03	ELA-03-67	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-03-68	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-03-69	10/2/2009	DISCRETE	Fine	1	1				1	1
			ELA-03-70	10/2/2009	DISCRETE	Coarse	1	1				1	1
			ELA-03-71	10/2/2009	DISCRETE	Coarse	1	1				1	1
			ELA-03-72	10/2/2009	DISCRETE	Fine	1	1				1	1
Reference	REF	ERA-01	ECO-REF-01	4/6/2009	DISCRETE	Fine	1	1	1	1	1	1	1
			ERA-01-49	10/1/2009	DISCRETE	Coarse	1	1				1	1
			ERA-01-50	10/1/2009	DISCRETE	Fine	1	1				1	1
			ERA-01-51	10/1/2009	DISCRETE	Coarse	1	1				1	1
			ERA-01-52	10/1/2009	DISCRETE	Coarse	1	1				1	1
			ERA-01-53	10/1/2009	DISCRETE	Coarse	2	2				2	2
			ERA-01-54	10/1/2009	DISCRETE	Fine	1	1		1		1	1
		ERA-02	ECO-REF-02	4/6/2009	DISCRETE	Fine	1	1	1	1	1	1	1
			ERA-02-13	9/29/2009	DISCRETE	Coarse	1	1				1	1
			ERA-02-14	9/29/2009	DISCRETE	Fine	1	1				1	1
			ERA-02-15	9/29/2009	DISCRETE	Fine	1	1				1	1
			ERA-02-16	9/29/2009	DISCRETE	Fine	1	1				1	1
			ERA-02-17	9/29/2009	DISCRETE	Coarse	1	1				1	1
			ERA-02-18	9/29/2009	DISCRETE	Coarse	1	1				1	1
		ERA-03	ECO-REF-03	4/6/2009	DISCRETE	Coarse	1	1	1	1	1	1	1
			ERA-03-37	10/1/2009	DISCRETE	Gravel	1	1				1	1
			ERA-03-38	10/1/2009	DISCRETE	Fine	1	1				1	1
			ERA-03-39	10/1/2009	DISCRETE	Coarse	1	1		1		1	1
			ERA-03-40	10/1/2009	DISCRETE	Coarse	1	1				1	1
			ERA-03-41	10/1/2009	DISCRETE	Gravel	1	1				1	1
			ERA-03-42	10/1/2009	DISCRETE	Fine	1	1				1	1

Table 4-18. Sediment Samples Included in Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Notes:

[1] Congeners analyzed: BZ77, BZ81, BZ105, BZ114, BZ118, BZ123, BZ26, BZ153, BZ156, BZ157, BZ167, BZ169, BZ189

Ba: barium

BSA: biological sampling area

Co: cobalt

Cr: chromium

EU: exposure unit

Pb: lead

PCB: polychlorinated biphenyl

TOC: total organic carbon

V: vanadium

Table 4-19. Soil Samples Included in the Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU	BSA	Location ID	Date	Analyses						
					PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Cr, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Upper	C2B	EUT-01	C2N-18	2/19/2009	1	1				1	1
			EUT-01-09	9/16/2009	1	1				1	1
			EUT-01-10	9/16/2009	1	1				1	1
		EUT-02	C2N-22	2/19/2009	1	1				1	1
			C2N-26	2/19/2009	1	1				1	1
			EUT-02-11	9/16/2009	1	1				1	1
			EUT-02-12	9/16/2009	1	1				1	1
		EUT-03	C2N-21	2/19/2009	1	1		1		1	1
			EUT-03-13	9/16/2009	2	2				2	2
			EUT-03-14	9/16/2009	1	1		1		1	1
	C3N	EUT-04	C3N-03	3/31/2009	1	1				1	1
			EUT-04-07	9/16/2009	1	1				1	1
			EUT-04-08	9/16/2009	1	1	1		1	1	1
		EUT-05	C3N-08	3/31/2009	1	1				1	1
			C3N-09	3/31/2009	1	1	1	1	1	1	1
			C3N-10	3/31/2009	1	1				1	1
			C3NF-05	3/31/2009	1	1				1	1
			C3NF-07	3/31/2009	1	1	1		1	1	1
			C3NF-08	3/31/2009	1	1				1	1
			C3NF-10	3/31/2009	1	1				1	1
			C3NF-11	3/31/2009	1	1				1	1
			EUT-05-05	9/16/2009	1	1				1	1
			EUT-05-06	9/16/2009	1	1				1	1
		EUT-06	C3N-14	3/31/2009	1	1				1	1
			EUT-06-03	9/16/2009	1	1				1	1
			EUT-06-04	9/16/2009	1	1				1	1
		EUT-07	C3NF-17	4/1/2009	1	1				1	1
			EUT-07-01	9/16/2009	1	1	1		1	1	1
			EUT-07-02	9/16/2009	1	1				1	1

Table 4-19. Soil Samples Included in the Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU	BSA	Location ID	Date	Analyses						
					PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Cr, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Upper	C4S	EUT-08	C3S-27	3/25/2009	1	1				1	1
			EUT-08-49	9/18/2009	1	1		1		1	1
			EUT-08-50	9/18/2009	1	1				1	1
		EUT-09	C4S-04	3/16/2009	1	1		1		1	1
			EUT-09-51	9/18/2009	1	1	1		1	1	1
			EUT-09-51b	9/18/2009	1	1				1	1
Middle	C5N	EMT-01	C5N-19	3/5/2009	1	1				1	1
			EMT-01-25	9/17/2009	1	1				1	1
			EMT-01-26	9/17/2009	1	1				1	1
		EMT-02	C5N-24	2/24/2009	1	1				1	1
			EMT-02-17	9/16/2009	2	2				2	2
			EMT-02-18	9/16/2009	1	1	1	1	1	1	1
		EMT-03	C5N-26	2/24/2009	1	1				1	1
			C5N-27	2/24/2009	1	1				1	1
			EMT-03-15	9/16/2009	1	1				1	1
			EMT-03-16	9/16/2009	1	1				1	1
		EMT-04	C5N-29	2/24/2009	1	1				1	1
			C5NF-10	2/24/2009	1	1				1	1
			EMT-04-19	9/17/2009	1	1				1	1
			EMT-04-20	9/17/2009	1	1				1	1
		EMT-05	C5N-30	2/24/2009	1	1				1	1
			EMT-05-21	9/17/2009	1	1				1	1
			EMT-05-22	9/17/2009	1	1				1	1
		EMT-06	C5N-31	2/24/2009	1	1				1	1
			EMT-06-23	9/17/2009	1	1				1	1
			EMT-06-24	9/17/2009	1	1				1	1

Table 4-19. Soil Samples Included in the Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU	BSA	Location ID	Date	Analyses						
					PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Cr, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Middle	C5S	EMT-07	C5S-34	2/22/2009	1	1				1	1
			C5S-36	2/22/2009	1	1	1		1	1	1
			C5S-37	2/22/2009	1	1		1		1	1
			EMT-07-27	9/17/2009	1	1		1		1	1
			EMT-07-28	9/17/2009	1	1				1	1
		EMT-08	C5S-40	2/22/2009	1	1				1	1
			EMT-08-29	9/17/2009	1	1	1		1	1	1
			EMT-08-30	9/17/2009	1	1	1		1	1	1
		EMT-09	C5S-44	2/23/2009	1	1				1	1
			C5S-45	2/22/2009	1	1				1	1
			EMT-09-31	9/17/2009	1	1				1	1
			EMT-09-32	9/17/2009	1	1				1	1
Lower	C7N	ELT-08	C7N-28	6/20/2007	1					1	1
			ELT-08-33	9/17/2009	1	1				1	1
			ELT-08-34	9/17/2009	1	1				1	1
		ELT-09	C7N-33	6/20/2007	1					1	1
			C7N-34	6/20/2007	1					1	1
			ELT-09-35	9/17/2009	1	1				1	1
			ELT-09-36	9/17/2009	1	1				1	1
	C7S	ELT-01	C7S-01	6/28/2007	1					1	1
			ELT-01-39	9/17/2009	2	2		2		2	2
			ELT-01-40	9/17/2009	1	1				1	1
		ELT-02	ELT-02-38	9/17/2009	1	1				1	1
			C7S-03	6/28/2007	2					2	2
			ELT-02-37	9/17/2009	1	1				1	1
		ELT-03	C7S-11	6/27/2007	1					1	1
			ELT-03-41	9/17/2009	1	1				1	1
			ELT-03-42	9/17/2009	1	1				1	1
		ELT-04	C7S-12	6/27/2007	1					1	1
			ELT-04-43	9/18/2009	1	1				1	1
			ELT-04-44	9/18/2009	1	1				1	1

Table 4-19. Soil Samples Included in the Bioaccumulation Factor Datasets
Anniston PCB Site, Anniston, Alabama

Assessment Area	EU	BSA	Location ID	Date	Analyses						
					PCB Aroclors	Mercury	PCB Congeners[1] and PCB Homologues	Cr, Pb, V	Dioxins/ Furans	Grain Size	TOC by Lloyd Kahn
Lower	C7S	ELT-05	C7S-14	6/27/2007	1					1	1
			ELT-05-45	9/18/2009	1	1				1	1
			ELT-05-46	9/18/2009	1	1				1	1
		ELT-06	ELT-06-47	9/18/2009	1	1		1		1	1
			ELT-06-48	9/18/2009	1	1				1	1
		ELT-07	C7S-22	6/27/2007	1					1	1
			ELT-07-54	9/18/2009	1	1				1	1
			ELT-07-55	9/18/2009	1	1	1		1	1	1
Reference	REF	ERT-01-MF	ERT-01-62	9/23/2009	1	1				1	1
			ERT-01-63	9/23/2009	1	1				1	1
			ERT-01-52	9/18/2009	1	1				1	1
			ERT-01-53	9/18/2009	1	1				1	1
		ERT-02-FF	ERT-02-60	9/22/2009	1	1				1	1
			ERT-02-56	9/22/2009	2	2				2	2
			ERT-02-57	9/22/2009	1	1		1		1	1
		ERT-02-SF	ERT-02-58	9/22/2009	1	1				1	1
			ERT-02-59	9/22/2009	1	1				1	1
			ERT-02-61	9/22/2009	1	1				1	1
		ERT-03-FF	ERT-03-64	9/28/2009	1	1				1	1
			ERT-03-65	9/28/2009	1	1				1	1
		ERT-03-SF	ERT-03-66	9/28/2009	1	1				1	1
			ERT-03-67	9/28/2009	1	1				1	1

Notes:

[1] Congeners analyzed: BZ77, BZ81, BZ105, BZ114, BZ118, BZ123, BZ26, BZ153, BZ156, BZ157, BZ167, BZ169, BZ189

BSA: biological sampling area

Cr: chromium

EU: exposure unit

Pb: lead

PCB: polychlorinated biphenyl

TOC: total organic carbon

V: vanadium

Table 4-20. Summary of OU-4 Bioaccumulation Factors/Regressions for PCBs and Mercury
Anniston PCB Site, Anniston, Alabama

Aquatic Media-Receptor Pair	Uptake Factor	PCB	Mercury
Sediment to Aquatic Plants	BAF	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to Emergent Insects	BAF	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to Benthic Invertebrates[b]	BAF	--	--
	Regression Equation[c]	Median BAFs (Table 4-21)	log (tissue, ww) = 0.3083*log (sediment, dw) - 1.2447
	R^2 value	--	0.59
	P value	--	0.003
Sediment to Aquatic Oligochaetes (*Lumbriculus*)	BAF	--	--
	Regression Equation[c]	log(tissue, ww) = 0.6272*log (sediment Aroclors, dw) +1.0224)	Gilmour et al (2013) BAF= 1
Sediment to Crayfish	BAF	Median BAFs (Table 4-21)	--
	Regression Equation	--	log (tissue, dw) = 0.2185*log (sediment, dw) - 0.7272
	R^2 value	--	0.51
	P value	--	0.02
Sediment to Mollusc	BAF	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to Frogs	BAF	Median BAFs (Table 4-21)	--
	Regression Equation	--	log (tissue, dw) = 0.4577*log (sediment, dw) - 0.2419
	R^2 value	--	0.621
	P value	--	0.01
Sediment to Snakes	BAF	Median BAFs (Table 4-21)	--
	Regression Equation	--	Log (tissue, ww) = 0.2167*log (sediment, dw) - 0.5347
	R^2 value	--	0.41
	P value	--	0.05
Sediment to Forage Fish	BAF[e]	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to Bottom Fish	BAF[e]	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to Predator Fish	BAF[e]	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--
Sediment to All Fish	BAF[d]	Median BAFs (Table 4-21)	Median BAFs (Table 4-21)
	Regression Equation	--	--

Table 4-20. Summary of OU-4 Bioaccumulation Factors/Regressions for PCBs and Mercury
Anniston PCB Site, Anniston, Alabama

Terrestrial Media Receptor Pair	Uptake Factor	PCB	Mercury
Soil to All Small Mammals	BAF[e]	--	Median BAFs (Table 4-21)
	Regression Equation	log (tissue, dw) = 0.5446*log (soil, dw) + 0.3164	--
	R^2 value	0.48	--
	P value	0.003	--
Soil to Soil Invertebrates (Earthworms)	BAF[e]		
	Regression Equation	tissue, dw = 4.7017*(soil, dw) - 0.5528	tissue, dw = 1.3029*(soil, dw) + 0.69
	R^2 value	0.85	0.89
	P value	0.008	0.0001
Soil to Terrestrial Insects (Grasshoppers)	BAF[e]	Blankenship et al. (2005) BAF = 0.17	Median BAFs (Table 4-21)
	Regression Equation	--	--
Soil to Terrestrial Plants	BAF[e]	--	Pant et al. (2011) BAF = 0.05
	Regression Equation	Ficko et al. tissue, ww (ng/g) = 0.1433*(soil, ng/g dw) + 34.546	--

Notes:

a. The regression equation and statistics represent the correlation pair with the highest R^2 value and the lowest P value. If a dry weight to dry weight pair had similar R^2 and P values to the correlation pair with highest R^2 value and the lowest P value, the dry weight to dry weight equation and statistics were selected. R^2 and P values have only been included when a regression equation has been included. Regression equations for negative relationships were not included.
b. PCB uptake also evaluated based on the regression equation from the laboratory data analysis.
c. Significant regression equations based on dry weight tissue and sediment unavailable.
e. Updated from values presented in the OU4 BAF Memo (Arcadis 2011) to include nearby historical sediment data, as requested by USEPA.
d. This BAF is calculated using data from the three individual fish tissue types.
--: no correlation pairs with $R^2 > 0.3$ and $p < 0.1$ and/or the regression showed a negative correlation
BAF: bioaccumulation factor
dw: dry weight
ERA: ecological risk assessment
PCB: polychlorinated biphenyl
USEPA: United States Environmental Protection Agency
ww: wet weight

Table 4-21. Summary of Median BAFs for PCBs and Metals
Anniston PCB Site, Anniston, Alabama

Habitat	Type	AA	Bioaccumulation Factors (Median)																
			Aquatic Plants	Emergent Insects	Benthic Invertebrates	Lumbriculus	Crayfish	Molluscs	Frog	Snake	Forage Fish	Bottom Fish	Predator Fish	All Fish	Worms	Terrestrial Insects	Terrestrial spiders	Aquatic spiders	Terrestrial plants	Small Mammals
Polychlorinated Biphenyls																				
Aquatic	AA Median	Upper (Median)	0.60	20.18	1.14	regression	1.92	10.53	8.67	83.29	16.65	43.99	80.60	22.24						
Aquatic	AA Median	Middle (Median)	0.42	0.53	1.14	regression	1.37	4.73	2.49	62.71	22.01	21.59	46.60	23.72						
Aquatic	AA Median	Lower (Median)	0.26	0.56	0.58	regression	0.58	7.24	2.18	24.54	19.31	43.60	62.15	22.41						
Aquatic	Site-wide Median	Site-wide	0.45	0.68	0.78	regression	0.93	7.24	3.36	24.54	18.24	32.71	62.15	22.41						
Terrestrial	AA Median	Upper (Median)													3.72	AA ND	3.72	3.72	0.01	0.50
Terrestrial	AA Median	Middle (Median)													7.38	AA ND	7.38	7.38	0.35	1.44
Terrestrial	AA Median	Lower (Median)													3.00	AA ND	3.00	3.00	AA ND	1.24
Terrestrial	Site-wide Median	Site-wide													4.75	0.17 b	4.75	4.75	0.29	0.74
Mercury																				
Aquatic	AA Median	Upper (Median)	0.09	0.33	regression	1.0 a	regression	0.32	0.61	regression	regression	0.48	1.37	0.26						
Aquatic	AA Median	Middle (Median)	0.07	0.13	regression	1.0 a	regression	0.26	0.36	regression	regression	0.29	1.34	0.47						
Aquatic	AA Median	Lower (Median)	0.08	0.13	regression	1.0 a	regression	0.83	0.43	regression	regression	0.40	1.58	0.55						
Aquatic	Site-wide Median	Site-wide	0.08	0.14	regression	1.0 a	regression	0.33	0.37	regression	regression	0.40	1.38	0.43						
Terrestrial	AA Median	Upper (Median)													2.15	0.02	2.15	2.15	AA ND	0.01
Terrestrial	AA Median	Middle (Median)													3.69	AA ND	3.69	3.69	0.07	0.08
Terrestrial	AA Median	Lower (Median)													3.83	0.07	3.83	3.83	AA ND	0.14
Terrestrial	Site-wide Median	Site-wide													2.80	0.02	2.80	2.80	0.07	0.04
Barium																				
Aquatic	Site-wide Median	Site-wide	1.47	0.05	0.91		5.68	0.80	Median NA	Median NA	0.94	0.24	0.23	0.30						
Aquatic	Site-wide Ave Ratio	Site-wide	--	--	--		--	--	1.17	0.27	--	--	--	--						
Terrestrial	Site-wide Median	Site-wide													0.82	0.04	0.82	0.82	Median NA	Median NA
Terrestrial	Site-wide Ave Ratio	Site-wide													--	--			0.87	0.21
Chromium																				
Aquatic	Site-wide Median	Site-wide	0.28	Median NA	0.35		0.08	1.27	Median NA	Median NA	0.59	0.06	0.16	0.17						
Aquatic	Site-wide Ave Ratio	Site-wide	--	1.10	--		--	--	1.11	Site ND	--	--	--	--						
Terrestrial	Site-wide Median	Site-wide													0.92	Median NA	0.92	0.92	Median NA	Median NA
Terrestrial	Site-wide Ave Ratio	Site-wide													--	Site ND			0.09	0.30
Cobalt																				
Aquatic	Site-wide Median	Site-wide	Median NA	Median NA	1.24		Median NA	1.69	Median NA	Median NA	Median NA	0.09	0.06	0.07						
Aquatic	Site-wide Ave Ratio	Site-wide	Site ND	0.07	--		Site ND	--	0.39	Site ND	Site ND	--	--	--						
Terrestrial	Site-wide Median	Site-wide													0.86	Median NA	0.86	0.86	Median NA	Median NA
Terrestrial	Site-wide Ave Ratio	Site-wide													--	Site ND			0.06	Site ND
Lead																				
Aquatic	Site-wide Median	Site-wide	0.51	0.02	0.80		0.13	1.04	Median NA	Median NA	0.02	0.03	0.03	0.03						
Aquatic	Site-wide Ave Ratio	Site-wide	--	--	--		--	--	0.39	0.09	--	--	--	--						
Terrestrial	Site-wide Median	Site-wide													0.66	0.01	0.66	0.66	Median NA	Median NA
Terrestrial	Site-wide Ave Ratio	Site-wide													--	--			0.003	0.10
Vanadium																				
Aquatic	Site-wide Median	Site-wide	0.33	Median NA	0.44		0.19	0.55	Median NA	Median NA	0.16	0.05	0.03	0.05						
Aquatic	Site-wide Ave Ratio	Site-wide	--	0.44	--		--	--	0.18	Site ND	--	--	--	--						
Terrestrial	Site-wide Median	Site-wide													0.63	0.01	0.63	0.63	Median NA	Median NA
Terrestrial	Site-wide Ave Ratio	Site-wide													--	--			0.01	Site ND

Notes:
a. Based on data presented by Gilmour et al. (2013)
b. Based on data presented by Blankenship et al. (2005)
AA: assessment area
NA: not applicable
ND: nondetect

Table 5-1. Overview of Toxicity Benchmarks, TRVs, and CTCs Developed or Selected for OU-4
Anniston PCB Site, Anniston, Alabama

Media	Relevant Receptor	PCBs	Mercury	Barium	Chromium	Cobalt	Lead	Vanadium
Media-Based Benchmarks								
Soil	Terrestrial plants	yes	yes	NA	yes	NA	yes	yes
	Terrestrial invertebrates	yes	yes	NA	yes	NA	yes	yes
	Reptiles and amphibians	NS	NS	NA	NS	NA	NS	NS
Sediment	Aquatic plants	NS	NS	NS	NS	NS	NS	NS
	Benthic invertebrates	yes	yes	yes	yes	yes	yes	yes
	Fish	NS	NS	NS	NS	NS	NS	NS
	Reptiles and amphibians	NS	NS	NS	NS	NS	NS	NS
Water	Aquatic plants	yes	yes	yes	yes	yes	yes	yes
	Aquatic invertebrates	yes	yes	yes	yes	yes	yes	yes
	Fish	yes	yes	yes	yes	yes	yes	yes
	Reptiles and amphibians	NS	NS	NS	NS	NS	NS	NS
Tissue-Based CTCs								
Aquatic Plant Tissue	Aquatic plants	NS	NS	NS	NS	NS	NS	NS
Terrestrial Plant Tissue	Terrestrial plants	NS	NS	NA	NS	NA	NS	NS
Benthic Invertebrate Tissue	Oligochaetes	yes	NS	NS	NS	NS	NS	NS
	Emergent Insects	yes	yes	NS	NS	NS	NS	NS
	Odonata/Epibenthic	yes	yes	NS	NS	NS	NS	NS
	Molluscs	yes	yes	NS	NS	NS	NS	NS
	Crayfish	yes	yes	NS	NS	NS	NS	NS
Terrestrial Invertebrate Tissue	Earthworm	yes	yes	NS	NS	NS	NS	NS
	Terrestrial insects	yes	NS	NS	NS	NS	NS	NS
Fish Tissue (whole body)	Fish	yes	yes	NS	NS	NS	yes	yes
Reptile/Amphibian Tissue	Reptiles and amphibians	NS	NS	NS	NS	NS	NS	NS
Bird Egg Tissue	Birds (representative receptors)	yes	yes	NS	NS	NS	NS	NS
Small Mammal Tissue (whole body)	Small mammals (representative receptors)	yes	NS	NA	NS	NA	NS	NS
Dietary TRVs								
Birds	Birds (representative receptors)	yes	yes	yes	yes	yes	yes	yes
Mammals	Small mammals (representative receptors)	yes	yes	yes	yes	yes	yes	yes

Notes:
CTC: critical tissue concentration
NA: not applicable because constituent is not a soil/terrestrial constituent of potential concern (COPC)
NS: value was not developed, as the dataset was not sufficient
PCB: polychlorinated biphenyl
TRV: toxicity reference value

Table 5-2a. Site-Specific PCB and Mercury Toxicity Thresholds for Benthic Invertebrates
Anniston PCB Site, Anniston Alabama

Species[d]	Endpoint Type	Endpoint	Site-Specific PCB Toxicity Thresholds (mg PCB/kg dw sed)				Site-Specific PCB Toxicity Thresholds (mg PCB/kg OC)			Site-Specific Mercury Toxicity Thresholds (mg/kg dw sed)		
			EC0[b]	EC0* [a]	EC10* [a]	EC20* [a]	EC0* [a]	EC10* [a]	EC20* [a]	EC0* [a]	EC10* [a]	EC20* [a]
C. dilutus	Growth	13-d ash-free dry weight	0.05[c]	6.0	17	32	322	880	1610	1.6	5.3	7.6
		13-d biomass per replicate chamber	0.05[c]	6.0	14	23	346	711	1170	2.3	5.0	6.6
H. azteca		28-d biomass per replicate chamber	0.05[c]	1.7	25	58	UND[e]	4880	7600	0.90	4.0	7.5
		42-d biomass per replicate chamber	0.05[c]	18	40	68	1220	2520	3930	4.1	6.9	10
C. dilutus	Reproduction	Emergence percentage	0.05[c]	2.0	6.8	14	170	465	873	0.94	3.0	4.7
		No. of egg cases	0.05[c]	21	31	46	1160	1660	2310	3.1	4.5	6.3
		Total young	0.05[c]	69	89	114	3390	4150	5080	11	12	14
		Young/egg case	18[b]	209	260	324	8390	9890	11700	18	20	22
H. azteca		42-d total young	0.05[c]	9.2	13	18	453	627	866	2.2	2.8	3.5
		42-d young/female	0.05[c]	1.5	3.0	5.4	102	181	302	0.50	0.84	1.3
		42-d young/female (normalized to 42-d survival)	0.05[c]	1.4	2.6	4.4	73	120	195	0.41	0.66	1.0
C. dilutus	Survival	13-d survival	0.05[c]	14	76	123	1000	3710	5570	3.6	9.2	13
		Adult survival time	1[b]	98	186	323	4580	8320	13900	--[f]	--[f]	--[f]
H. azteca		28-d survival	0.05[c]	UND[e]	105	152	UND[e]	4636	6390	2.4	8.1	11
		42-d survival	0.05[c]	31	127	165	2380	5250	6690	5.6	10	13

Notes:

[a] EC0*, EC10*, and EC20* are the regression-predicted PCB concentrations (measured as Aroclors) that would cause an additional 0%, 10%, or 20% effect beyond the lowest response measured in the reference sediments (i.e., 1×, 0.9×, and 0.8× the response at the "bottom" of the reference envelope).

[b] EC0 is the PCB concentration at which the average reference-sediment response would be predicted to occur, when projected onto the concentration-response curve generated for that endpoint with OU-4 sediments.

[c] EC0 was set at a concentration of 0.05 (the mean reference sediment concentration) when the average reference-sediment response was greater than the regression-predicted maximum control-normalized response.

[d] Values not calculated for 7 endpoints because a decreasing concentration-response relationship did not exist for the endpoint (see Table C-1 in Appendix C). In addition, values for the adult biomass endpoint for *C. dilutus* are not included as site-specific toxicity thresholds because of the high uncertainty associated with the fact that adult ash-free dry weight was not measured.

[e] UND: undefined EC0*, because the lowest control-normalized reference-sediment response (88.8%) was greater than the regression-predicted maximum control-normalized response (85.9%).

[f] Value not calculated because a decreasing concentration-response relationship did not exist for the endpoint.

d: day
mg/kg dw sed: milligrams per kilogram dry weight sediment
PCB: polychlorinated biphenyl
OC: organic carbon

Table 5-2b. Summary of Toxicity Benchmarks, TRVs, and CTCs for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

Media	Receptor	PCBs			Mercury [b]			Barium			Chromium			Cobalt			Lead			Vanadium		
		(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference
Media-Based Toxicity Benchmarks																						
Sediment (mg/kg dw)		**TEC**	**PEC**		**TEC**	**PEC**		**TEC**	**PEC**		**TEC**	**PEC**		**TEC**	**PEC**		**TEC**	**PEC**		**TEC**	**PEC**	
	Benthic invertebrates*	0.060	0.68	MacDonald et al. (2000)	0.18	1.1	MacDonald et al. (2000)	NA	NA	--	43	111	MacDonald et al. (2000)	NA	NA	--	36	128	MacDonald et al. (2000)	NA	NA	--
Soil (mg/kg dw)		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**	
	Terrestrial plants	40	NA	Efroymson et al. (1997a)	0.30	NA	Efroymson et al. (1997a)	--	--	Not a soil COPC	1.0	NA	Efroymson et al. (1997a)	--	--	Not a soil COPC	120	NA	USEPA (2005c)	2.0	NA	Efroymson et al. (1997a)
	Terrestrial invertebrates	3.6	36	USEPA (2015) [i]	0.10	0.23	Efroymson et al. (1997b) / Son et al. 1997	--	--	Not a soil COPC	0.40	NA	Efroymson et al. (1997b)	--	--	Not a soil COPC	1700	NA	USEPA (2005c)	NA	NA	--
Water (µg/L)		**Acute**	**Chronic**		**Acute**	**Chronic**		**Acute**	**Chronic**		**Acute**	**Chronic**		**Acute**	**Chronic**		**Acute**	**Chronic**		**Acute**	**Chronic**	
	Aquatic life (water column invertebrates, fish, and amphibians)	0.60	0.014	ADEM (2015)[a], USEPA (2016)	2.4 1.4	0.012 0.77	ADEM (2015) [g] USEPA (2016) [h]	110	4.0	Suter and Tsao (1996)	1005	131	ADEM (2015)[c], USEPA (2016)	1500	23	Suter and Tsao (1996)	136	5	ADEM (2015)[c], USEPA (2016)	280	20	Suter and Tsao (1996)
	Aquatic plants	NA	0.14	Suter and Tsao (1996)	NA	5.0	Suter and Tsao (1996)	NA	NA	--	NA	400	Suter and Tsao (1996)	NA	NA	--	NA	500	Suter and Tsao (1996)	NA	NA	--
	Aquatic invertebrates	NA	1.2	Suter and Tsao (1996)	NA	0.87	Suter and Tsao (1996)	NA	NA	--	NA	NA	--	NA	4.4	Suter and Tsao (1996)	NA	NA	--	NA	430	Suter and Tsao (1996)
	Fish	NA	0.4	Suter and Tsao (1996)	NA	0.87	Suter and Tsao (1996)	NA	NA	--	NA	89	Suter and Tsao (1996)	NA	810	Suter and Tsao (1996)	NA	22	Suter and Tsao (1996)	NA	41	Suter and Tsao (1996)
Dietary Toxicity Reference Values		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**	
Dietary TRV (mg/kg bw-d; dw)	Birds - high sensitivity	0.043	0.13	Lillie et al. (1974)	0.023	0.068	Spalding et al. (2000)	21	42	Sample et al. (1996)	2.7	2.8	USEPA (2008)[d]	7.6	7.8	USEPA (2005b)[d]	1.6	3.3	USEPA (2005c)[d]	0.34	0.70	USEPA (2005d)[d]
	Birds - mid-range sensitivity	0.47	1.4	Koval et al. (1987)																		
	Small mammals	0.23	0.68	McCoy et al. (1995)	0.075	0.15	Dansereau et al. (1999)	52	121	USEPA (2005a)[d]	2.4	2.8	USEPA (2008)[d]	7.3	10	USEPA (2005b)[d]	4.7	8.9	USEPA (2005c)[d]	4.2	8.3	USEPA (2005d)[d]
	Mink	0.050	0.10	Restum et al. (1998)																		
	Mink (alternate)	NA	0.05	Restum et al. (1998) [k]																		
Tissue Critical Tissue Concentrations (dry weight basis) [f]		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**	
Benthic Invertebrates	Oligochaetes	541	659	converted to dw assuming 17% solids (Landrum et al. 2004)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Emergent Insects	21	NA	converted to dw assuming 31% solids (OU-4 data)	24	NA	converted to dw assuming 31% solids	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Odonata/Epibenthic	158	422	converted to dw assuming 18% solids (OU-4 data)	56	90	converted to ww assuming 18% solids (OU-4 data)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Molluscs	1263	1875	converted to dw assuming 8% solids (OU-4 data)	8	150	converted to dw assuming 8% solids	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Crayfish	21	57	converted to dw assuming 28% solids (OU-4 data)	0.92	16	converted to ww assuming 10% solids (Biesinger et al. 1984)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Terrestrial Invertebrates	Earthworms	78	83	converted to ww assuming 22% solids (Rodriguez-Grau et al. 1989)	15	NA	converted to ww assuming 29% solids (OU-4 data)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Grasshoppers/Crickets	307	480	converted to dw assuming 30% solids (Paine et al. 1993)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Amphibians and Reptiles	Frogs	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Snakes	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--

Table 5-2b. Summary of Toxicity Benchmarks, TRVs, and CTCs for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

Media	Receptor	PCBs			Mercury [b]			Barium			Chromium			Cobalt			Lead			Vanadium		
		(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference	(low)	(high)	Reference
Bird Eggs (mg/kg dw)	Birds - high sensitivity	2.1	4.5	Britton and Houston (1973)	0.44	0.80	Jackson et al. (2011)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Birds - mid-range sensitivity	28	66	NOAEL : McLane and Hughes (1980) LOAEL : Peakall and Peakall (1973), Peakall et al. (1972)				NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Mammal Tissue (mg/kg dw)	Small mammals	10	23	McCoy et al. (1995)[e]	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Fish Tissue (mg/kg dw)	Non-salmonid	7.0	34	Hansen et al. (1974)	0.85	0.93	Webber and Haines 2003/Friedmann et al. 1976	NA	NA	--	NA	NA	--	NA	NA	--	9.3	15	Holcombe et al. (1976)	0.090	2.1	Hilton and Bettger (1988)
Tissue Critical Tissue Concentrations (wet weight basis) [f]		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**		**NOAEL**	**LOAEL**	
Benthic Invertebrates (mg/kg ww)	Oligochaetes	92	112	Fisher et al. 1999	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Emergent Insects	6.5	NA	Sanders and Chandler 1974	7.5	NA	Saouter et al. 1993	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Odonata/Epibenthic	28	76	Borgman et al. 1990; Nebeker and Puglisi 1974	10	16	Borgmann et al. 1993	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Molluscs	101	150	Lowe et al. 1972	0.6	12	LOAEL: Thain et al. 1984 NOAEL: Dillon et al. 1977; acute-to-chronic UF (0.1)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Crayfish	6.0	16	Sanders and Chandler 1974; Duke et. al 1970	0.092	1.6	Biesinger et al. 1982	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Terrestrial Invertebrates (mg/kg ww)	Earthworms	17	18	Rodriguez-Grau et al. 1989, acute-to-chronic UF (0.1)	4.4	NA	Burton et al. 2006	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Grasshoppers/Crickets	92	144	Paine et al. 1993	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Amphibians and Reptiles (mg/kg ww)	Frogs	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Snakes	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Bird Eggs (mg/kg ww)	Birds - high sensitivity	0.52	1.1	Britton and Houston (1973)	0.11	0.20	Jackson et al. (2011)	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
	Birds - mid-range sensitivity	7.1	17	NOAEL : McLane and Hughes (1980) LOAEL : Peakall and Peakall (1973), Peakall et al. (1972)				NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Mammal Tissue (mg/kg ww)	Small mammals	3.3	7.2	McCoy et al. (1995)[e]	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--	NA	NA	--
Fish Tissue (mg/kg ww)	Non-salmonid	1.9	9.3	Hansen et al. (1974)	0.23	0.25	Webber and Haines 2003/Friedmann et al. 1976	NA	NA	--	NA	NA	--	NA	NA	--	2.5	4	Holcombe et al. (1976)	0.024	0.554	Hilton and Bettger (1988)

Table 5-2b. Summary of Toxicity Benchmarks, TRVs, and CTCs for Ecological Receptors
Anniston PCB Site, Anniston, Alabama

Notes:

a. No ADEM low value available. Screening value from Tier II Secondary Acute Value (Suter and Tsao 1996) for Aroclor 1254.
b. Mercury values based on total, inorganic, or methylmercury depending on media.
c. Ambient water quality criteria were adjusted for hardness = 200 mg/L, which represents a mid-range of site hardness data.
d. LOAELs selected from USEPA EcoSSL datasets were selected as the lowest LOAEL in the dataset for reproduction, growth, or survival that was above the selected NOAEL.
Values were used as presented in the EcoSSL dataset. Specific underlying studies were note reviewed. See Appendix D for details on development of specific TRVs.
e. Study results assumed to be in dw.
f. Tissue-based CTCs were available on wet weight basis, as reported in the studies, but converted to dw for the risk assessment using site-specific percent solids data where available, or using appropriate literature values (see text).
g. Value based on methylmercury but applies to total mercury
h. Value based on total mercury but also applies to methylmercury
i. Soil benchmark calculated using equilibrium partitioning approach from USEPA (2015) using a LOAEL water quality criteria based on freshwater aquatic invertebrate Final Chronic Value (0.54 ug/L), as calculated by Fuchsman et al. (2006).
An uncertainty factor of 10 was applied to estimate the NOAEL-equivent benchmark.
j. Based on reproductive endpoint
k. Based on kit growth endpoint
* Site-specific PCB toxicity values for benthic invertebrates are presented in Table 5-2a.

ADEM: Alabama Department of Environmental Management
BERA: Baseline Ecological Risk Assessment
COPC: constituent of potential concern
CTC: Common toxicity criteria
dw: dry weight
EcoSSL = ecological soil screening level
high: selected high toxicity benchmark
LOAEL: lowest-observed adverse effects level
low: selected low toxicity benchmark
mg/kg dw: milligrams per kilogram of dry weight
mg/L: milligrams per liter
mg/kg bw-d: milligrams per kilogram body weight per day
NA: value not available
NOAEL: no-observed adverse effects level
PCB: polychlorinated biphenyl
PEC: probable effects concentration
TEC: threshold effects concentration
TRV: toxicity reference value
USEPA: United States Environmental Protection Agency
µg/L: micrograms per liter
--: not applicable

References:

ADEM 2015. Water Division - Water Quality Program. Volume 1. ADEM Admin Code r. 335-6-x-xx available. at:http://www.adem.state.al.us/alEnviroRegLaws/files/Division6Vol1.pdf

Biesinger, K.E., L.E. Anderson, and J.G. Eaton. 1982. Chronic effects of inorganic and organic mercury on Daphnia magna: Toxicity, accumulation, and loss. Arch. Environ. Contam. Toxicol. 11:769-774

Borgmann, U., W.P. Norwood, and K.M. Ralph. 1990. Chronic toxicity and bioaccumulation of 2,5,2N,5N- and 3,4,3N,4N-tetrachlorobiphenyl and Aroclor 1242 in the amphipod Hyalella azteca. Arch. Environ. Contam. Toxicol. 19:558-564

Borgmann, U., W.P Norwood, and C. Clarke. 1993. Accumulation, regulation, and toxicity of copper, zinc, lead, and mercury in Hyalella azteca. Hydrobiologia 259:79-89.

Britton, WM, and Huston, TM 1973. Influence of Polychlorinated Biphenyls in the Laying Hen. Poultry Sci. 52 (Part II): 1620-1624.

Burton, DT, SD Turley, DJ Fsiher, DJ Green, and TR Shedd. 2006. Bioaccumulation of total mercury andmonomethylmercury in the earthworm Eisenia fetida. Water, Air, and Soil Pollution 170: 37-54

Custer, T.W., and Heinz, G.H. 1980. Reproductive Success and Nest Attentiveness of Mallard Ducks Fed Aroclor 1254. Environ. Pollution, Series A 21:313-318.

Dahlgren, RB, RL Linder, and CW Carlson. 1972. Polychlorinated biphenyls: Their effects on penned pheasants. *Environ. Health Perspect.* 89:101.

Dansereau, M, N Lariviere, D Du Trembley, D Belanger. 1999. Reproductive Performance of Two Generations of Femal Semidomesticated Mink Fed diets containing organic mercury contaminated freshwater fish. Arch. Environ. Contam. Toxicol. 36:221-226.

Dillon, TM. 1977. Mercury and the Estuarine Marsh Clam, Rangia Cuneata Gray. I. Toxicity Arch Environ Contam Toxicol 06:249-255.

Duke, T.W., J.I. Lowe, and A.J. Wilson Jr. 1970. Polychlorinated biphenyl (Aroclor 1254) in the water, sediment, and biota of Escambia Bay, Florida. Bull. Environ. Contam. Toxicol. 5(2):171-180.

Efroymson, RA, ME Will, GW Suter II, and AC Wooten. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 128 pp. ES/ER/TM-85/R3.

Efroymson, RA, ME Will, and GW Suter II. 1997b. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-126/R2.

Fisher,S, SW Chordas III, PF Landrum. 1999. Lethal and sublethal body residues for PCB intoxication in the oligochaete, Lumbriculus variegatus Aquatic Toxicology Volume 45, Issues 2–3: 115–126.

Fuchsman PC, JC Barber, JC Lawton, KB Liegh. 2006. An evaluation of cause-effect relationships between polychlorinated biphenyl concentrations and sediment toxicity to benthic invertebrates. Envion Tox. Chem 25:2601-2612.

Hansen, DJ, SC Schimmel, and J Forester. 1974. Aroclor 1254 in eggs of sheepshead minnows: effect of fertilization success and survival of embryos and fry. Proc. 27th Annu. Conf. S Southeastern Assoc. Game Fish. Comm. Pp 420-423.

Hilton, J. W. and Bettger, W. J., 1988: Dietary vanadium toxicity in juvenile rainbow trout: a preliminary study. Aquatic Toxicology 12(1): 63-71.

Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. McKim. 1976. Long-term effects of lead exposure on three generations of brook trout (*Salvelinus fontinalis*). J. Fish. Res. Board Can. 33 : 1731-1741.

Jackson, AK, DC Evers, MA Etterson, AM Condon, SB Folsom, J Detweiler, J Schmerfeld, and DA Cristol. 2011. Mercury exposure affects the reproductive success of a free-living terrestrial songbird, the Carolina wren (Thryothorus ludovicianus). The Auk 128(4):759 769.

Koval, PJ, T. Peterle, and JD Harder. 1987. Effects of Polychlorinated Biphenyls on Mourning Dove Reproduction and Circulating Progesterone Levels. Bull. Environ. Contam. Toxicol. 39:663-670.

Landrum PF; M Leppanen, SD Robinson, DC Gossiaux, GA Burton, M Greenberg, JVK Kukkonen, BJ Eadie, MB Lansing. Effect of 3,4,3′,4′-tetrachlorobiphenyl on the reworking behavior of Lumbriculus variegatus exposed to contaminated sediment 2004. Environ Tox & Chem 23:178-186.

Lillie, RJ, HC Cecil, J Bitman, and GF Fries. 1974. Differences in response of caged white leghorn layers to various polychlorinated biphenyls (PCBs) in the diet. *Poult. Sci.* 53:726 732.

Lowe, J.I., P.R. Parrish, J.A. Patrick, Jr., and J. Forester. 1972. Effects of the polychlorinated biphenyl Aroclor 1254 on the American oyster Crassostrea virginica. Marine Biol. 17:209-214

McCoy, G, MF Finlay, A Rhone, K James, and GP Cobb. 1995. Chronic polychlorinated biphenyls exposure on three generations of oldfield mice (Peromyscus polionotus): Effects on reproduction, growth, and body residues. *Arch. Environ. Contam. Toxicol.* 28(4):431 435.

MacDonald, DD, CG Ingersoll, and TA Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environmental Toxicology and Chemistry 39(1):20- 31.
McLane, M.A.R., and D.L. Hughes. 1980. Reproductive success of screech owls fed Aroclor 1248. Archives of Environmental Contamination and Toxicology 9:661–665.
Nebeker, A.V., Puglisi, F.A., 1974. Effect of polychlorinated biphenyls (PCBs) on survival and reproduction of Daphnia, Gammarus and Tanytarsus. Trans. Am. Fish. Soc. 4, 722– 728.
Paine, JM, MJ McKee, ME Ryan. 1993. Toxicity and bioaccumulation of soil PCBs incrikets: comparison of laboratory and field studies. Environ Tox Chem 12: 2097-2103.
Peakall, D.B., Lincer, J.L., and Bloom, S.E. 1972. Embryonic Mortality and Chromosomal Alterations Caused by Aroclor 1254 in Ring Doves. Environ. Health Perspect. April:103-104.
Peakall, D.B., and M.L. Peakall. 1973. Effect of a polychlorinated biphenyl on the reproduction of artificially and naturally incubated dove eggs. The Journal of Applied Ecology 10(3):863–868.
Restum, J, S Bursian, J Giesy, J Render, W Helferich, E Shipp, D Verbrugge, and R Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink: 1. Effects on mink reproduction, kit growth, and survival, and selected biological parameters. J. Toxicol. Environ. Health Part A 54: 343 375.
Rodriguez-Grau, J, BJ Venables, LC Fitzpatrick, AJ Goven. 1989. Suppression of secretory rosette formation by PCBs in Lumbriculus terrestris: an earthworm assay for humoral immunotoxicity of xenobiotics. Environ Tox Chem 8: 1201-1207.
Saouter E, Hare L, Campbell PGC, Boudou A, Ribeyre F. 1993. Water Research 27: 1041-1048
Sanders, H. O., and J. H. Chandler. 1972. Biological magnification of a polychlorinated biphenyl (Aroclor 1254) from water by aquatic invertebrates. Bull. Environ. Contain. Toxicol. 7(5), 257-63
Sample, B E, DM Opresko, and GW Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision.* ES/ER/TM-86-R3. U. S. Department of Energy, Office of Environmental Management.
Son, J, MI Ryoo, J Jung, K Cho. 2007. Effects of cadmium, mercury, and lead on the survival and instantaneous rate of increase of Paronychiurus kimi (Lee) (Collembola). Applied Soil Ecology 35: 404-411.
Spalding, MG, PC Frederick, HC McGill, SN Bouton, and LR McDowell. Metylmercury accumulation in tissues and its effects on growth and appetite in captive great egrets. J. Wildl. Dis. 36(3): 411-422.
Suter, GW II and CL Tsao. 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104 pp. ES/ER/TM-96/R2.
Thain, JE. 1984. Effects of Mercury on the prosobranch molusc Crepidula fornicata acute lethal toxicity and effects on growth and reproduction of chronic exposure. Mar environ Res 12:285-309.
USEPA. 2005a. Ecological Soil Screening Levels for Barium. Available at: http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf.
USEPA. 2005b. Ecological Soil Screening Levels for Cobalt. Available at: http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_cobalt.pdf.
USEPA. 2005c. Ecological Soil Screening Levels for Lead. Available at: http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf.
USEPA. 2005d. Ecological Soil Screening Levels for Vanadium. Available at: http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_vanadium.pdf.
USEPA. 2008. Ecological Soil Screening Levels for Chromium. Available at: http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_chromium.pdf.
USEPA. 2015. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Interim Final. Originally published November 1995. Available online: https://www.epa.gov/sites/production/files/2015-09/documents/r4_era_guidance_document_draft_final_8-25-2015.pdf
USEPA. 2016. National Ambient Water Quality Criteria for Protection of Aquatic Life. Available online: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table
Webber HM and TA Haines. 2003. Mercury effects on predator avoidance behavior of a forage fish, golden shiner (Notemigonus crysoleucas). Environ. Toxicol. Chem. 22:1556 1561.

Table 5-4. Terrestrial Vegetation Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean (SD) Richness (Number of Species) of Vegetation by Reach and Sampling Season[1]

Season	Reach[2]			
	UAA	MAA	LAA	All Reaches
Fall 2001	49 (8)	42 (6)	43 (17)	44 (9)
Spring 2002	64 (6)	48 (3)	58 (2)	57 (8)
All Seasons	56 (11)	45 (6)	50 (13)	50 (11)

b. Mean (SD) Shannon-Wiener Diversity Index for Vegetation by Reach and Sampling Season

Season	Reach			
	UAA	MAA	LAA	All Reaches
Fall 2001	3.7 (0.15)	3.6 (0.07)	3.6 (0.39)	3.6 (0.18)
Spring 2002	3.9 (0.08)	3.7 (0.04)	3.9 (0.02)	3.9 (0.11)
All Seasons	3.8 (0.17)	3.7 (0.08)	3.8 (0.29)	3.7 (0.18)

c. Mean (SD) Simpsons Dominance Index for Vegetation by Reach and Sampling Season

Season	Reach			
	UAA	MAA	LAA	All Reaches
Fall 2001	0.030 (0.005)	0.030 (0.000)	0.032 (0.012)	0.031 (0.006)
Spring 2002	0.024 (0.002)	0.027 (0.001)	0.023 (0.000)	0.025 (0.002)
All Seasons	0.027 (0.005)	0.029 (0.002)	0.027 (0.009)	0.028 (0.005)

d. Mean (SD) Percent Multi-layer Vegetation Cover by Reach and Sampling Season[3]

Season	Reach			
	UAA	MAA	LAA	All Reaches
Fall 2001	95 (35)	68 (32)	77 (23)	80 (31)
Spring 2002	155 (58)	92 (30)	106 (16)	117 (54)
All Seasons	125 (55)	80 (29)	91 (23)	99 (49)

e. Estimated Proportion of Habitat Type on Vegetation Transects in Each Reach

Transect	Reach	Floodplain Forest	Maintained Field	Early-Successional[4]
C- FPO1	UAA	0.50	0.25	0.25
C-FPO2	UAA	0.25	0.75	0
C-FPO3	UAA	0.80	0.20	0
C-FPO4	UAA	0.050	0.80	0.050
C-FPO5	UAA	0.20	0.80	0
C-FPO6	UAA	0.60	0.40	0
Average Proportion UAA		0.40	0.53	0.050
C-FPO7	MAA	0.50	0	0.50
C-FPO8	MAA	1.0	0	0
Average Proportion MAA		0.75	0	0.25
C-FPO9	LAA	0.10	0.85	0.050
C-FPO10	LAA	0.40	0.60	0
Average Proportion LAA		0.25	0.73	0.025

Table 5-4. Terrestrial Vegetation Community Measures
Anniston PCB Site, Anniston, Alabama

Notes:

[1] Transects used to estimate species richness within each river reach were of unequal length. This may confound estimates of species richness due to differences in sampling area (Gotelli and Colwell 2001).

[2] UAA, MAA, LAA reaches have high, medium, and low COPC concentrations, respectively.

[3] Percent cover sums to more than 100% because it is sum of three overlapping canopy layers on the transect (herbaceous, shrub, tree).

[4] Early-successional habitat was not directly included in the statistical analysis. It was indirectly included, as it was the compliment to the total proportion of floodplain forest and maintained field.

Proportions were visually estimated using Figure 2-10 and 2-11 of BBL (2005) Data Summary Report for OU-4.

COPC: constituent of potential concern
BBL: Blasland, Bouck & Lee, Inc. (now ARCADIS)
LAA: lower assessment area
MAA: middle assessment area
OU-4: Operable Unit 4
UAA: upper assessment area
PCB: polychlorinated biphenyl
SD: standard deviation

References:

BBL. 2005. Data Summary Report for Operable Unit 4 Anniston PCB Site Revision 1. September 2005.
Gotelli, Nicholas J., and Robert K. Colwell. 2001. Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. Ecology letters 4.4 (2001): 379-391.

Table 5-5. Trends for Terrestrial Vegetation Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Plant Species Richness	Sampling Season (Fall 2001, Spring 2002)	566	1	11	0.0060
	River Reach (UAA, MAA, LAA)	603	2	5.9	**0.016**
	Sampling Season x Reach	60	2	0.59	0.57
	Floodplain Forest Proportion	168	1	3.3	0.094
	Maintained Field Proportion	241	1	4.7	0.050
	Error	611	12	NA	NA
Shannon-Wiener Diversity	Sampling Season (Fall 2001, Spring 2002)	0.19	1	8.3	0.014
	River Reach (UAA, MAA, LAA)	0.054	2	1.2	0.33
	Sampling Season x Reach	0.020	2	0.45	0.65
	Floodplain Forest Proportion	0.031	1	1.4	0.27
	Maintained Field Proportion	0.016	1	0.70	0.42
	Error	0.27	12	NA	NA
Simpsons Dominance[1]	Sampling Season (Fall 2001, Spring 2002)	0.00014	1	5.8	0.030
	River Reach (UAA, MAA, LAA)	0.0000049	2	0.10	0.90
	Sampling Season x Reach	0.000023	2	0.48	0.63
	Floodplain Forest Proportion	0.0000076	1	0.32	0.58
	Maintained Field Proportion	0.000000022	1	0.00090	0.98
	Error	0.00029	12	NA	NA
Vegetation Cover	Sampling Season (Fall 2001, Spring 2002)	5408	1	8.5	0.013
	River Reach (UAA, MAA, LAA)	23711	2	19	**<0.001**
	Sampling Season x Reach	1306	2	1.0	0.39
	Floodplain Forest Proportion	4510	1	7.1	0.021
	Maintained Field Proportion	14827	1	23	<0.001
	Error	7628	12	NA	NA

Notes:
Vegetation community results of three-way ANOVA to test if river reaches differ significantly depending on year after taking into account relative proportions of habitat type sampled in each reach (n = 20).
Bolded values are P values that are significant that evaluate effect of reach location.
ANOVA: analysis of variance
df: degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PCB: polychlorinaed biphenyl
Type III SS: Type III Sum of Squares
UAA: upper assessment area

Table 5-6. Summary of Water Quality Parameters by Habitat Type
Anniston PCB Site, Anniston, Alabama

Sample Location	Habitat Type	Date	Water depth (ft)	Water Velocity (ft/sec)	Water Temperature (˚C)	Specific Conductance (mS/cm)	Dissolved Oxygen (mg/L)	pH (s.u.)	Turbidity (NTU)
Ref 3	BW	11/1/2006	0.8	0	15.4	0.040	11.83	5.37	32.7
Ref 3	BW	5/17/2007	1.4	0.13	25.9	0.029	10.98	8.77	9.2
UBW 1	BW	10/24/2006	1.2	-0.03	14	0.155	12.15	7.76	132
UBW 1	BW	5/14/2007	1.5	0.1	24.5	0.125	9.36	7.81	33
UBW 2	BW	10/25/2006	1.1	0.03	12.8	0.149	10.62	7.36	21.1
UBW 2	BW	5/17/2007	1.1	0.164	22.4	0.135	11.13	8.28	45
MBW 1	BW	10/26/2006	1.4	0.03	14.8	0.169	11.01	6.93	69.3
MBW 1	BW	5/16/2007	1.3	-0.01	21.7	0.172	10.24	8.26	25
MBW 2	BW	5/16/2007	0.4	-0.02	22	0.183	9.87	8.13	46
LBW 1	BW	10/28/2006	0.5	0.03	15.3	0.093	8.63	6.31	235
LBW 2	BW	10/29/2006	0.9	0.21	14	0.197	11.71	6.57	35.6
LBW 2	BW	5/15/2007	2.1	0.09	24.5	0.156	11.57	9.00	109
Ref 1	Dep	5/17/2007	2.9	0.065	21.6	0.091	11.61	8.42	25
Ref 3	Dep	5/17/2007	2.6	0.295	23.4	0.029	10.69	8.18	12
UDEP 1	Dep	10/24/2006	3.4	0.36	14	0.157	11.03	6.23	0
UDEP 1	Dep	5/14/2007	2.2	0.38	23.9	0.129	9.71	8.10	16.2
UDEP 2	Dep	10/25/2006	1.1	0.31	12.6	0.15	11.19	6.29	6.3
UDEP 2	Dep	5/17/2007	0.8	0.426	22.7	0.127	11.59	8.14	18
MDEP 1	Dep	10/26/2006	1.3	0.07	13.9	0.171	10.82	6.99	7.9
MDEP 1	Dep	5/16/2007	1.2	0.06	21.8	0.166	10.23	8.22	11
MDEP 2	Dep	10/27/2006	4	0.33	14.6	0.157	10	6.47	21
MDEP 2	Dep	5/16/2007	3.8	0.3	21.6	0.162	10.19	8.17	17
LDEP 1	Dep	10/28/2006	1.5	0.29	15.9	0.094	9.87	6.63	287
LDEP 1	Dep	5/15/2007	1.9	0.2	23	0.139	10.18	8.40	37
LDEP 1	Dep	5/15/2007	1.2	0.14	24.2	0.138	11.63	8.50	150
LDEP 2	Dep	10/29/2006	1.1	0.08	14.1	0.11	10.3	7.56	41.6
LDEP 2	Dep	5/15/2007	0.4	0.14	24.1	0.151	10.9	8.50	120
Ref 1	EAV	11/6/2006	1.4	0.2	12.4	0.113	9.8	6.70	16
Ref 1	EAV	5/16/2007	1.3	0.18	21.1	0.107	11.4	8.19	15
Ref 2	EAV	10/29/2006	0.9	0.13	14.9	0.075	10.21	6.86	2.2
Ref 2	EAV	5/17/2007	1.6	0.23	21	0.095	14.74	9.26	7.8
Ref 3	EAV	11/1/2006	2.2	0.02	14.2	0.039	11.89	5.65	1.3
Ref 3	EAV	5/17/2007	1	-0.328	23.6	0.029	10.9	8.69	7.9
UEAV 1	EAV	10/25/2006	1.8	0.44	12.7	0.148	10.8	6.81	7
UEAV 1	EAV	5/17/2007	2.2	0.623	21.5	0.13	10.75	8.13	17
UEAV 2	EAV	10/25/2006	1.8	0.04	13.1	0.149	11.12	6.84	18.7
UEAV 2	EAV	5/17/2007	1.7	0.328	21.7	0.131	11.22	8.14	31
MEAV 1	EAV	10/26/2006	0.6	1.1	13	0.173	10.4	7.01	6.8
MEAV 1	EAV	5/16/2007	0.6	1	21.5	0.189	10.17	8.02	9
MEAV 2	EAV	10/26/2006	0.2	0.01	14.5	0.17	12.05	6.93	75
MEAV 2	EAV	5/16/2007	0.2	0.02	21.5	0.176	10.67	8.34	20
LEAV 1	EAV	10/28/2006	1.8	0.03	15.4	0.087	9.63	5.68	276
LEAV 1	EAV	5/15/2007	2	-0.05	23.2	0.138	9.57	8.26	12
LEAV 2	EAV	10/29/2006	1.1	0.21	14.2	0.109	10.35	8.02	69.3
LEAV 2	EAV	5/15/2007	1.5	0.67	24.7	0.14	10.87	8.58	12

Table 5-6. Summary of Water Quality Parameters by Habitat Type
Anniston PCB Site, Anniston, Alabama

Sample Location	Habitat Type	Date	Water depth (ft)	Water Velocity (ft/sec)	Water Temperature (˚C)	Specific Conductance (mS/cm)	Dissolved Oxygen (mg/L)	pH (s.u.)	Turbidity (NTU)
Ref 1	Riffle	11/9/2006	0.9	1.58	14	0.105	9.26	5.70	48
Ref 1	Riffle	5/16/2007	1	1.45	21.7	0.102	11.83	8.32	20
Ref 2	Riffle	10/29/2006	0.9	1.7	14.8	0.076	10.03	6.76	<1
Ref 2	Riffle	5/17/2007	1	1.83	21.4	0.095	14.55	9.45	12
URI 1	Riffle	10/24/2006	0.2	3.4	13.1	0.152	10.27	6.03	78.4
URI 1	Riffle	5/14/2007	1.8	3.3	24	0.135	9.95	7.37	25
URI 2	Riffle	10/25/2006	0.4	0.74	12.2	0.155	10.11	6.14	9.8
URI 2	Riffle	5/17/2007	1	1.9	20.4	0.129	10.09	8.24	23
MRI 1	Riffle	10/26/2006	0.9	1.53	13.4	0.175	10.1	6.92	7.7
MRI 1	Riffle	5/16/2007	0.8	1.5	21.4	0.166	10.12	8.10	6.8
MRI 2	Riffle	10/27/2006	0.6	1.34	14.5	0.165	9.98	6.30	4
MRI 2	Riffle	5/16/2007	0.5	1.27	21.6	0.109	10.32	8.21	14
LRI 1	Riffle	10/28/2006	1.4	3.77	15.6	0.086	10.2	5.89	287
LRI 1	Riffle	5/15/2007	1.6	2.79	23.4	0.139	10.86	8.34	12
LRI 2	Riffle	10/29/2006	1.2	2.63	14.4	0.11	11.2	7.82	72
LRI 2	Riffle	5/15/2007	1.2	2.47	24.6	0.123	11.32	8.55	10.8
Ref 1	Run	11/9/2006	3.1	0.55	14.2	0.107	10	6.70	40
Ref 1	Run	5/17/2007	2.9	0.53	21.8	0.099	11.77	8.27	30
Ref 2	Run	10/29/2006	2.1	0.68	14.9	0.075	10.19	6.67	<1
Ref 2	Run	5/17/2007	1.3	0.49	21.2	0.095	14.5	9.40	8
Ref 3	Run	11/1/2006	0.8	0.3	14	0.039	11.85	5.45	0.8
Ref 3	Run	5/17/2007	1.5	0.558	23.6	0.029	10.56	8.71	43
URU 1	Run	10/24/2006	1.3	1	14	0.154	11.6	6.57	47.2
URU 1	Run	5/14/2007	2.3	1.36	24	0.128	9.94	8.05	38
URU 2	Run	10/25/2006	1.1	0.72	12.3	0.151	10.65	6.20	7.8
URU 2	Run	5/17/2007	1.5	0.68	20.5	0.13	10.22	8.16	33
MRU 1	Run	10/26/2006	1.3	0.7	13.6	0.171	10.74	6.88	3.8
MRU 2	Run	10/27/2006	1.2	2.4	14.5	0.17	10.2	6.40	22.7
MRU 2	Run	5/16/2007	1	1.47	21.9	0.141	10.17	8.47	18.3
LRU 1	Run	10/28/2006	0.9	2.7	15.8	0.092	10.14	5.94	348
LRU 1	Run	5/15/2007	1.1	1.75	24	0.14	11.14	8.50	14
LRU 2	Run	10/29/2006	1.3	2.95	13.8	0.111	10.26	7.24	69.7
LRU 2	Run	5/15/2007	0.6	1.81	24.5	0.148	11.01	8.47	12

Notes:
BW: backwater
Dep: depositional
EAV: emergent aquatic vegetation
ft: feet
ft/sec: feet per second
L: Lower (from old EDR convention)
M: Middle
mg/L: milligrams per liter
mS/cm: milliSiemens per centimeter
NTU: nephelometric turbidity unit
U: Upper
Ref 1: Upper Choccolocco Creek
Ref 2: Cheaha Creek
Ref 3: Talladega Creek
s.u.: standard units
°C: degrees Celsius

Table 5-7. General Substrate Composition in Aquatic Habitats
Anniston PCB Site, Anniston, Alabama

Location/ Substrate Type:		Cheaha Creek (Ref 2)		Talladega Creek (Ref 3)		Upper Choccolocco Creek (Ref 1)		Upper Assessment Area		Middle Assessment Area		Lower Assessment Area	
		Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Riffle Habitat													
Inorganic	Bedrock	10	10			0	0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0
	Boulder	20	20			10	15	<5, 5	5, <5	<5, 30	<5, 30	5, <5	5, 0
	Cobble	30	30			10	15	5, 30	30, 5	20, 30	20, 35	30, 10	30, 15
	Gravel	30	25			60	50	40, 45	40, 35	60, 30	55, 25	45, 60	40, 60
	Sand	10	15			20	20	40, 20	25, 45	15, 10	20, 10	20, 20	25, 20
	Silt	0	0			0	0	10, 0	0, 10	<5, <1	<5, tr	<5, 5	<5, 5
	Clay	0	0			0	0	<5, 0	0, <5	0, 0	0, 0	0, 0	0, 0
Organic	Detritus	<5	5			5	5	<5, 0	0, <5	<5, <5	<5, tr	<5, 0	<5, 0
	Muck-Mud	<5	<5			5	5	<5, 0	0, <5	5, <1	<5, tr	<5, 0	<5, 0
	Marl	<5	<5			tr	tr	5, <5	<5, 5	5, 10	5, 5-10	10, 0	10, 0
Run Habitat													
Inorganic	Bedrock	20	20	0	0	0	0	0, 0	0, 0	0, 0	0, *	0, 0	0, 0
	Boulder	15	20	10	15	10	10	0, 5	5, 0	5, <5	<5, *	<5, <5	<5, <5
	Cobble	35	30	25	20	<5	<5	<5, <5	<5, <5	20, 40	25, *	35, 60	30, 50
	Gravel	20	20	50	50	20	25	20, 40	45, 25	40, 30	40, *	35, 25	40, 30
	Sand	10	10	15	15	65	60	60, 40	35, 55	30, 20	25, *	30, 10	30, 15
	Silt	0	0	<5	<5	<5	<5	10, 15	15, 10	5, <5	5, *	<5, <5	<5, <5
	Clay	0	0	<5	<5	0	0	10, <5	<5, 10	0, <1	0, *	0, 0	0, 0
Organic	Detritus	10	5-10	10	5-10	10	10	5, <5	5, 5	<5, <5	<5, *	0, 0	0, 0
	Muck-Mud	5	5	<5	<5	10	15	<5, 0	0, <5	<5, <5	<5, *	0, 0	0, 0
	Marl	<5	tr	<5	5	<5	<5	10, <5	<5, 5-10	10, 5	5-10,*	0, tr	0, tr
Backwater Habitat													
Inorganic	Bedrock			0	0			0, 0	0, 0	0	0, 0	0, 0	0, 0
	Boulder			0	0			0, 0	0, 0	0	0, 0	0, 0	0, 0
	Cobble			10	10			0, 0	0, 0	<5	<5, 0	0, 0	0, 0
	Gravel			40	35			<5, <1	<5, <5	20	15, <5	<5, 10	<5, 5
	Sand			40	45			10, 5	15, 5	30	35, 30	30, 30	35, 35
	Silt			10	10			85, 90	80, 85	45	45, 60	60, 60	55, 60
	Clay			<5	<5			<5, <5	0, <5	<5	<5, <5	<5, 0	<5, 0
Organic	Detritus			10	5-10			50, 40	40, 40	20	15, 20	30, 60	30, 50
	Muck-Mud			<5	5			0, 40	5-10, 30	10	20, 35	30, 20	35, 30
	Marl			<5	<5			0, <5	0, 5	10	5-10, tr	10, 10	5-10, 5-10

Table 5-7. General Substrate Composition in Aquatic Habitats
Anniston PCB Site, Anniston, Alabama

Location/ Substrate Type:		Cheaha Creek (Ref 2)		Talladega Creek (Ref 3)		Upper Choccolocco Creek (Ref 1)		Upper Assessment Area		Middle Assessment Area		Lower Assessment Area	
		Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Depositional Habitat													
Inorganic	Bedrock				0		0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0
	Boulder				0		0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0
	Cobble				<5		0	0, 0	0, 0	0, 0	0, 0	0, 0	<5, 0
	Gravel				10		25	35, 25	25, 35	<5, 5	<5, <5	<5, <5	5, <5
	Sand				60		50	40, 40	35, 35	20, 60	25, 65	5, 15	5, 20
	Silt				0		20	25, 30	35, 30	75, 35	65, 30	85, 80	80, 70
	Clay				0		<5	<1, 5	5, <5	<5, 0	<5, 0	<5, <5	5, <5
Organic	Detritus				10		25	40, 60	50, 40	30, 20	25, 20	40, 40	40, 30
	Muck-Mud				10		<5	30, 20	25, 25	30, 40	35, 35	30, 40	30, 40
	Marl				<5		10	10, 5	5-10, 10-15	15, 20	20, 25	10, 5	10, 5-10
Emergent Aquatic Habitats													
Inorganic	Bedrock	*	*	0	0	0	0	--**	--**	0, 0	0, 0	0, --**	--**
	Boulder	0	0	5	<5	0	0	--**	--**	0, 0	0, 0	0, --**	--**
	Cobble	<5	5	5	5	0	0	--**	--**	0, 5	0, <5	0, --**	--**
	Gravel	50	45	60	55	15	15	--**	--**	<5, 50	<5, 50	<5, --**	--**
	Sand	45	50	20	25	40	45	--**	--**	50, 40	50, 40	35, --**	--**
	Silt	<5	5	10	10	40	35	--**	--**	40, <5	35, tr	60, --**	--**
	Clay	0	0	<5	<5	<5	<5	--**	--**	<5, <5	5, tr	<5, --**	--**
Organic	Detritus	40	35	5	5-10	40	45	--**	--**	50, 40	45, 35	40, --**	--**
	Muck-Mud	30	35	<5	<5	30	25	--**	--**	30, 30	35, 35	30, --**	--**
	Marl	5	<5	<5	<5	0	0	--**	--**	10, 20	5-10, 20	10, 5	--**

Notes:

All values are percent composition. Inorganic substrates will total 100%. Organic are estimates of percent observed in addition to the inorganic substrate and do not total 100%.

Blank cells indicate no location of this habitat type assessed.

* Community sample collected from previous fall run #1 habitat area. Rapid Bioassessment Protocol habitat sheet was lost; however, conditions were similar to fall.

** Not applicable as the community sampled at this location was strictly phytophilus within the aquatic vegetation and water column.

Ref: reference

tr: trace

Table 5-8. Benthic Invertebrate Community Measures and Relationship to Assessment Area and PCB Concentration
Anniston PCB Site, Anniston, Alabama

Benthic Community Measure	Assessment Area	Year/Season	Mean (Standard Deviation)					Comparison to Reference[a] (p-value)		Relationship to PCB Concentration[d]	
			Backwater	Depositional	Riffle	Run	Emerged Aquatic Vegetation	Dunnett's Test[b]	Pairwise by habitat[c]	Slope	p-value
Abundance	Lower	Fall 2006	79.5 (8.2)	33 (18)	138 (61)	116 (49)	93 (71)	1.000		0.072	0.052
		Spring 2007	76.3 (27)	99.3 (38)	376 (110)	166 (110)	425 (190)	1.000			
	Middle	Fall 2006	75.5 (70)	27.3 (19)	268 (89)	55.5 (28)	61.5 (29)	1.000			
		Spring 2007	106 (35)	61 (56)	596 (430)	423 (210)	486 (290)	1.000			
	Upper	Fall 2006	55.8 (41)	13 (5.3)	139 (64)	21.8 (6.8)	66.8 (16)	0.905			
		Spring 2007	275 (62)	116 (97)	632 (320)	267 (140)	316 (120)	1.000			
	Reference	Fall 2006	26.5 (22)	--	221 (160)	40 (36)	40.3 (37)				
		Spring 2007	3 (0)	60.5 (46)	548 (440)	367 (430)	560 (480)				
Diversity	Lower	Fall 2006	2.19 (0.25)	1.12 (0.63)	1.91 (0.24)	1.8 (0.16)	1.45 (0.45)	0.305		0.154	0.291
		Spring 2007	2.2 (0.49)	2.3 (0.14)	2.23 (0.28)	2.37 (0.25)	2.18 (0.55)	1.000			
	Middle	Fall 2006	1.87 (0.25)	1.99 (0.3)	1.98 (0.11)	1.65 (0.4)	1.6 (0.18)	0.175			
		Spring 2007	1.86 (0.53)	1.74 (0.32)	2.55 (0.6)	2.47 (0.35)	2.43 (0.38)	1.000			
	Upper	Fall 2006	1.19 (0.51)	1.51 (0.086)	1.54 (0.26)	1.4 (0.21)	0.888 (0.67)	**0.0001**	NS		
		Spring 2007	1.41 (0.4)	1.79 (0.14)	2.24 (0.32)	2.23 (0.06)	1.88 (0.31)	0.983			
	Reference	Fall 2006	1.75 (0.39)	--	1.87 (0.71)	2.12 (0.71)	1.97 (0.43)				
		Spring 2007	0.549 (0.78)	2.14 (0.26)	2.18 (0.47)	1.98 (0.5)	1.87 (0.42)				
EPT Index	Lower	Fall 2006	1.75 (1.7)	0 (0)	7.5 (1.9)	4.5 (1.3)	2.25 (0.5)	0.288		0.011	0.963
		Spring 2007	1.25 (0.96)	0.5 (1)	9.5 (1.9)	9 (3.9)	4.75 (3.6)	0.9498			
	Middle	Fall 2006	0 (0)	0 (0)	8 (1.4)	4.25 (0.5)	3.75 (1.5)	0.4068			
		Spring 2007	0.5 (0.58)	0 (0)	12 (2.4)	8.5 (2.4)	4.5 (3.5)	0.9641			
	Upper	Fall 2006	0.25 (0.5)	0.25 (0.5)	4 (0.82)	2.5 (0.58)	0.5 (1)	**0.0003**	NS		
		Spring 2007	0 (0)	0 (0)	6.25 (2.2)	3.25 (2.2)	4 (1.6)	**0.0274**	Riffle[e]		
	Reference	Fall 2006	1 (0)	--	10.3 (2.6)	5 (5.3)	2.83 (1.8)				
		Spring 2007	0 (0)	1.25 (0.5)	10.5 (3)	4.83 (2.2)	5.33 (2.8)				
Percent EPT	Lower	Fall 2006	6.3 (6.6)	0 (0)	70.4 (5.1)	31.6 (11)	5.4 (1.4)	1.000		0.010	0.466
		Spring 2007	8.6 (6.8)	0.8 (1.6)	48.6 (21)	31.0 (1.4)	8.6 (12)	NS			
	Middle	Fall 2006	0 (0)	0 (0)	75.6 (13)	38.5 (11)	19.1 (18)	1.000			
		Spring 2007	0.6 (0.7)	0 (0)	27.0 (10)	26.2 (18)	11.1 (13)	NS			
	Upper	Fall 2006	0.9 (1.8)	1.3 (2.5)	59.2 (20)	37.3 (33)	0.6 (1.2)	0.993			
		Spring 2007	0 (0)	0 (0)	38.3 (12)	7.7 (9.2)	6.2 (3.7)	NS			
	Reference	Fall 2006	5.7 (4.7)	--	31.4 (18)	16.6 (13)	12.2 (12)				
		Spring 2007	0 (0)	2.8 (1.5)	47.4 (28)	23.7 (22)	12.2 (8.8)				

Table 5-8. Benthic Invertebrate Community Measures and Relationship to Assessment Area and PCB Concentration
Anniston PCB Site, Anniston, Alabama

Benthic Community Measure	Assessment Area	Year/Season	Mean (Standard Deviation)					Comparison to Reference[a] (p-value)		Relationship to PCB Concentration[d]	
			Backwater	Depositional	Riffle	Run	Emerged Aquatic Vegetation	Dunnett's Test[b]	Pairwise by habitat[c]	Slope	p-value
Taxa	Lower	Fall 2006	16 (2.2)	6.5 (3.3)	15.3 (2.2)	11.5 (3.1)	12 (10)	0.544		0.100	0.203
		Spring 2007	17.5 (6.4)	18.3 (1.5)	24.5 (6.4)	23.3 (9.5)	30.8 (4.6)	1.000			
	Middle	Fall 2006	11.5 (3.5)	9.75 (2.8)	15.5 (2.6)	9.75 (2.4)	10.3 (2.9)	0.166			
		Spring 2007	14 (4.1)	9.5 (3.1)	39.3 (6.8)	29.5 (6.2)	26.5 (10)	1.000			
	Upper	Fall 2006	8 (2.9)	5.75 (0.96)	10.8 (2.1)	7 (0.82)	7.5 (3.1)	**0.001**	NS		
		Spring 2007	9.5 (2.6)	10.8 (1.7)	23 (5.2)	20.3 (4.9)	21.3 (8.1)	0.865			
	Reference	Fall 2006	8.5 (4.9)	--	20 (5.8)	15.8 (13)	12.5 (3.6)				
		Spring 2007	2 (1.4)	14 (2.7)	28.3 (9)	20.5 (6.5)	24.2 (3.4)				
Tolerance	Lower	Fall 2006	7.39 (0.45)	7.87 (0.99)	4.14 (0.33)	3.95 (0.43)	4.74 (1.3)	0.866		0.049	0.681
		Spring 2007	7.18 (0.65)	7.5 (0.13)	4.43 (0.62)	4.66 (0.48)	4.42 (0.68)	0.669			
	Middle	Fall 2006	7.11 (0.18)	6.46 (1.3)	4.24 (0.15)	3.72 (0.9)	4.39 (1.6)	0.944			
		Spring 2007	7.38 (0.43)	6.61 (0.43)	5.08 (0.62)	6.01 (0.49)	5.41 (1)	0.050			
	Upper	Fall 2006	8.7 (0.23)	6.58 (0.91)	4.54 (0.64)	4.58 (1.6)	8.5 (0.46)	**0.0018**	Vegetation[f]		
		Spring 2007	6.96 (0.36)	7.23 (0.24)	5.66 (0.26)	6.75 (0.52)	6.19 (0.25)	**0.0002**	Run[g]		
	Reference	Fall 2006	6.68 (0.28)	--	3 (0.75)	5.56 (1.9)	5.59 (1.7)				
		Spring 2007	6.05 (0.071)	6.28 (0.38)	4.83 (1.1)	5.32 (1.4)	5.48 (1.3)				

Notes:

[a]Post-hoc comparison tests conducted following a finding that the ANOVA model controlling for habitat and is significant.

[b]One-sided post-hoc test comparing the lower, middle, and upper assessment areas to reference while controlling for differences among habitast. A p-value less than 0.05 (in bold) indicates that the mean measure in reference is greater (or lower for tolerance) than the mean in the assessment area.

[c]Pairwise post-hoc test comparing the lower, middle, and upper assessment areas to reference when significant while controlling for differences among habitat. The test was only conducted when the corresponding Dunnett's test was significant and the habitat by area interaction term was significant. NS indicates that the interaction term was not significant, and pairwise testing was not conducted.

[d] Slope and significance of the co-variate, mean total PCB concentration (sum of Aroclors) within a half mile of the benthic sampling location, in an ANCOVA model that controls for habitat and season. Positive slope indicates that the value of the benthic metric increases with PCB concentration. A p-value less than 0.05 (in bold) indicates that the slope is significant and negative (positive for tolerance).

[e] Pairwise testing indicates a signifcant difference in the riffle habitat only.

[f] Pairwise testing indicates a signifcant difference in the vegetation habitat only.

[g] Pairwise testing indicates a signifcant difference in the run habitat only.

Units in results are not comparable across habitats and are based on abundance of no/0.046 m^2 for backwater and depositional habitats (ponar dredge), no./5 kicknets for riffles (~0.5 m^2 per net), no./15 jabs for vegetation along bank, and no./no. kicknets performed over set period of time for runs (about 4x more area than riffles covered in runs). m^2 = meters squared.

EPT Index : Number of Taxa in the orders Ephemeroptera, Trichoptera, and Plecoptera. Percent EPT = EPT abundance as a percent of total abundance.
ANCOVA: analysis of covariance
ANOVA: analysis of variance
PCB: polychlorinated biphenyl

Table 5-9. Trends for Benthic Invertebrate Community
Anniston PCB Site, Anniston, Alabama

Benthic Measure	Model Type[3]	Effect Variable	df	Type III SS	F-Ratio	P-value
Abundance[1]	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	3.6	13.76	<.0001
		Area (Reference, Upper, Middle, Lower)	3	1.2	4.61	0.0059
		Error	57	4.9		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	11.5	28.19	<.0001
		Area (Reference, Upper, Middle, Lower)	3	2.3	7.66	0.0002
		Habitat x Area Interaction	12	5.0	4.06	0.0001
		Error	62	6.3		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	10.4	19.25	<.0001
		Year/Season (Fall 2006, Spring 2007)	1	10.4	77.47	<.0001
		Mean Toal PCBs (within half mile range)	1	0.5	3.83	0.0523
		Habitat x Year/Season Interaction	4	2.2	4.02	0.0041
		Error	135	18.2		
Diversity	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	1.1	1.9	0.1395
		Area (Reference, Upper, Middle, Lower)	3	5.1	8.87	**<.0001**
		Error	57	10.9		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	5.7	8.91	<.0001
		Area (Reference, Upper, Middle, Lower)	3	3.5	7.33	0.0003
		Habitat x Area Interaction	12	4.0	2.1	0.0299
		Error	62	9.9		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	2.9	3.1	0.0177
		Mean Toal PCBs (within half mile range)	1	0.3	1.13	0.2905
		Habitat x Year/Season Interaction	5	4.6	3.9	0.0025
		Total PCBs x Year/Season Interaction	1	1.0	4.25	0.0412
		Error	134	31.8		
EPT Index	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	341	24.29	<.0001
		Area (Reference, Upper, Middle, Lower)	3	84	5.96	**0.0013**
		Error	57	267		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	948	48.37	<.0001
		Area (Reference, Upper, Middle, Lower)	3	74	5.03	**0.0035**
		Habitat x Area Interaction	12	108	1.84	0.0605
		Error	62	304		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	949	40.79	<.0001
		Mean Toal PCBs (within half mile range)	1	0	0	0.9631
		Habitat x Year/Season Interaction	5	116	3.98	0.0021
		Error	62	23.9		

Table 5-9. Trends for Benthic Invertebrate Community
Anniston PCB Site, Anniston, Alabama

Benthic Measure	Model Type[3]	Effect Variable	df	Type III SS	F-Ratio	P-value
Percent EPT	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	2.83	48.72	<.0001
		Area (Reference, Upper, Middle, Lower)	3	0.21	3.65	0.0188
		Habitat x Area Interaction	9	0.41	2.36	0.0269
		Error	48	0.93		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	1.68	27.36	<.0001
		Area (Reference, Upper, Middle, Lower)	3	0.11	2.3	0.0847
		Error	74	1.14		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	3.99	47.99	<.0001
		Year/Season (Fall 2006, Spring 2007)	1	0.08	3.67	0.0576
		Mean Total PCBs (within half mile range)	1	0.01	0.54	0.4657
		Error	139	2.89		
Taxa[2]	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	5.2	3.65	0.0178
		Area (Reference, Upper, Middle, Lower)	3	7.9	5.54	**0.0021**
		Error	57	27.3		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	55.6	35.99	<.0001
		Area (Reference, Upper, Middle, Lower)	3	10.2	8.85	<.0001
		Habitat x Area Interaction	12	16.2	3.5	0.0006
		Error	50	22.5		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	33.2	13.86	<.0001
		Year/Season (Fall 2006, Spring 2007)	1	38.5	64.32	<.0001
		Mean Toal PCBs (within half mile range)	1	1.0	1.64	0.2028
		Habitat x Year/Season Interaction	4	13.3	5.54	0.0004
		Error	135	80.9		

Table 5-9. Trends for Benthic Invertebrate Community
Anniston PCB Site, Anniston, Alabama

Benthic Measure	Model Type[3]	Effect Variable	df	Type III SS	F-Ratio	P-value
Tolerance	ANOVA Fall 2006	Habitat (Backwater, Emergent Aquatic Vegetation, Riffle, Run)	3	94.8	25.65	<.0001
		Area (Reference, Upper, Middle, Lower)	3	28.1	7.6	**0.0003**
		Habitat x Area Interaction	9	36.9	3.33	0.0031
		Error	48	59.2		
	ANOVA Spring 2007	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	47.3	21.01	<.0001
		Area (Reference, Upper, Middle, Lower)	3	12.1	7.15	**0.0003**
		Habitat x Area Interaction	12	14.6	2.16	0.0254
		Error	62	34.9		
	ANCOVA	Habitat (Backwater, Depositional, Emergent Aquatic Vegetation, Riffle, Run)	4	111.4	20.23	<.0001
		Year/Season (Fall 2006, Spring 2007)	1	3.2	2.36	0.1272
		Mean Toal PCBs (within half mile range)	1	0.2	0.17	0.6808
		Habitat x Year/Season Interaction	4	17.9	3.26	0.0138
		Error	135	185.9		

Notes:

[1] Log-transformed before analysis.

[2] Square-root transformed before analysis.

[3] A two-way analysis of variance (ANOVA) model tested if assessment area (upper, middle, or lower) differs significantly from reference after accounting for habitat (n = 158). Significant p-values (< 0.05) are bolded when the area effect is significant and suggest a lower value (higher for tolerance) compared to reference. An ANCOVA model tested if the change in metrics was related to PCB concentration while controlling for habitat and season. Non-significant factors or interaction terms were removed from the model. Significant p-values (< 0.05) are bolded when PCBs are associated with a negative effect on the value of the metric.

ANCOVA: analysis of covariance
EPT Index = Number of taxa in the orders Ephemeroptera, Trichoptera, and Plecoptera. Percent EPT is EPT abundance as a percent of total abundance.
df = degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
P-value indicates statistical significance at a selected probability, in this case 95% (or P < 0.05)
PCB: polychlorinated biphenyl
Type III SS: Type III Sum of Squares

Table 5-10. Soil Invertebrate Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean (SD) Abundance (Number/Pitfall Trap[1]) of Soil Invertebrates by Habitat and Location in May 2007

Location	Habitat				Percent Decrease
	Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	29 (29)	28 (19)	33 (19)	33 (22)	NA
Site	118 (108)	22 (21)	112 (100)	84 (92)	None (increase)

b. Mean (SD) Richness (Number of Taxa/Pitfall Trap) of Soil Invertebrates by Habitat and Location in May 2007

Location	Habitat				Percent Decrease
	Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	3.3 (1.0)	4.2 (1.7)	3.7 (1.9)	3.7 (1.5)	NA
Site	7.0 (1.5)	4.7 (2.0)	5.7 (2.3)	5.8 (2.1)	None (increase)

c. Mean (SD) Shannon-Wiener Diversity Index of Soil Invertebrates by Habitat and Location in May 2007

Location	Habitat				Percent Decrease
	Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	0.89 (0.36)	1.0 (0.52)	0.82 (0.49)	0.91 (0.44)	NA
Site	1.0 (0.55)	1.2 (0.28)	0.90 (0.34)	1.0 (0.40	None (increase)

d. Mean (SD) Simpsons Dominance Index of Soil Invertebrates by Habitat and Location in May 2007

Location	Habitat				Percent Increase
	Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	0.48 (0.19)	0.47 (0.25)	0.56 (0.25)	0.50 (0.22)	NA
Site	0.54 (0.27)	0.40 (0.10)	0.53 (0.18)	0.49 (0.20)	None (Decrease)

Notes:

[1] Pitfall trap was a 450 milliliter plastic cup with 92 millimeter diameter placed into the ground.

NA: not applicable

PCB: polychlorinated biphenyl

Table 5-11. Trends for Soil Invertebrate Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance[1]	Habitat (Forested Floodplain, Maintained Field, Successional Field)	4.7	2	2.3	0.12
	Location (Reference, Site)	3.9	1	3.8	0.059
	Location x Habitat Interaction	5.6	2	2.7	0.080
	Error	30	30	NA	NA
Taxa Richness[2]	Habitat (Forested Floodplain, Maintained Field, Successional Field)	0.17	2	0.44	0.65
	Location (Reference, Site)	2.0	1	11	**0.0030**
	Location x Habitat Interaction	0.74	2	1.9	0.16
	Error	5.7	30	NA	NA
Shannon-Wiener Diversity	Habitat (Forested Floodplain, Maintained Field, Successional Field)	0.33	2	0.87	0.43
	Location (Reference, Site)	0.12	1	0.64	0.43
	Location x Habitat Interaction	0.0050	2	0.012	0.99
	Error	5.7	30	NA	NA
Simpsons Dominance	Habitat (Forested Floodplain, Maintained Field, Successional Field)	0.080	2	0.87	0.43
	Location (Reference, Site)	0.0020	1	0.054	0.82
	Location x Habitat Interaction	0.025	2	0.27	0.77
	Error	1.4	30	NA	NA

Notes:

[1] Abundance log transformed.

[2] Richness square root transformed.

Soil invertebrate community results of two-way ANOVA to test if site significantly differs from reference after accounting for habitat and year effects (n = 36).

P values that involve location (effect of Site vs. reference) that are considered significant are **bolded**.

ANOVA: analysis of variance

df: degrees of freedom

F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups

NA: not applicable

P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)

PCB: polychlorinated biphenyl

Type III SS: Type III Sum of Squares

Table 5-12. Fish Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean Abundance of Fish (CPUE[1]) by Habitat, Year, and Location

Location	Year	Habitat					Percent Decrease
		Backwater	Riffle	Run	Vegetation	All habitats	
Reference	2006	23 (39)	51 (45)	81 (37)	78 (72)	58 (27)	
Reference	2007	16 (27)	158 (137)	46 (22)	56 (22)	69 (62)	
Reference mean		19	104	64	67	64	
Site	2006	55 (24)	48 (20)	28 (2)	29 (11)	40 (13)	
Site	2007	132 (37)	182 (44)	65 (10)	178 (85)	139 (55)	
Site mean		93	115	46	108	91	None (Increase)

b. Mean Richness (Number of Species) of Fish by Habitat, Year, and Location

Location	Year	Habitat					Percent Decrease
		Backwater	Riffle	Run	Vegetation	All habitats	
Reference	2006	11 (n/a)	9 (3)	17 (3)	13 (5)	13 (3)	
Reference	2007	14 (n/a)	19 (4)	13 (4)	14 (3)	15 (3)	
Reference mean		13	14	15	14	14	
Site	2006	10 (1)	9 (2)	10 (1)	9 (1)	10 (1)	
Site	2007	14 (3)	16 (3)	16 (2)	16 (4)	15 (1)	
Site mean		12	13	13	13	13	None (Increase)

c. Mean Shannon-Wiener Diversity Index of Fish by Habitat, Year, and Location

Location	Year	Habitat					Percent Decrease
		Backwater	Riffle	Run	Vegetation	All habitats	
Reference	2006	1.5 (n/a)	1.9 (0.29)	2.4 (0.09)	1.9 (0.39)	1.9 (0.39)	
Reference	2007	2.0 (n/a)	2.1 (0.34)	2.2 (0.34)	2.1 (0.13)	2.1 (0.06)	
Reference mean		1.7	1.8	2.2	1.9	1.9	
Site	2006	1.9 (0.06)	1.7 (0.26)	2.0 (0.14)	1.9 (0.16)	1.9 (0.11)	
Site	2007	2.1 (0.19)	1.9 (0.12)	2.4 (0.09)	2.0 (0.28)	2.1 (0.19)	
Site mean		2.1	2.0	2.3	2.1	2.1	None (Increase)

d. Mean Simpsons Dominance Index of Fish by Habitat, Year, and Location

Location	Year	Habitat					Percent Increase
		Backwater	Riffle	Run	Vegetation	All Habitats	
Reference	2006	0.38 (n/a)	0.19 (0.05)	0.12 (0.01)	0.23 (0.10)	0.23 (0.11)	
Reference	2007	0.22 (n/a)	0.20 (0.08)	0.16 (0.07)	0.16 (0.03)	0.19 (0.03)	
Reference mean		0.30	0.20	0.14	0.19	0.21	
Site	2006	0.19 (0.01)	0.24 (0.07)	0.18 (0.04)	0.35 (0.19)	0.24 (0.08)	
Site	2007	0.16 (0.03)	0.22 (0.01)	0.13 (0.02)	0.23 (0.11)	0.19 (0.05)	
Site mean		0.18	0.23	0.15	0.29	0.21	0%

Revised from 2015 BERA

Notes:

[1] CPUE is catch per unit effort, where effort is standardized to 600 seconds of electrofishing.

%: percent

BERA: Baseline Ecological Risk Assessment

PCB: polychlorinated biphenyl

Table 5-13. Trends for Fish Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance[1]	Location (Site, Reference)	0.0010	1	0.0050	0.94
	Habitat (Backwater, Riffle, Run, Vegetation)	3.5	3	5.8	0.0030
	Year (2006, 2007)	3.3	1	17	<0.001
	Location x Year Interaction	3.3	1	17	**<0.001**
	Habitat x Year Interaction	1.7	3	2.8	0.055
	Habitat x Location Interaction	1.1	3	1.8	0.17
	Error	5.7	29	NA	NA
Species Richness[2]	Location (Site, Reference)	0.25	1	1.4	0.25
	Habitat (Backwater, Riffle, Run, Vegetation)	0.26	3	0.49	0.70
	Year (2006, 2007)	2.6	1	15	0.0010
	Location x Year Interaction	0.84	1	4.8	**0.037**
	Habitat x Year Interaction	1.3	3	2.5	0.083
	Habitat x Location Interaction	0.017	3	0.032	0.99
	Error	5.1	29	NA	NA
Shannon-Wiener Diversity	Location (OU-4, Reference)	0.0050	1	0.086	0.77
	Habitat (Backwater, Riffle, Run, Vegetation)	0.87	3	5.3	0.0050
	Year (2006, 2007)	0.29	1	5.2	0.030
	Location x Year Interaction	0.030	1	0.54	0.47
	Habitat x Year Interaction	0.068	3	0.42	0.74
	Habitat x Location Interaction	0.16	3	0.98	0.41
	Error	1.6	29	NA	NA
Simpsons Dominance	Location (Site, Reference)	0.0012	1.0	0.088	0.77
	Habitat (Backwater, Riffle, Run, Vegetation)	0.22	3.0	5.4	0.0046
	Year (2006, 2007)	0.032	1	2.3	0.14
	Location x Year Interaction	0.010	1	0.72	0.40
	Habitat x Year Interaction	0.036	3	0.85	0.48
	Habitat x Location Interaction	0.12	3	2.9	**0.051**
	Error	0.40	29	NA	NA

Notes:

[1] Abundance log transformed.

[2] Richness square root transformed.

[3] Dominance transformed with Box-Cox transformation (raised to power of 3.6).

Fish community results of three-way ANOVA to test if site significantly differs from reference after accounting for habitat and year effects (n = 42).

P values that involve location (effect of Site vs. Reference) that are considered significant are **bolded.**

If interaction term is significant with location, non-parallel trends are plotted for Site vs. Reference in Figure 5-3.

ANOVA: analysis of variance

df: degrees of freedom

F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups

NA: not applicable

P-value: indicates statistical significance at a selected probability, in this case 95% (or P < 0.05)

PCB: polychlorinated biphenyl

Type III SS: Type III Sum of Squares

Table 5-14. Summary of DELT Anomalies in Fish Species
Anniston PCB Site, Anniston, Alabama

Location	Location Description	Species	Anomaly	DELT	Number of DELT Fish	Total Fish	Percent DELTs
Reference							**0.84**
Ref 1	Choccolocco Creek	Blacktail Redhorse	Eroded caudal fin	Yes	1	96	1.0
Ref 2	Cheaha Creek	Southern Studfish	Eroded caudal fin	Yes	1	140	0.71
		Redeye Bass	Hook scar	No			
Ref 3	Talladega Creek	Spotted Bass	Lesion on opercular flap	Yes	1	129	0.78
Site							**0.37**
UAA	Below Snow Creek Confluence	NA	NA	NA	0	151	0.0
UAA	Weaver Property	Spotted Bass	Popeye	No	0	131	0.0
UAA	Reaves Property	NA	NA	NA	0	116	0.0
MAA	Priebes Mill Road Bridge	NA	NA	NA	0	117	0.0
MAA	Nowland Property	NA	NA	NA	0	117	0.0
MAA	McCaig Property	Blacktail Redhorse	Lesion on pelvic fin	Yes	1	96	1.0
LAA	Rt. 339 Bridge	Blacktail Redhorse	Eroded caudal fin	Yes	1	96	1.0
LAA	Wright Property Oxbow	Spotted Bass	Deformed opercular flap	Yes	2	159	1.3
		Blacktail Redhorse	Lesion on opercular flap	Yes			
LAA	Wright Property below Oxbow	Spotted Bass	Wound	No	0	155	0.0

Notes:
DELT: deformities, erosions, lesions, tumors
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable, no anomalies observed
PCB: polychlorinated biphenyl
Ref: reference
UAA: upper assessment area

Table 5-15. Aquatic Bird Community Measures
Anniston PCB Site, Anniston, Alabama

a. Abundance of Observed Aquatic Birds by Season and Reach

Reach[1]	Season Year				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	30	12	18	35	24
MAA	28	63	33	23	37
LAA	14	24	16	10	16
All Reaches	24	33	22	23	26

b. Richness (Number of Species) of Aquatic Birds by Season and Reach

Reach	Season Year				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	4	3	5	5	4
MAA	4	5	5	5	5
LAA	4	3	6	4	4
All Reaches	4	4	5	5	4

c. Shannon-Wiener Diversity Index of Aquatic Birds by Season and Reach

Reach	Season Year				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	1.2	1.1	1.4	1.1	1.2
MAA	1.3	0.99	1.4	1.2	1.2
LAA	1.3	0.86	1.6	1.3	1.2
All Reaches	1.2	0.98	1.5	1.2	1.2

d. Simpsons Dominance Index for Aquatic Birds by Season and Reach

Reach	Season Year				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	0.35	0.35	0.29	0.43	0.35
MAA	0.30	0.50	0.25	0.36	0.35
LAA	0.31	0.50	0.23	0.30	0.34
All Reaches	0.32	0.45	0.26	0.36	0.35

Notes:

[1]UAA, MAA, LAA reaches have high, medium, and low COPC concentrations, respectively.

COPC: constituent of potential concern

LAA: lower assessment area

MAA: middle assessment area

PCB: polychlorinated biphenyl

UAA: upper assessment area

Table 5-16. Trends for Aquatic Bird Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance	Season (Fall, Spring, Summer, Winter)	230	3	0.39	0.77
	Reach (UAA, MAA, LAA)	880	2	2.2	0.19
	Error	1180	6	NA	NA
Species Richness	Season (Fall, Spring, Summer, Winter)	4.9	3	3.0	0.12
	Reach (UAA, MAA, LAA)	0.67	2	0.60	0.58
	Error	3.3	6	NA	NA
Shannon-Wiener Diversity	Season (Fall, Spring, Summer, Winter)	0.38	3	12	0.0060
	Reach (UAA, MAA, LAA)	0.0090	2	0.42	0.68
	Error	0.063	6	NA	NA
Simpsons Dominance	Season (Fall, Spring, Summer, Winter)	0.059	3	4.4	0.058
	Reach (UAA, MAA, LAA)	0.0010	2	0.099	0.91
	Error	0.027	6	NA	NA

Notes:
Aquatic bird community results of ANOVA to test if reaches significantly differ after accounting for seasonal effects (n = 12).
No location effects are significant.
ANOVA: analysis of variance
df: degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PCB: polychlorinated biphenyl
Type III SS: Type III Sum of Squares
UAA: upper assessment area

Table 5-17. Terrestrial Bird Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean (SD) Terrestrial Bird Abundance (Number/4 ha) Observed by Habitat, Year, and Location

Location	Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	36 (33)	--	4 (n/a)	20 (30)	
Reference	2007	23 (2)	4 (n/a)	2 (n/a)	10 (11)	
Reference mean		29	4	3	12	
Site	2006	119 (65)	46 (n/a)	24 (16)	63 (62)	
Site	2007	168 (22)	31 (15)	18 (22)	72 (76)	
Site mean		143	39	21	68	None (increase)

b. Mean (SD) Species Richness (Number of Species/4 ha) of Terrestrial Birds by Habitat, Year, and Location

Location	Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	6 (4)	--	2 (n/a)	4 (4)	
Reference	2007	5 (1)	3 (n/a)	1 (n/a)	3 (2)	
Reference mean		6	3	2	3	
Site	2006	10 (2)	5 (n/a)	6 (5)	7 (4)	
Site	2007	15 (2)	8 (1)	5 (6)	9 (5)	
Site mean		12	6	5	8	None (increase)

c. Mean (SD) Shannon-Wiener Diversity Index for Terrestrial Birds by Habitat, Year, and Location

Location	Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	1.4 (0.50)	--	0.69 (n/a)	1.1 (0.60)	
Reference	2007	1.6 (0.26)	1.0 (n/a)	0 (n/a)	0.89 (0.74)	
Reference mean		1.5	1.0	0.35	0.98	
Site	2006	2.0 (0.36)	0.93 (n/a)	1.3 (0.76)	1.4 (0.65)	
Site	2007	2.3 (0.22)	1.4 (0.33)	0.98 (1.4)	1.6 (0.87)	
Site mean		2.1	1.2	1.1	1.5	None (increase)

d. Mean (SD) Simpsons Dominance Index for Terrestrial Birds by Habitat, Year, and Location

Location	Year	Habitat				Percent Increase
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	0.29 (0.06)	--	0.50 (n/a)	0.40 (0.13)	
Reference	2007	0.43 (0.36)	0.38 (n/a)	1.0 (n/a)	0.60 (0.36)	
Reference mean		0.36	0.38	0.75	0.50	
Site	2006	0.20 (0.12)	0.50 (n/a)	0.36 (0.19)	0.35 (0.17)	
Site	2007	0.14 (0.04)	0.32 (0.09)	0.59 (0.59)	0.35 (0.33)	
Site mean		0.17	0.41	0.48	0.35	None (decrease)

Notes:
ha: hectare
n/a: not applicable
PCB: polychlorinated biphenyl
SD: standard deviation

Table 5-18. Trends for Terrestrial Bird Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance[1]	Location (Site, Reference)	8.9	1	13	**0.0040**
	Habitat (SF, MF, FF)	18	2	14	0.0010
	Year (2006, 2007)	0.63	1	0.94	0.35
	Year x Location Interaction	0.094	1	0.14	0.72
	Habitat x Location Interaction	0.039	2	0.029	0.97
	Habitat x Year Interaction	1.1	2	0.79	0.48
	Error	7.5	11	NA	NA
Taxa Richness[2]	Location (Site, Reference)	2.9	1	6.2	**0.030**
	Habitat (SF, MF, FF)	5.8	2	6.3	0.015
	Year (2006, 2007)	0.0060	1	0.013	0.91
	Year x Location Interaction	0.22	1	0.47	0.51
	Habitat x Location Interaction	0.11	2	0.11	0.89
	Habitat x Year Interaction	0.47	2	0.50	0.62
	Error	5.1	11	NA	NA
Shannon-Wiener Diversity	Location (Site, Reference)	0.98	1	2.8	0.12
	Habitat (SF, MF, FF)	4.7	2	6.6	0.013
	Year (2006, 2007)	0.011	1	0.03	0.87
	Year x Location Interaction	0.041	1	0.12	0.74
	Habitat x Location Interaction	0.10	2	0.14	0.87
	Habitat x Year Interaction	0.65	2	0.92	0.43
	Error	3.9	11	NA	NA
Simpsons Dominance[3]	Location (Site, Reference)	0.079	1	1.7	0.23
	Habitat (SF, MF, FF)	0.27	2	2.9	0.10
	Year (2006, 2007)	0.0043	1	0.090	0.77
	Year x Location Interaction	0.010	1	0.21	0.66
	Habitat x Location Interaction	0.022	2	0.23	0.80
	Habitat x Year Interaction	0.017	2	0.18	0.84
	Error	3.9	11	NA	NA

Notes:

[1] Abundance log transformed before analysis.

[2] Taxa Richness square root transformed before analysis.

[3] Dominance transformed with Box-Cox transformation (raised to power of 3.6).

Terrestrial bird results of three-way ANOVA to test if site significantly differs from reference after accounting for habitat[1] and year effects (n = 21).

P values that involve location (effect of Site vs. Reference) that are considered significant are **bolded**.

ANOVA: analysis of variance

df: degrees of freedom

F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups

FF: forested floodplain

MF: maintained field

n: number

NA: not applicable

P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)

PCB: polychlorinated biphenyl

SF: successional field

Type III SS: Type III Sum of Squares

Table 5-19. Aquatic Mammal Community Measures
Anniston PCB Site, Anniston, Alabama

a. Abundance of Observed Aquatic Mammals by Season and Reach

Reach[1]	Season				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	59	24	75	51	52
MAA	23	22	58	37	35
LAA	29	13	36	37	29
All Reaches	37	20	56	42	39

b. Richness (Number of Species) of Aquatic Mammals by Season and Reach

Reach	Season				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	4	4	3	3	4
MAA	3	3	4	4	4
LAA	4	3	3	4	4
All Reaches	4	3	3	4	4

c. Shannon-Wiener Diversity Index of Aquatic Birds by Season and Reach

Reach	Season				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	1.2	1.3	0.90	1.1	1.1
MAA	0.94	0.92	1.1	1.2	1.0
LAA	1.2	1.1	1.0	1.2	1.1
All Reaches	1.1	1.1	1.0	1.1	1.1

d. Simpsons Dominance Index of Aquatic Birds by Season and Reach

Reach	Season				
	Fall 2006	Winter 2007	Spring 2007	Summer 2007	All Seasons
UAA	0.67	0.71	0.56	0.66	0.65
MAA	0.55	0.56	0.65	0.67	0.61
LAA	0.66	0.65	0.59	0.66	0.64
All Reaches	0.63	0.64	0.60	0.66	0.63

Notes:

[1] UAA, MAA, LAA reaches have high, medium, and low COPC concentrations, respectively.

COPC: constituent of potential concern

LAA: lower assessment area

MAA: middle assessment area

PCB: polychlorinated biphenyl

UAA: upper assessment area

Table 5-20. Trends for Aquatic Mammal Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance	Season (Fall, Winter, Spring, Summer)	2055	3	7.9	0.017
	Reach (UAA, MAA, LAA)	1185	2	6.8	**0.029**
	Error	523	6	NA	NA
Species Richness	Season (Fall, Winter, Spring, Summer)	0.33	3	0.25	0.86
	Reach (UAA, MAA, LAA)	0	2	0	1.0
	Error	2.7	6	NA	NA
Shannon-Wiener Diversity	Season (Fall, Winter, Spring, Summer)	0.033	3	0.53	0.68
	Reach (UAA, MAA, LAA)	0.012	2	0.28	0.76
	Error	0.13	6	NA	NA
Simpsons Dominance	Season (Fall, Winter, Spring, Summer)	0.0060	3	0.62	0.63
	Reach (UAA, MAA, LAA)	0.0040	2	0.55	0.60
	Error	0.021	6	NA	NA

Notes:
Aquatic mammal community results of ANOVA to test if reaches significantly differ after accounting for seasonal effects (n = 12).

Bolded values are P values that are significant that evaluate effect of reach location.
ANOVA: analysis of variance
df: degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
P-value: indicates statistical significance at a selected probability, in this case 95% (or P < 0.05)
PCB: polychlorinated biphenyl
Type III SS: Type III Sum of Squares
UAA: upper assessment area

Table 5-21. Terrestrial Mammal Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean (SD) Abundance of Observed Terrestrial Mammals or Their Sign (Number/4 ha) by Habitat, Year, and Location

Location	Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	8 (0)	---	0	4 (6)	
Reference	2007	0	0	0	0	
Reference mean		4	0	0	1	
Site	2006	8 (n/a)	0	10 (9)	6 (5)	
Site	2007	8 (n/a)	0	8 (n/a)	5 (5)	
Site mean		8	0	9	6 (1)	None (increase)

b. Mean (SD) Richness (Number of Species/4 ha) of Terrestrial Mammals by Habitat, Year, and Location

Location	Year	Habitat			Mean	Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	2 (0)	--	0	1 (1)	
Reference	2007	0	0	0	0	
Reference mean		1	0	0	0	
Site	2006	2 (n/a)	0	3 (1)	2 (2)	
Site	2007	2 (n/a)	0	2 (n/a)	1 (1)	
Site mean		2	0	3	2	None (increase)

c. Mean (SD) Shannon-Wiener Diversity Index of Terrestrial Mammals by Habitat, Year, and Location

Location	Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	0.69 (0)	--	0	0.35 (0.49)	
Reference	2007	--	--	0	--	
Reference mean		0.69	--	0	0.35	
Site	2006	0.69 (n/a)	--	0.88 (0.27)	0.79 (0.13	
Site	2007	0.69 (n/a)	--	0.69 (n/a)	0.69 (0)	
Site mean		0.69	--	0.79	0.74	None (increase)

d. Mean (SD) Simpsons Dominance Index of Terrestrial Mammals by Habitat, Year, and Location

Location	Year	Habitat				Percent Increase
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	2006	0.5 (0)	--	--	0.5 (n/a)	
Reference	2007	--	--	--	--	
Reference mean		0.50	--	--	0.50	
Site	2006	0.5 (n/a)	--	0.47 (0.04)	0.49 (0.02)	
Site	2007	0.5 (n/a)	--	0.5 (n/a)	0.5 (0)	
Site mean		0.50	--	0.49	0.49	None (decrease)

Notes:
BERA: Baseline Ecological Risk Assessment
ha: hectare
%: percent
PCB: polychlorinated biphenyl
SD: standard deviation

Table 5-22. Trends for Terrestrial Mammal Community
Anniston PCB Site, Anniston, Alabama

Metric	Variable	Type III SS	df	F-Ratio	P-value
Abundance	Location (Site, Reference)	29	1	1.4	0.26
	Habitat (SF, MF, FF)	59	2	0.34	0.57
	Year (2006, 2007)	7.1	1	1.4	0.28
	Error	338	16	NA	NA
Taxa Richness	Location (Site, Reference)	2.3	1	1.8	0.20
	Habitat (SF, MF, FF)	4.4	2	1.7	0.21
	Year (2006, 2007)	0.72	1	0.56	0.47
	Error	21	16	NA	NA
Shannon-Wiener Diversity	Location (Site, Reference)	0.0030	1	0.16	0.71
	Habitat (SF, MF, FF)	0.012	1	0.57	0.49
	Year (2006, 2007)	0.012	1	0.57	0.49
	Error	0.084	4	NA	NA
Simpsons Dominance	Location (Site, Reference)	0	1	0.16	0.71
	Habitat (SF, MF, FF)	0	1	0.57	0.49
	Year (2006, 2007)	0	1	0.57	0.49
	Error	0.0020	4	NA	NA

Notes:
Terrestrial mammal community results of two-way ANOVA to test if site significantly differs from reference after accounting for habitat and year effects (n = 21 for abundance and richness, n = 8 for diversity and dominance).

No P values were significant.
ANOVA: analysis of variance
df: degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
FF: forested floodplain
MF: maintained field
n: number
NA: not applicable
P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PCB: polychlorinated biphenyl
SF: successional field
Type III SS: Type III Sum of Squares

Table 5-23. Small Mammal Community Measures
Anniston PCB Site, Anniston, Alabama

a. Mean Abundance (CPUE = number/trap night) of Trapped Small Mammals by Habitat, Season, Year, and Location

Location	Season Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	Spring 2007	0.040 (0)	0.080 (0.113)	0.080 (0.057)	0.067 (0.060)	
Site	Fall 2006	0.031 (0.039)	0.036 (0.047)	0.091 (0.089)	0.053 (0.062)	
Site	Spring 2007	0.010 (0.141)	0.040 (0.057)	0	0.047 (0.082)	
Site	Winter 2007	0.080 (0.113)	0.160 (0.170)	0	0.080 (0.116)	
Site Mean		0.070	0.079	0.030	0.060	10%

b. Mean Species Richness of Trapped Small Mammals by Habitat, Season, Year, and Location

Location	Season Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	Spring 2007	1.0 (0.0)	1.0 (1.41)	1.0 (0.0)	1.0 (0.63)	
Site	Fall 2006	0.67 (0.71)	0.78 (0.97)	1.1 (1.0)	0.86 (0.87)	
Site	Spring 2007	1.0 (1.41)	0.50 (0.71)	0	0.50 (0.84)	
Site	Winter 2007	1.0 (1.41)	2.0 (1.41)	0	1.0 (1.27)	
Site Mean		0.89	1.1	0.38	0.79	21%

c. Mean Shannon-Wiener Diversity Index of Trapped Small Mammals by Habitat, Season, Year, and Location

Location	Season Year	Habitat				Percent Decrease
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	Spring 2007	0	0.56 (n/a)	0	0.19 (0.25)	
Site	Fall 2006	0.13 (0.28)	0.51 (0.34)	0.38 (0.35)	0.34 (0.34)	
Site	Spring 2007	0.50 (n/a)	0	NA	0.25 (0.35)	
Site	Winter 2007	0.56 (n/a)	0.40 (0.56)	NA	0.48 (0.41)	
Site Mean		0.40	0.30	0.38	0.36	None (increase)

d. Mean Simpsons Dominance Index of Trapped Small Mammals by Habitat, Season, Year, and Location

Location	Season Year	Habitat				Percent Increase
		Forested Floodplain	Maintained Field	Successional Field	All Habitats	
Reference	Spring 2007	1.0 (0.0)	0.63 (n/a)	1.0 (0.0)	0.88 (0.17)	
Site	Fall 2006	0.91 (0.20)	0.64 (0.24)	0.74 (0.24)	0.76 (0.24)	
Site	Spring 2007	0.68 (n/a)	1.0 (n/a)	NA	0.84 (0.23)	
Site	Winter 2007	0.81 (n/a)	0.78 (0.31)	NA	0.79 (0.24)	
Site Mean		0.80	0.80	0.74	0.80	None (decrease)

Notes:
CPUE: catch per unit effort
PCB: polychlorinated biphenyl

Table 5-24. Trends for Small Mammal Community
Anniston PCB Site, Anniston, Alabama

Metric	Variables	Type II SS	df	F-ratio or Z	P-value
Abundance[1]	Season (Fall 2006, Spring 2007, Winter 2007)	NA	NA	0.60	0.55
	Habitat (FF, MF, SF)	NA	NA	-0.030	0.98
	Location (Site, Reference)	NA	NA	-0.38	0.71
	Habitat x Location Interaction	NA	NA	0.27	0.79
	Constant	NA	NA	0.48	0.63
	Poisson regression residual DF	NA	38	NA	NA
Species Richness[1]	Season (Fall 2006, Spring 2007, Winter 2007)	NA	NA	-0.80	0.43
	Habitat (FF, MF, SF)	NA	NA	-0.24	0.81
	Location (Site, Reference)	NA	NA	0.25	0.80
	Habitat x Location Interaction	NA	NA	0.14	0.89
	Constant	NA	NA	0.65	0.51
	Poisson regression residual DF	NA	38	NA	NA
Shannon-Wiener Diversity[2]	Season (Fall 2006, Spring 2007, Winter 2007)	0.010	2	0.010	0.99
	Habitat (FF, MF, SF)	1.4	2	1.5	0.26
	Location (Site, Reference)	0.092	1	0.19	0.67
	Habitat x Location Interaction	0.98	2	1.0	0.39
	Constant	8.2	17	NA	NA
Simpsons Dominance[3]	Season (Fall 2006, Spring 2007, Winter 2007)	0.0070	2	0.03	0.97
	Habitat (FF, MF, SF)	0.34	2	1.4	0.27
	Location (Site, Reference)	0.010	1	0.084	0.78
	Habitat x Location Interaction	0.17	2	0.73	0.49
	Constant	2.0	17	NA	NA

Notes:

[1] Poisson Distribution Generalized Linear Model (identity link) applied so uses maximum likelihood Z value, not F ratio or SS.

[2] Diversity transformed with Box-Cox transformation (raised to power of -0.13).

[3] Dominance transformed with Box-Cox transformation (raised to power of 1.52).

No P-values were significant.

Small mammal results of Poisson regression (for abundance and taxa richness) and 3-way ANOVA (for diversity and dominance) to test if site significantly differs from reference after accounting for habitat and season effects (n = 43 for abundance and richness and n = 18 for diversity and dominance).

ANOVA: analysis of variance
df: degrees of freedom
F-ratio: the ratio of sample group variances, used to calculate whether there are significant differences between groups
FF: forested floodplain
MF: maintained field
NA: not applicable
P-value: indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PCB: polychlorinated biphenyl
SF: successional field
Type III SS: Type III Sum of Squares
Z: (aka standard score) is the number of standard deviations an observation is above the mean.

Table 6-1. Summary of Range of Hazard Quotients Calculated for OU-4
Anniston PCB Site, Anniston, Alabama

Receptor Type[1]	Media	PCBs[2]	Mercury	Barium	Chromium	Cobalt	Lead	Vanadium
Aquatic Life	Surface Water	✓	✓	✓	✓	✓	✓	✓
Aquatic Plants	Surface Water	✓[7]	✓[7]	✓	✓[7]	✓	✓[7]	✓
	Tissue	--	--	--	--	--	--	--
Aquatic Invertebrates	Surface Water	✓[7]	✓[7]	✓	✓[7]	✓	✓[7]	✓
Benthic Invertebrates [6]	Sediment	✓[7]	✓[7]	✓	✓[7]	✓	✓[7]	✓
	Tissue	✓	✓	--	--	--	--	--
Terrestrial Plants	Soil	✓	✓	Not a Soil COPC	✓	Not a Soil COPC	✓	✓
	Tissue	--	--	--	--	--	--	--
Terrestrial Invertebrates [4]	Soil	✓	✓	Not a Soil COPC	✓	Not a Soil COPC	✓	--
	Tissue	✓	✓[5]	--	--	--	--	--
Mammals	Diet[3]	✓	✓	✓	✓	✓	✓	✓
	Tissue (wb)	✓	--	--	--	--	--	--
Birds	Diet[3]	✓	✓	✓	✓	✓	✓	✓
	Egg Tissue	✓	✓	--	--	--	--	--
Fish	Surface Water	✓[7]	✓[7]	✓	✓[7]	✓	✓[7]	✓
	Tissue (wb)	✓	✓	--	--	--	✓	✓
Amphibians/	Soil/Sed/	--	--	--	--	--	--	--
Reptiles	Tissue							

Notes:

1. NOAEL and LOAEL HQs or chronic and acute HQs were estimated for each receptor type, where available.

2. For benthic invertebrates, HQs calculated using literature-based benchmarks and a range of site-specific PCB toxicity thresholds; for birds, high and mid-range sensitivity HQs calculated for PCBs; for mammals, three TRVs evaluated: small mammal, mink based on reproduction endpoints, and mink based on growth endpoints.

3. Dietary HQs were calculated using both modeled tissue concentrations and measured tissue concentrations.

4. Terrestrial Invertebrates include grasshopper/crickets and earthworms.

5. Tissue HQs calculated for earthworm only.

6. Benthic invertebrates include benthic invertebrates (odonata larvae), emergent insects, craysfish, and mollusks.

7. Generic aquatic life and receptor-specific HQs calculated.

-- : insufficient toxicity data available to develop toxicity benchmarks, TRVs, or CTCs; HQs not calculated.

COPC: constituent of potential concern

CTC: critical tissue concentration

HQ: hazard quotient

LOAEL: lowest observed adverse effect level

NOAEL: no observed adverse effect level

PCB: polychlorinated biphenyl

TRV: toxicity reference value

wb: whole body

Table 6-2a. Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[1]	Middle AA	C7	C8[1]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors↓														
Aquatic Birds		NOAEL HQs												
Tree Swallow	tPCB-mid	166	103	11	25	42	0	0	0	0	0	0	0	0
	tPCB-high	1786	1112	122	270	457	2	0	2	3	3	1	2	3
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	5	2	2	2	2	5	5	5	1	1	2	3	2
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	2	96	3	3	16	1	1	1	1	1	1	1	2
	Vanadium	3	1	1	0	1	2	2	2	0	0	1	1	1
Spotted Sandpiper - 2	tPCB-mid	65	48	12	19	27	10	4	9	10	11	5	9	11
	tPCB-high	697	512	124	206	288	104	38	98	108	117	49	95	124
	Barium	2	2	1	0	1	2	2	2	0	0	1	1	1
	Chromium	2	1	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	1	0	0	0	0	1	1	1	0	0	0	0	0
	Lead	12	5	1	1	3	8	8	8	1	1	3	3	2
	Mercury	4	150	6	6	26	6	6	6	6	6	6	6	7
	Vanadium	17	4	5	2	4	14	14	14	2	2	5	7	6

Table 6-2a. Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[1]	Middle AA	C7	C8[1]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors↓														
Kingfisher - 1	tPCB-mid	90	56	6	14	23	6	1	6	6	7	2	5	7
	tPCB-high	969	603	66	147	248	66	13	61	63	72	18	52	78
	Barium	2	1	1	0	1	2	2	2	0	0	1	1	1
	Chromium	2	1	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	30	1	1	5	3	3	3	3	3	3	3	4
	Vanadium	4	1	1	1	1	4	4	4	1	1	1	2	2
Kingfisher - 2	tPCB-mid	73	45	5	11	19	5	1	4	5	5	1	4	6
	tPCB-high	783	487	54	119	200	51	10	47	49	55	14	40	60
	Barium	3	2	1	1	1	4	4	4	0	0	1	2	1
	Chromium	1	1	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	1	0	0	0	0	1	1	1	0	0	0	0	0
	Mercury	1	26	1	1	5	2	2	3	3	3	3	3	3
	Vanadium	5	1	1	1	1	4	4	4	1	1	1	2	2
Great Blue Heron[2]	tPCB-mid	128	80	9	19	33	7	1	6	7	8	2	6	9
	tPCB-high	1383	861	95	210	354	75	15	69	77	88	22	63	96
	Barium	1	1	0	0	0	1	1	1	0	0	0	0	0
	Chromium	1	0	0	0	0	1	1	1	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead[7]	1	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	58	2	2	10	3	3	3	4	4	4	4	5
	Vanadium	2	1	1	0	1	2	2	2	0	0	1	1	1
Osprey	tPCB-mid	54	34	4	8	14	3	1	3	3	3	1	2	4
	tPCB-high	580	361	40	88	148	32	6	29	33	37	9	27	41
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	22	1	1	4	1	1	1	1	1	1	1	2
	Vanadium	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-2a. Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[1]	Middle AA	C7	C8[1]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors↓														
Aquatic Mammals		NOAEL HQs												
Bat	tPCB	248	155	17	38	64	0	0	0	0	0	0	0	0
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	4	1	2	1	1	4	4	4	1	1	2	2	2
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	21	1	1	3	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Mink - 2[2]	tPCB-mink	232	145	17	36	60	16	3	14	15	17	4	12	19
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	0	0	0	0	1	1	1	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead[7]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	2	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Otter	tPCB-mink	372	232	26	56	95	16	3	15	19	22	5	15	23
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	6	0	0	1	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Sediment data unavailable for this reach for non-mercury metals. Non-mercury metal EPCs from the upstream reach were conservatively used to estimate exposure.

[2] Great blue heron and Mink-2 are exposed to sediment and riparian soil.

AA: assessment area
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
PCB: polychlorinated biphenyl
tPCB: total polychlorinated biphenyl
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin
Sediment: Instream Sediment

Table 6-2b. Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[1]	Middle AA	C7	C8[1]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors↓														
Aquatic Birds		NOAEL HQs												
Tree Swallow	tPCB-mid	12	12	12	12	12	0	0	0	1	1	1	1	1
	tPCB-high	125	125	125	125	125	4	4	4	6	6	6	6	6
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	3	3	3	3	3	2	2	2	2	2	2	2	2
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Sandpiper - 2	tPCB-mid	2	2	1	1	1	1	1	1	0	0	0	0	0
	tPCB-high	23	18	12	13	14	8	8	8	5	5	5	5	5
	Barium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Chromium	1	0	1	0	0	1	1	1	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	3	2	1	1	1	2	2	2	1	1	1	1	1
	Mercury	3	41	3	3	8	4	4	4	5	5	5	5	5
	Vanadium	6	3	3	2	3	5	5	5	2	2	3	3	3
Kingfisher - 1	tPCB-mid	8	8	8	8	8	12	12	12	11	11	11	11	11
	tPCB-high	88	87	86	87	87	131	131	131	122	122	122	122	122
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	5	1	1	2	4	4	4	5	5	5	5	5
	Vanadium	1	1	1	1	1	1	1	1	1	1	1	1	1
Kingfisher - 2	tPCB-mid	7	7	7	7	7	9	9	9	9	9	9	9	9
	tPCB-high	76	76	75	75	76	102	102	102	94	94	94	94	94
	Barium	1	1	1	1	1	1	1	1	0	0	1	1	1
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	2	5	2	2	2	4	4	4	4	4	4	4	4
	Vanadium	1	1	1	1	1	1	1	1	1	1	1	1	1
Great Blue Heron[5]	tPCB-mid	19	18	18	18	18	16	16	16	19	19	19	19	19
	tPCB-high	199	199	198	198	198	177	177	177	203	203	203	203	203
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead[7]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	6	10	6	6	6	6	6	6	8	8	8	8	8
	Vanadium	1	1	1	1	1	1	1	1	1	1	1	1	1
Osprey	tPCB-mid	8	8	8	8	8	7	7	7	8	8	8	8	8
	tPCB-high	82	82	82	82	82	75	75	75	86	86	86	86	86
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	2	2	2	2	2	2	2	2	3	3	3	3	3
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-2b. Summary of Aquatic Receptors NOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[1]	Middle AA	C7	C8[1]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors↓														
Aquatic Mammals		NOAEL HQs												
Bat	tPCB	17	17	17	17	17	1	1	1	1	1	1	1	1
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	1	1	1	1	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Mink - 2[5]	tPCB-mink	22	22	22	22	22	32	32	32	30	30	30	30	30
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead[7]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Otter	tPCB-mink	39	39	39	39	39	38	38	38	40	40	40	40	40
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	1	1	1	1	1
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Sediment data unavailable for this reach for non-mercury metals. Non-mercury metal EPCs from the upstream reach were conservatively used to estimate exposure.

[2] Great blue heron and Mink-2 are exposed to riparian soil.

AA: assessment area
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin
Sediment: Instream Sediment

Table 6-3a. Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[2]	Middle AA	C7	C8[2]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors[5]↓														
Aquatic Birds		LOAEL HQs												
Tree Swallow	tPCB-mid	55	34	4	8	14	0	0	0	0	0	0	0	0
	tPCB-high	595	371	41	90	152	1	0	1	1	1	0	1	1
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	4	2	2	2	2	5	5	5	1	1	2	3	2
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	32	1	1	5	0	0	0	0	0	0	0	1
	Vanadium	1	0	0	0	0	1	1	1	0	0	0	1	1
Spotted Sandpiper - 2	tPCB-mid	22	16	4	6	9	3	1	3	3	4	2	3	4
	tPCB-high	232	171	41	69	96	35	13	33	36	39	16	32	41
	Barium	1	1	0	0	0	1	1	1	0	0	0	1	0
	Chromium	2	1	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	1	0	0	0	0	1	1	1	0	0	0	0	0
	Lead	6	3	1	1	2	4	4	4	0	0	1	1	1
	Mercury	1	50	2	2	9	2	2	2	2	2	2	2	2
	Vanadium	8	2	3	1	2	7	7	7	1	1	3	3	3
Kingfisher - 1	tPCB-mid	30	19	2	5	8	2	0	2	2	2	1	2	2
	tPCB-high	323	201	22	49	83	22	4	20	21	24	6	17	26
	Barium	1	1	0	0	0	1	1	1	0	0	0	0	0
	Chromium	2	1	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	10	0	0	2	1	1	1	1	1	1	1	1
	Vanadium	2	1	1	0	1	2	2	2	0	0	1	1	1
Kingfisher - 2	tPCB-mid	24	15	2	4	6	2	0	1	2	2	0	1	2
	tPCB-high	261	162	18	40	67	17	3	16	16	18	5	13	20
	Barium	2	1	1	0	1	2	2	2	0	0	1	1	1
	Chromium	1	0	1	1	1	2	2	2	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	9	0	0	2	1	1	1	1	1	1	1	1
	Vanadium	2	1	1	0	1	2	2	2	0	0	1	1	1
Great Blue Heron[3]	tPCB-mid	43	27	3	6	11	2	0	2	2	3	1	2	3
	tPCB-high	461	287	32	70	118	25	5	23	26	29	7	21	32
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	0	0	0	0	1	1	1	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	19	1	1	3	1	1	1	1	1	1	1	2
	Vanadium	1	0	0	0	0	1	1	1	0	0	0	0	0
Osprey	tPCB-mid	18	11	1	3	5	1	0	1	1	1	0	1	1
	tPCB-high	193	120	13	29	49	11	2	10	11	12	3	9	14
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	7	0	0	1	0	0	0	0	0	0	0	1
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-3a. Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[2]	Middle AA	C7	C8[2]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors[5]↓														
Aquatic Mammals		LOAEL HQs												
Bat	tPCB	84	52	6	13	21	0	0	0	0	0	0	0	0
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	3	1	1	1	1	4	4	4	1	1	2	2	2
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	11	0	0	2	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Mink - 2[3]	tPCB-mink	116	73	8	18	30	8	2	7	8	9	2	6	9
Mink - 2 (Alternate TRV)[1]	tPCB-mink	232	145	17	36	60	16	3	14	15	17	4	12	19
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	1	1	1	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	1	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Otter	tPCB-mink	186	116	13	28	48	8	2	7	9	11	3	8	12
Otter (Alternate TRV)[1]	tPCB-mink	372	232	26	56	95	16	3	15	19	22	5	15	23
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	3	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Alternate TRVs were selected from Restum et al. (1998) based on growth. The LOAEL TRV is 0.05 mg/kg-day.

[2] Sediment data unavailable for this reach for non-mercury metals. Non-mercury metal EPCs from the upstream reach were conservatively used to estimate exposure.

[3] Great blue heron and Mink-2 are exposed to riparian soil.

AA: assessment area
HQ: hazard quotient
LOAEL: lowest-observed adverse effect level
mg/kg-day: milligrams per kilogram per day
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin
Sediment: Instream Sediment

References:

Restum, J., S. Bursian, J. Giesy, J. Render, W. Helferich, E. Shipp, D. Verbrugge, and R. Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink: 1. Effects on mink reproduction, kit growth, and survival, and selected biological parameters. J. Toxicol. Environ. Health Part A 54: 343 375.

Table 6-3b. Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[2]	Middle AA	C7	C8[2]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors[5]↓														
Aquatic Birds		**LOAEL HQs**												
Tree Swallow	tPCB-mid	4	4	4	4	4	0	0	0	0	0	0	0	0
	tPCB-high	42	42	42	42	42	1	1	1	2	2	2	2	2
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	1	1	1	1	1	1	1	1	1	1	1	1
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Sandpiper - 2	tPCB-mid	1	1	0	0	0	0	0	0	0	0	0	0	0
	tPCB-high	8	6	4	4	5	3	3	3	2	2	2	2	2
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	0	0	0	0	1	1	1	0	0	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	1	1	0	0	1	1	1	1	0	0	1	1	1
	Mercury	1	14	1	1	3	1	1	1	2	2	2	2	2
	Vanadium	3	1	1	1	1	3	3	3	1	1	1	2	2
Kingfisher - 1	tPCB-mid	3	3	3	3	3	4	4	4	4	4	4	4	4
	tPCB-high	29	29	29	29	29	44	44	44	41	41	41	41	41
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	2	0	0	1	1	1	1	2	2	2	2	2
	Vanadium	1	0	0	0	0	0	0	0	0	0	0	0	0
Kingfisher - 2	tPCB-mid	2	2	2	2	2	3	3	3	3	3	3	3	3
	tPCB-high	25	25	25	25	25	34	34	34	31	31	31	31	31
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	2	1	1	1	1	1	1	1	1	1	1	1
	Vanadium	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-3b. Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[2]	Middle AA	C7	C8[2]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors[5]↓														
Great Blue Heron[3]	tPCB-mid	6	6	6	6	6	5	5	5	6	6	6	6	6
	tPCB-high	66	66	66	66	66	59	59	59	68	68	68	68	68
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	2	3	2	2	2	2	2	2	3	3	3	3	3
	Vanadium	1	0	0	0	0	1	1	1	0	0	0	0	0
Osprey	tPCB-mid	3	3	3	3	3	2	2	2	3	3	3	3	3
	tPCB-high	27	27	27	27	27	25	25	25	29	29	29	29	29
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	1	1	1	1	1	1	1	1	1	1	1	1	1
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Aquatic Mammals		LOAEL HQs												
Bat	tPCB	6	6	6	6	6	0	0	0	0	0	0	0	0
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Mink - 2[3]	tPCB-mink	11	11	11	11	11	16	16	16	15	15	15	15	15
Mink - 2 (Alternate TRV)[1]	tPCB-mink	22	22	22	22	22	32	32	32	30	30	30	30	30
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-3b. Summary of Aquatic Receptors LOAEL Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1	C2	C3	C4	Upper AA	C5	C6[2]	Middle AA	C7	C8[2]	C9	C10	Lower AA
Exposure Subarea→		Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Receptors[5]↓														
Otter	tPCB-mink	19	19	19	19	19	19	19	19	20	20	20	20	20
Otter (Alternate TRV)[1]	tPCB-mink	39	39	39	39	39	38	38	38	40	40	40	40	40
	Barium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Alternate TRVs were selected from Restum et al. (1998) based on growth. The LOAEL TRV is 0.05 mg/kg-day.

[2] Sediment data unavailable for this reach for non-mercury metals. Non-mercury metal EPCs from AA used to estimate incidential sediment ingestion.

[3] Great blue heron and Mink-2 are exposed to riparian soil.

AA: assessment area
HQ: hazard quotient
LOAEL: lowest-observed adverse effect level
mg/kg-day: milligrams per kilogram per day
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

References:

Restum, J., S. Bursian, J. Giesy, J. Render, W. Helferich, E. Shipp, D. Verbrugge, and R. Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake

Table 6-4a Percentage of Surface Sediment Samples Exceeding Toxicity Thresholds by Reach
Anniston PCB Site, Anniston, Alabama

EU	Total Number of Samples in Reach	Percentage of Surface Sediment Samples Exceeding Sediment Toxicity Threshold Values[a]									
		Total PCBs (mg/kg dw)					Total PCBs (mg/kg-OC)				
		H. azteca 42-day young/female (normalized to survival)				*C. dilutis* Survival	*H. azteca* 42-day young/female (normalized to survival)				*C. dilutis* Survival
		< EC0* (1.4)	>EC0*; ≤ EC10* (2.6)	>EC10*; ≤ EC20* (4.4)	> EC20*	> EC0* (14)	< EC0* (72.8)	>EC0*; ≤ EC10* (120)	>EC10*; ≤ EC20* (195)	> EC20*	> EC0* (1000)
C1	16	31%	25%	25%	19%	6%	25%	0%	6%	69%	25%
C2	39	72%	5%	10%	13%	10%	74%	0%	5%	21%	8%
C3	14	57%	36%	7%	0%	0%	43%	14%	14%	29%	0%
C4	25	84%	8%	0%	8%	4%	52%	12%	8%	28%	0%
C5	48	83%	10%	4%	2%	0%	54%	15%	17%	15%	0%
C6	4	100%	0%	0%	0%	0%	75%	25%	0%	0%	0%
C7	36	69%	11%	19%	0%	0%	50%	14%	17%	19%	3%
C8	32	78%	19%	3%	0%	0%	94%	6%	0%	0%	0%
C9	17	100%	0%	0%	0%	0%	100%	0%	0%	0%	0%
C10	37	89%	8%	3%	0%	0%	92%	8%	0%	0%	0%
Total	268	77%	12%	7%	4%	2%	67%	9%	8%	16%	3%

Table 6-4a Percentage of Surface Sediment Samples Exceeding Toxicity Thresholds by Reach
Anniston PCB Site, Anniston, Alabama

EU	Total Number of Samples in Reach	Percentage of Surface Sediment Samples Exceeding Sediment Toxicity Threshold Values[a] — Mercury (mg/kg dw) — *H. azteca* 42-day young/female (normalized to survival)				*C. dilutis* Survival
		< EC0*	>EC0*; ≤ EC10*	>EC10*; ≤ EC20*	> EC20*	> EC0* (3.6)
C1	2	0%	100%	0%	0%	0%
C2	7	43%	0%	14%	43%	14%
C3	10	40%	20%	30%	10%	0%
C4	7	29%	0%	57%	14%	0%
C5	25	8%	44%	32%	16%	0%
C6	0	--	--	--	--	--
C7	21	38%	33%	14%	14%	5%
C8	3	33%	0%	33%	33%	0%
C9	1	0%	0%	100%	0%	0%
C10	15	47%	7%	13%	33%	0%
Total	91	30%	25%	25%	20%	2%

Notes

[a] EC0*, EC10*, and EC20* are the regression-predicted PCB or mercury concentrations that would cause an additional 0%, 10%, or 20% effect beyond the lowest response measured in the reference sediments (i.e., 1×, 0.9×, and 0.8× the response at the "bottom" of the reference envelope).

H. azteca 42-day young/female (normalized to survival) is the most sensitive endpoint.

-- : Not calculated since there were no samples collected for mercury from this EU.

EU: exposure unit

OC: organic carbon

PCBs: polychlorinated biphenyls

Negligible risk when concentration is below EC0* for most sensitive reproduction endpoint

Low risk based on exceedance of EC0* for most sensitive reproduction endpoint

Moderate risk based on exceedance of EC10*for most sensitive reproduction endpoint

High risk based on exceedance of EC20* for most sensitive reproduction endpoint

Risk Based based on EC0* for most sensitive survival endpoint.

Table 6-4b. Percentage of Surface Sediment Samples Exceeding Literature-Based Benchmarks by Reach
Anniston PCB Site, Anniston, Alabama

	Percentage of Surface Sediment Samples Exceeding Sediment Toxicity Benchmarks[a]											
	Total PCBs (mg/kg dw)			Mercury (mg/kg dw)			Barium (mg/kg dw)			Chromium (mg/kg dw)		
EU	Total Number of Samples in Reach	TEC (0.06)	PEC (0.68)	Total Number of Samples in Reach	TEC (0.18)	PEC (1.1)	Total Number of Samples in Reach	TEC (NA)	PEC (NA)	Total Number of Samples in Reach	TEC (43)	PEC (111)
C1	**16**	94%	88%	**2**	100%	0%	**2**	--	--	**2**	50%	0%
C2	**39**	46%	38%	**7**	57%	43%	**4**	--	--	**4**	0%	0%
C3	**14**	100%	50%	**10**	80%	10%	**2**	--	--	**2**	0%	0%
C4	**25**	96%	32%	**7**	100%	14%	**2**	--	--	**2**	0%	0%
C5	**48**	88%	38%	**25**	100%	16%	**4**	--	--	**4**	25%	0%
C6	**4**	75%	25%	**0**	--	--	**0**	--	--	**0**	--	--
C7	**36**	75%	47%	**21**	95%	14%	**3**	--	--	**3**	0%	0%
C8	**32**	91%	56%	**3**	100%	33%	**0**	--	--	**0**	--	--
C9	**17**	53%	6%	**1**	100%	0%	**1**	--	--	**1**	0%	0%
C10	**37**	84%	22%	**15**	67%	33%	**10**	--	--	**10**	0%	0%
Total	**268**	79%	40%	**91**	88%	20%	**28**	--	--	**28**	7%	0%

Table 6-4b. Percentage of Surface Sediment Samples Exceeding Literature-Based Benchmarks by Reach
Anniston PCB Site, Anniston, Alabama

	Percentage of Surface Sediment Samples Exceeding Sediment Toxicity Benchmarks[a]								
	Cobalt (mg/kg dw)			Lead (mg/kg dw)			Vanadium (mg/kg dw)		
EU	Total Number of Samples in Reach	TEC (NA)	PEC (NA)	Total Number of Samples in Reach	TEC (36)	PEC (128)	Total Number of Samples in Reach	TEC (NA)	PEC (NA)
C1	2	--	--	2	100%	0%	2	--	--
C2	4	--	--	4	25%	0%	7	--	--
C3	2	--	--	2	0%	0%	10	--	--
C4	2	--	--	2	0%	0%	7	--	--
C5	4	--	--	4	25%	0%	25	--	--
C6	0	--	--	0	--	--	0	--	--
C7	3	--	--	3	0%	0%	21	--	--
C8	0	--	--	0	--	--	3	--	--
C9	1	--	--	1	0%	0%	1	--	--
C10	10	--	--	10	10%	0%	15	--	--
Total	28	--	--	28	18%	0%	91	--	--

Notes

[a] Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs) from MacDonald et al. (2000)

--: Not calculated, no sediment benchmark available.

EU: exposure unit

mg/kg dw: milligrams per kilogram dry weight

NA: not applicable

PCBs: polychlorinated biphenyls

PEC: probable effects concentration

TEC: threshold effect concentration

Table 6-5a. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1,2]	C1[1,2]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA	Upper AA	C5	C5	C5
Exposure Subarea→		East	West	North	South	Central	Riparian	North	South	Riparian	North	South	Riparian	Combined Soil	Riparian	North	South	Riparian
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Lower Trophic Receptors																		
Terrestrial Plants[3]	PCB	0	5	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
	Chromium	--	--	34	11	13	13	18	55	16	44	26	46	28	28	20	25	42
	Lead	--	--	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0
	Mercury	--	--	5	0	1	2	11	11	20	7	8	12	7	9	2	3	5
	Vanadium	--	--	11	11	10	11	10	12	8	12	11	11	10	10	14	16	8
Terrestrial Invertebrates[3]	PCB	3	6	2	0	0	9	4	8	7	3	2	3	3	3	0	0	1
	Chromium	--	--	86	28	34	34	45	138	41	110	66	115	70	69	50	63	105
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	14	1	2	5	32	34	59	22	24	36	22	28	7	9	14
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Birds																		
Mourning Dove	tPCB-mid	2	40	1	0	0	--	3	5	--	2	1	--	2	--	0	0	--
	tPCB-high	24	426	12	1	4	--	28	59	--	20	13	--	20	--	2	3	--
	Mercury	--	--	2	0	0	--	4	4	--	3	3	--	3	--	1	1	--
	Chromium	--	--	0	0	0	--	0	1	--	1	0	--	0	--	0	0	--
	Lead	--	--	0	0	1	--	1	1	--	1	1	--	1	--	0	1	--
	Vanadium	--	--	1	1	1	--	1	1	--	1	1	--	1	--	2	2	--
Blue Jay	tPCB-mid	4	72	2	0	1	--	5	10	--	3	2	--	3	--	0	1	--
	tPCB-high	43	774	21	2	7	--	51	106	--	35	24	--	36	--	4	6	--
	Mercury	--	--	4	1	1	--	7	8	--	5	6	--	5	--	2	2	--
	Chromium	--	--	1	0	0	--	0	1	--	1	1	--	1	--	0	0	--
	Lead	--	--	1	0	1	--	1	2	--	1	1	--	1	--	0	1	--
	Vanadium	--	--	2	2	2	--	2	2	--	2	2	--	2	--	3	3	--
Carolina Wren - 1	tPCB-mid	14	261	7	0	2	--	17	36	--	12	8	--	12	--	1	2	--
	tPCB-high	154	2814	74	4	23	--	183	384	--	126	84	--	128	--	12	18	--
	Mercury	--	--	15	4	5	--	29	31	--	22	23	--	21	--	9	11	--
	Chromium	--	--	2	1	1	--	1	3	--	3	2	--	2	--	1	2	--
	Lead	--	--	2	2	3	--	3	7	--	4	3	--	3	--	1	4	--
	Vanadium	--	--	7	7	6	--	6	8	--	7	7	--	6	--	9	10	--
Hawk	tPCB-mid	31	38	19	19	19	--	3	4	--	6	5	--	9	--	1	2	--
	tPCB-high	336	404	209	202	205	--	37	46	--	61	58	--	95	--	16	17	--
	Chromium	--	--	0	0	0	--	0	1	--	0	0	--	0	--	0	0	--
	Lead	--	--	0	0	0	--	0	1	--	0	0	--	0	--	0	1	--
	Mercury	--	--	7	7	7	--	1	1	--	1	1	--	2	--	1	1	--
	Vanadium	--	--	2	2	2	--	2	2	--	2	2	--	2	--	2	3	--
Terrestrial Mammals																		
Shrew - 1	tPCB	19	352	9	0	3	--	23	48	--	16	11	--	16	--	2	2	--
	Mercury	--	--	3	1	1	--	5	6	--	4	4	--	4	--	2	2	--
	Chromium	--	--	1	0	1	--	1	2	--	2	1	--	1	--	1	1	--
	Lead	--	--	0	0	1	--	1	1	--	1	1	--	1	--	0	1	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Shrew - 2	tPCB	27	341	14	6	8	--	22	46	--	16	11	--	17	--	2	3	--
	Chromium	--	--	1	0	1	--	1	2	--	2	1	--	1	--	1	1	--
	Lead	--	--	0	0	1	--	1	1	--	1	1	--	1	--	0	1	--
	Mercury	--	--	4	2	2	--	5	5	--	4	4	--	4	--	2	2	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--

Table 6-5a. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1,2]	C1[1,2]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA	Upper AA	C5	C5	C5
Exposure Subarea→		East	West	North	South	Central	Riparian	North	South	Riparian	North	South	Riparian	Combined Soil	Riparian	North	South	Riparian
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Deer	tPCB	0	7	0	0	0	--	0	1	--	0	0	--	0	--	0	0	--
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Weasel	tPCB	2	12	1	0	1	--	2	4	--	2	2	--	2	--	1	1	--
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Fox - 1	tPCB	2	15	1	0	0	--	2	3	--	1	1	--	1	--	0	0	--
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Fox - 2	tPCB	1	8	1	0	0	--	1	2	--	1	1	--	1	--	0	0	--
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--

Table 6-5a. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8	C8	C8	C9	C9	C9	C10[2]	Lower AA	Lower AA
Exposure Subarea→		North	South	Riparian	Combined Soil	Riparian	North	South	Riparian	North	South	Riparian	North	South	Riparian	Sediment	Combined Soil	Riparian
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Lower Trophic Receptors																		
Terrestrial Plants[3]	PCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--	0	0
	Chromium	18	10	18	19	42	22	30	28	24	19	24	14	14	14	--	20	20
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--	0	0
	Mercury	5	9	7	3	5	2	6	10	16	3	16	6	2	6	--	3	13
	Vanadium	14	6	7	13	8	14	15	8	11	14	14	6	14	5	--	12	10
Terrestrial Invertebrates[3]	PCB	1	1	1	0	1	0	0	1	1	0	1	0	0	1	--	0	1
	Chromium	46	25	46	47	105	56	74	70	59	47	59	36	35	36	--	51	49
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--	0	0
	Mercury	16	28	20	8	14	5	18	30	47	8	47	17	5	17	--	9	39
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Birds																		
Mourning Dove	tPCB-mid	0	1	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	tPCB-high	4	6	--	3	--	2	3	--	4	3	--	4	1	--	--	2	--
	Mercury	2	3	--	1	--	1	2	--	5	1	--	2	1	--	--	1	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	1	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	2	1	--	2	--	2	2	--	1	2	--	1	2	--	--	1	--
Blue Jay	tPCB-mid	1	1	--	0	--	0	0	--	1	0	--	1	0	--	--	0	--
	tPCB-high	7	10	--	5	--	3	5	--	7	5	--	6	1	--	--	3	--
	Mercury	4	7	--	2	--	2	4	--	11	2	--	4	2	--	--	3	--
	Chromium	0	0	--	0	--	0	1	--	0	0	--	0	0	--	--	0	--
	Lead	1	0	--	1	--	1	1	--	1	1	--	0	0	--	--	0	--
	Vanadium	3	1	--	2	--	3	3	--	2	3	--	1	3	--	--	2	--
Carolina Wren - 1	tPCB-mid	2	3	--	2	--	1	2	--	2	2	--	2	0	--	--	1	--
	tPCB-high	24	36	--	18	--	9	17	--	25	16	--	21	3	--	--	10	--
	Mercury	16	26	--	10	--	8	18	--	42	10	--	17	8	--	--	11	--
	Chromium	1	1	--	1	--	1	2	--	2	1	--	1	1	--	--	1	--
	Lead	2	1	--	3	--	3	2	--	2	2	--	1	1	--	--	2	--
	Vanadium	8	4	--	8	--	9	9	--	7	9	--	4	8	--	--	7	--
Hawk	tPCB-mid	1	1	--	1	--	1	1	--	1	1	--	1	0	--	--	1	--
	tPCB-high	7	9	--	16	--	8	9	--	11	10	--	6	3	--	--	10	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	1	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	1	2	--	1	--	1	2	--	4	1	--	2	1	--	--	1	--
	Vanadium	2	2	--	2	--	2	2	--	2	2	--	2	2	--	--	2	--
Terrestrial Mammals																		
Shrew - 1	tPCB	3	4	--	2	--	1	2	--	3	2	--	3	0	--	--	1	--
	Mercury	3	5	--	2	--	2	3	--	8	2	--	3	2	--	--	2	--
	Chromium	1	0	--	1	--	1	1	--	1	1	--	1	1	--	--	1	--
	Lead	0	0	--	1	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Shrew - 2	tPCB	3	4	--	2	--	1	2	--	3	2	--	3	0	--	--	1	--
	Chromium	1	1	--	1	--	1	1	--	1	1	--	1	1	--	--	1	--
	Lead	0	0	--	1	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	3	5	--	2	--	2	3	--	7	2	--	3	1	--	--	2	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--

Table 6-5a. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8	C8	C8	C9	C9	C9	C10[2]	Lower AA	Lower AA
Exposure Subarea→		North	South	Riparian	Combined Soil	Riparian	North	South	Riparian	North	South	Riparian	North	South	Riparian	Sediment	Combined Soil	Riparian
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Deer	tPCB	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Weasel	tPCB	1	1	--	1	--	0	1	--	1	1	--	1	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	1	0	--	0	0	--	--	0	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Fox - 1	tPCB	0	1	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Fox - 2	tPCB	0	1	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Chromium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Lead	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Vanadium	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Soil in C1 was not sampled for metals. Hawk and shrew-2 are exposed to both soil and sediment, therefore, the HQs presented for metals in C1 are based on exposures to sediment only.

[2] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

[3] NOAEL TRV for terrestrial invertebrates and plants was not available for vanadium.

AA: assessment area
HQ: hazard quotient
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:
C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Hwy 77 Bridge to Lake Logan Martin

Exposure Subareas:
East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-5b. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C2	C2	C2	C3	C3	C4	C4	Upper AA	C5	C5
Exposure Subarea→		East	West	North	South	Central	North	South	North	South	Combined Soil	North	South
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Terrestrial Birds													
Mourning Dove	tPCB-mid	1	9	0	0	0	1	1	0	0	0	0	0
	tPCB-high	6	94	3	1	2	7	14	5	4	5	2	2
	Mercury	--	--	2	0	1	3	3	2	2	2	1	1
	Chromium	--	--	0	0	0	0	1	0	0	0	0	0
	Lead	--	--	0	0	1	1	1	1	1	1	0	1
	Vanadium	--	--	1	1	1	1	1	1	1	1	2	2
Blue Jay	tPCB-mid	2	11	2	2	2	2	3	2	2	2	0	0
	tPCB-high	24	120	21	18	19	25	32	23	21	23	4	4
	Mercury	--	--	6	5	5	7	8	7	7	7	3	4
	Chromium	--	--	1	0	0	0	1	1	0	1	0	0
	Lead	--	--	2	2	2	2	3	2	2	2	1	2
	Vanadium	--	--	2	2	2	2	2	2	2	2	2	3
Carolina Wren - 1	tPCB-mid	12	26	11	11	11	12	13	12	11	12	1	1
	tPCB-high	126	280	122	117	119	128	139	125	122	125	13	14
	Mercury	--	--	30	28	28	33	33	31	31	31	17	17
	Chromium	--	--	2	1	1	1	2	2	1	2	1	1
	Lead	--	--	9	8	9	9	10	9	9	9	8	9
	Vanadium	--	--	5	5	5	5	6	5	5	5	6	6
Hawk	tPCB-mid	5	7	5	5	5	5	5	5	5	5	5	5
	tPCB-high	53	74	52	51	52	52	53	52	51	52	54	54
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	1	0	0	0	0	1
	Mercury	--	--	6	6	6	1	1	1	1	2	1	1
	Vanadium	--	--	2	2	2	2	2	2	2	2	2	3
Terrestrial Mammals													
Shrew - 1	tPCB	16	19	16	16	16	16	16	16	16	16	2	2
	Mercury	--	--	6	6	6	6	6	6	6	6	3	3
	Chromium	--	--	1	1	1	1	1	1	1	1	1	1
	Lead	--	--	2	2	2	2	2	2	2	2	2	2
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0
Shrew - 2	tPCB	16	20	16	16	16	16	17	16	16	16	3	3
	Chromium	--	--	1	1	1	1	1	1	1	1	1	1
	Lead	--	--	2	2	2	2	2	2	2	2	2	2
	Mercury	--	--	7	7	7	6	6	6	6	6	3	3
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0
Deer	tPCB	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0

Table 6-5b. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C2	C2	C2	C3	C3	C4	C4	Upper AA	C5	C5
Exposure Subarea→		East	West	North	South	Central	North	South	North	South	Combined Soil	North	South
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Weasel	tPCB	2	4	2	2	2	2	2	2	2	2	4	4
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0
Fox - 1	tPCB	1	2	1	1	1	1	1	1	1	1	2	2
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0
Fox - 2	tPCB	1	2	1	1	1	1	1	1	1	1	2	2
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0

Table 6-5b. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C6	C6	Middle AA	C7	C7	C8	C8	C9	C9	C10[2]	Lower AA
Exposure Subarea→		North	South	Combined Soil	North	South	North	South	North	South	Sediment	Combined Soil
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Terrestrial Birds												
Mourning Dove	tPCB-mid	0	0	0	0	0	0	0	0	0	--	0
	tPCB-high	2	3	2	2	2	2	2	2	2	--	2
	Mercury	2	3	1	1	2	4	1	2	1	--	1
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	0	0	1	0	0	0	0	0	0	--	0
	Vanadium	2	1	1	2	2	1	2	1	2	--	1
Blue Jay	tPCB-mid	0	0	0	0	0	0	0	0	0	--	0
	tPCB-high	4	4	4	4	4	4	4	4	3	--	4
	Mercury	4	5	3	3	4	7	3	4	3	--	3
	Chromium	0	0	0	0	1	0	0	0	0	--	0
	Lead	2	1	2	2	2	2	2	1	1	--	2
	Vanadium	2	1	2	2	2	2	2	1	2	--	2
Carolina Wren - 1	tPCB-mid	1	1	1	1	1	1	1	1	1	--	1
	tPCB-high	14	15	14	15	15	15	15	15	14	--	15
	Mercury	18	20	17	13	15	19	13	15	13	--	14
	Chromium	1	1	1	1	2	1	1	1	1	--	1
	Lead	9	8	9	9	8	9	9	8	8	--	8
	Vanadium	6	4	6	6	6	5	6	4	6	--	5
Hawk	tPCB-mid	5	5	5	4	4	4	4	4	4	--	4
	tPCB-high	54	54	54	38	38	38	38	38	38	--	38
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	1	0	1	0	0	0	0	0	0	--	0
	Mercury	2	2	1	2	2	3	2	2	2	--	2
	Vanadium	2	2	2	2	2	2	2	2	2	--	2
Terrestrial Mammals												
Shrew - 1	tPCB	2	2	2	2	2	2	2	2	2	--	2
	Mercury	3	4	3	3	3	3	3	3	3	--	3
	Chromium	1	1	1	1	1	1	1	1	1	--	1
	Lead	2	2	2	2	2	2	2	2	2	--	2
	Vanadium	0	0	0	0	0	0	0	0	0	--	0
Shrew - 2	tPCB	3	3	3	3	3	3	3	3	3	--	3
	Chromium	1	1	1	1	1	1	1	1	1	--	1
	Lead	2	2	2	2	2	2	2	2	2	--	2
	Mercury	3	3	3	3	3	3	3	3	3	--	3
	Vanadium	0	0	0	0	0	0	0	0	0	--	0
Deer	tPCB	0	0	0	0	0	0	0	0	0	--	0
	Mercury	0	0	0	0	0	0	0	0	0	--	0
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	0	0	0	0	0	0	0	0	0	--	0
	Vanadium	0	0	0	0	0	0	0	0	0	--	0

Table 6-5b. Summary of Terrestrial Receptors NOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C6	C6	Middle AA	C7	C7	C8	C8	C9	C9	C10[2]	Lower AA
Exposure Subarea→		North	South	Combined Soil	North	South	North	South	North	South	Sediment	Combined Soil
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Weasel	tPCB	4	4	4	4	4	4	4	4	4	--	4
	Mercury	0	0	0	0	0	0	0	0	0	--	0
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	0	0	0	0	0	0	0	0	0	--	0
	Vanadium	0	0	0	0	0	0	0	0	0	--	0
Fox - 1	tPCB	2	2	2	2	2	2	2	2	2	--	2
	Mercury	0	0	0	0	0	0	0	0	0	--	0
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	0	0	0	0	0	0	0	0	0	--	0
	Vanadium	0	0	0	0	0	0	0	0	0	--	0
Fox - 2	tPCB	2	2	2	2	2	2	2	2	2	--	2
	Mercury	0	0	0	0	0	0	0	0	0	--	0
	Chromium	0	0	0	0	0	0	0	0	0	--	0
	Lead	0	0	0	0	0	0	0	0	0	--	0
	Vanadium	0	0	0	0	0	0	0	0	0	--	0

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Soil in C1 was not sampled for metals. Hawk and shrew-2 are exposed to both soil and sediment, therefore, the HQs presented for metals in C1 are based on exposures to sediment only.

[2] Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

AA = assessment area

HQ: hazard quotient

NOAEL: no observed adverse effect level

tPCB: total polychlorinated biphenyl

TRV: toxicity reference value

--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Hwy 77 Bridge to Lake Logan Martin

Exposure Subareas:

East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1,2]	C1[1,2]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA
Exposure Subarea→		East	West	North	South	Central	Riparian	North	South	Riparian	North	South	Riparian	Combined Soil
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Lower Trophic Receptors														
Terrestrial Plants[3]	**PCB**	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mercury	--	--	--	--	--	--	--	--	--	--	--	--	--
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Invertebrates[3]	**PCB**	0	6	0	0	0	1	0	1	1	0	0	0	0
	Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mercury	--	--	6	0	1	2	14	15	26	10	10	16	10
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Birds														
Mourning Dove	**tPCB-mid**	1	13	0	0	0	--	1	2	--	1	0	--	1
	tPCB-high	8	142	4	0	1	--	9	20	--	7	4	--	7
	Mercury	--	--	1	0	0	--	1	1	--	1	1	--	1
	Chromium	--	--	0	0	0	--	0	1	--	1	0	--	0
	Lead	--	--	0	0	0	--	0	1	--	0	0	--	0
	Vanadium	--	--	1	1	1	--	1	1	--	1	1	--	1
Blue Jay	**tPCB-mid**	1	24	1	0	0	--	2	3	--	1	1	--	1
	tPCB-high	14	258	7	1	2	--	17	35	--	12	8	--	12
	Mercury	--	--	1	0	0	--	2	3	--	2	2	--	2
	Chromium	--	--	1	0	0	--	0	1	--	1	0	--	1
	Lead	--	--	0	0	0	--	0	1	--	1	1	--	0
	Vanadium	--	--	1	1	1	--	1	1	--	1	1	--	1
Carolina Wren	**tPCB-mid**	5	87	2	0	1	--	6	12	--	4	3	--	4
	tPCB-high	51	938	25	1	8	--	61	128	--	42	28	--	43
	Mercury	--	--	5	1	2	--	10	10	--	7	8	--	7
	Chromium	--	--	2	1	1	--	1	3	--	2	2	--	2
	Lead	--	--	1	1	2	--	1	4	--	2	2	--	2
	Vanadium	--	--	3	3	3	--	3	4	--	4	3	--	3
Hawk	**tPCB-mid**	10	13	6	6	6	--	1	1	--	2	2	--	3
	tPCB-high	112	135	70	67	68	--	12	15	--	20	19	--	32
	Chromium	--	--	0	0	0	--	0	1	--	0	0	--	0
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0
	Mercury	--	--	2	2	2	--	0	0	--	0	0	--	1
	Vanadium	--	--	1	1	1	--	1	1	--	1	1	--	1

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1,2]	C1[1,2]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA
Exposure Subarea→		East	West	North	South	Central	Riparian	North	South	Riparian	North	South	Riparian	Combined Soil
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Terrestrial Mammals														
Shrew - 1	**tPCB**	7	119	3	0	1	--	8	16	--	5	4	--	5
	Mercury	--	--	1	0	0	--	3	3	--	2	2	--	2
	Chromium	--	--	1	0	0	--	1	2	--	1	1	--	1
	Lead	--	--	0	0	0	--	0	1	--	0	0	--	0
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0
Shrew - 2	**tPCB**	9	115	5	2	3	--	8	16	--	6	4	--	6
	Chromium	--	--	1	0	0	--	1	2	--	1	1	--	1
	Lead	--	--	0	0	0	--	0	1	--	0	0	--	0
	Mercury	--	--	2	1	1	--	3	3	--	2	2	--	2
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0
Deer	**tPCB**	0	2	0	0	0	--	0	0	--	0	0	--	0
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0
Weasel	**tPCB**	1	4	0	0	0	--	1	1	--	1	1	--	1
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0
Fox - 1	**tPCB**	1	5	0	0	0	--	1	1	--	0	0	--	0
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0
Fox - 2	**tPCB**	0	3	0	0	0	--	0	1	--	0	0	--	0
	Mercury	--	--	0	0	0	--	0	0	--	0	0	--	0
	Chromium	--	--	0	0	0	--	0	0	--	0	0	--	0
	Lead	--	--	0	0	0	--	0	0	--	0	0	--	0
	Vanadium	--	--	0	0	0	--	0	0	--	0	0	--	0

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8
Exposure Subarea→		Riparian	North	South	Riparian	North	South	Riparian	Combined Soil	Riparian	North	South	Riparian	North
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Lower Trophic Receptors														
Terrestrial Plants[3]	**PCB**	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mercury	--	--	--	--	--	--	--	--	--	--	--	--	--
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Invertebrates[3]	**PCB**	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	--	--	--	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mercury	12	3	4	6	7	12	9	4	6	2	8	13	20
	Vanadium	--	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Birds														
Mourning Dove	**tPCB-mid**	--	0	0	--	0	0	--	0	--	0	0	--	0
	tPCB-high	--	1	1	--	1	2	--	1	--	1	1	--	1
	Mercury	--	0	0	--	1	1	--	0	--	0	1	--	2
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	1	1	--	1	0	--	1	--	1	1	--	1
Blue Jay	**tPCB-mid**	--	0	0	--	0	0	--	0	--	0	0	--	0
	tPCB-high	--	1	2	--	2	3	--	2	--	1	2	--	2
	Mercury	--	1	1	--	1	2	--	1	--	1	1	--	4
	Chromium	--	0	0	--	0	0	--	0	--	0	1	--	0
	Lead	--	0	1	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	1	2	--	1	1	--	1	--	1	1	--	1
Carolina Wren	**tPCB-mid**	--	0	1	--	1	1	--	1	--	0	1	--	1
	tPCB-high	--	4	6	--	8	12	--	6	--	3	6	--	8
	Mercury	--	3	4	--	5	9	--	3	--	3	6	--	14
	Chromium	--	1	2	--	1	1	--	1	--	1	2	--	1
	Lead	--	1	2	--	1	0	--	1	--	1	1	--	1
	Vanadium	--	4	5	--	4	2	--	4	--	4	5	--	3
Hawk	**tPCB-mid**	--	0	1	--	0	0	--	0	--	0	0	--	0
	tPCB-high	--	5	6	--	2	3	--	5	--	3	3	--	4
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	0	0	--	0	1	--	0	--	0	1	--	1
	Vanadium	--	1	1	--	1	1	--	1	--	1	1	--	1

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8
Exposure Subarea→		Riparian	North	South	Riparian	North	South	Riparian	Combined Soil	Riparian	North	South	Riparian	North
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Terrestrial Mammals														
Shrew - 1	**tPCB**	--	1	1	--	1	2	--	1	--	0	1	--	1
	Mercury	--	1	1	--	2	2	--	1	--	1	2	--	4
	Chromium	--	1	1	--	1	0	--	1	--	1	1	--	1
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0
Shrew - 2	**tPCB**	--	1	1	--	1	1	--	1	--	0	1	--	1
	Chromium	--	1	1	--	1	0	--	1	--	1	1	--	1
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	1	1	--	1	2	--	1	--	1	2	--	4
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0
Deer	**tPCB**	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	0	0	--	0	0	--	0	--	0	0	--	0
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0
Weasel	**tPCB**	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	0	0	--	0	0	--	0	--	0	0	--	0
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0
Fox - 1	**tPCB**	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	0	0	--	0	0	--	0	--	0	0	--	0
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0
Fox - 2	**tPCB**	--	0	0	--	0	0	--	0	--	0	0	--	0
	Mercury	--	0	0	--	0	0	--	0	--	0	0	--	0
	Chromium	--	0	0	--	0	0	--	0	--	0	0	--	0
	Lead	--	0	0	--	0	0	--	0	--	0	0	--	0
	Vanadium	--	0	0	--	0	0	--	0	--	0	0	--	0

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C8	C8	C9	C9	C9	C10[1]	Lower AA	Lower AA
Exposure Subarea→		South	Riparian	North	South	Riparian	Sediment	Combined Soil	Riparian
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Lower Trophic Receptors									
Terrestrial Plants[3]	PCB	--	--	--	--	--	--	--	--
	Chromium	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--
	Mercury	--	--	--	--	--	--	--	--
	Vanadium	--	--	--	--	--	--	--	--
Terrestrial Invertebrates[3]	PCB	0	0	0	0	0	--	0	0
	Chromium	--	--	--	--	--	--	--	--
	Lead	--	--	--	--	--	--	--	--
	Mercury	3	20	7	2	7	--	4	17
	Vanadium	--	--	--	--	--	--	--	--
Terrestrial Birds									
Mourning Dove	tPCB-mid	0	--	0	0	--	--	0	--
	tPCB-high	1	--	1	0	--	--	1	--
	Mercury	0	--	1	0	--	--	0	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	1	--	0	1	--	--	1	--
Blue Jay	tPCB-mid	0	--	0	0	--	--	0	--
	tPCB-high	2	--	2	0	--	--	1	--
	Mercury	1	--	1	1	--	--	1	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	1	--	1	1	--	--	1	--
Carolina Wren	tPCB-mid	1	--	1	0	--	--	0	--
	tPCB-high	5	--	7	1	--	--	3	--
	Mercury	3	--	6	3	--	--	4	--
	Chromium	1	--	1	1	--	--	1	--
	Lead	1	--	1	1	--	--	1	--
	Vanadium	4	--	2	4	--	--	4	--
Hawk	tPCB-mid	0	--	0	0	--	--	0	--
	tPCB-high	3	--	2	1	--	--	3	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Mercury	0	--	1	0	--	--	0	--
	Vanadium	1	--	1	1	--	--	1	--

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C8	C8	C9	C9	C9	C10[1]	Lower AA	Lower AA
Exposure Subarea→		South	Riparian	North	South	Riparian	Sediment	Combined Soil	Riparian
Receptors↓ [3]		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Terrestrial Mammals									
Shrew - 1	tPCB	1	--	1	0	--	--	0	--
	Mercury	1	--	2	1	--	--	1	--
	Chromium	1	--	0	0	--	--	1	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	0	--	0	0	--	--	0	--
Shrew - 2	tPCB	1	--	1	0	--	--	0	--
	Chromium	1	--	0	0	--	--	1	--
	Lead	0	--	0	0	--	--	0	--
	Mercury	1	--	2	1	--	--	1	--
	Vanadium	0	--	0	0	--	--	0	--
Deer	tPCB	0	--	0	0	--	--	0	--
	Mercury	0	--	0	0	--	--	0	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	0	--	0	0	--	--	0	--
Weasel	tPCB	0	--	0	0	--	--	0	--
	Mercury	0	--	0	0	--	--	0	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	0	--	0	0	--	--	0	--
Fox - 1	tPCB	0	--	0	0	--	--	0	--
	Mercury	0	--	0	0	--	--	0	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	0	--	0	0	--	--	0	--
Fox - 2	tPCB	0	--	0	0	--	--	0	--
	Mercury	0	--	0	0	--	--	0	--
	Chromium	0	--	0	0	--	--	0	--
	Lead	0	--	0	0	--	--	0	--
	Vanadium	0	--	0	0	--	--	0	--

Table 6-6a. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→	C1[1,2]	C1[1,2]	C2	C2	C2	C2	C3	C3	C3	C4	C4
Exposure Subarea→	East	West	North	South	Central	Riparian	North	South	Riparian	North	South
Receptors↓ [3]	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.
[2] Soil in C1 was not sampled for metals. Hawk and shrew-2 are exposed to both soil and sediment, therefore, the HQs presented for metals in C1 are based on exposures to sediment only.
[3] LOAEL TRVs were only available for PCBs and mercury for terrestrial plants and invertebrates, therefore LOAEL-equivalent HQs could not be calculated for the remaining metals.

AA: assessment area
HQ: hazard quotient
LOAEL: lowest-observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:
C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:
East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-6b. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1,2]	C1[1,2]	C2	C2	C2	C3	C3	C4	C4	Upper AA	C5	C5	C6	C6	Middle AA	C7	C7	C8	C8	C9	C9	Lower AA
Exposure Subarea→		East	West	North	South	Central	North	South	North	South	Combined Soil	North	South	North	South	Combined Soil	North	South	North	South	North	South	Combined Soil
Terrestrial Birds																							
Mourning Dove	**tPCB-mid**	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	tPCB-high	2	31	1	0	1	2	5	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	1	0	0	1	1	1	1	1	0	0	1	1	0	0	1	1	0	1	0	0
	Chromium	--	--	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1
Blue Jay	**tPCB-mid**	1	4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	tPCB-high	8	40	7	6	6	8	11	8	7	8	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	2	2	2	2	3	2	2	2	1	1	1	2	1	1	1	2	1	1	1	1
	Chromium	--	--	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Vanadium	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Carolina Wren	**tPCB-mid**	4	9	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0
	tPCB-high	42	93	41	39	40	43	46	42	41	42	4	5	5	5	5	5	5	5	5	5	5	5
	Mercury	--	--	10	9	9	11	11	10	10	10	6	6	6	7	6	4	5	6	4	5	4	5
	Chromium	--	--	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Lead	--	--	4	4	4	4	5	5	5	4	4	5	4	4	4	4	4	4	4	4	4	4
	Vanadium	--	--	3	3	2	2	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3
Hawk	**tPCB-mid**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
	tPCB-high	18	25	17	17	17	17	18	17	17	17	18	18	18	18	18	13	13	13	13	13	13	13
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	2	2	2	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1
	Vanadium	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Terrestrial Mammals																							
Shrew - 1	**tPCB**	5	6	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1
	Chromium	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Lead	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrew - 2	**tPCB**	6	7	6	5	5	6	6	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1
	Chromium	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Lead	--	--	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	4	4	4	3	3	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deer	**tPCB**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weasel	**tPCB**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fox - 1	**tPCB**	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fox - 2	**tPCB**	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6-6b. Summary of Terrestrial Receptors LOAEL-based Hazard Quotients by Exposure Unit (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

[2] Soil in C1 was not sampled for metals. Hawk and shrew-2 are exposed to both soil and sediment, therefore, the HQs presented for metals in C1 are based on exposures to sediment only.

AA = assessment area
HQ: hazard quotient
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Hwy 77 Bridge to Lake Logan Martin

Exposure Subareas:

East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-7a. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4
Exposure Subarea→		East Floodplain Soil, Riparian Soil & Sediment	West Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Central Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Aquatic+Terrestrial Birds														
Carolina Wren - 2	tPCB-mid	18	112	--	10	8	9	--	7	14	--	6	5	--
	tPCB-high	193	1205	--	112	85	92	--	78	155	--	68	52	--
	Barium [2]	--	--	--	1	1	1	--	1	1	--	1	1	--
	Chromium	--	--	--	2	1	1	--	1	2	--	2	1	--
	Cobalt [2]	--	--	--	0	1	1	--	1	1	--	0	0	--
	Lead	--	--	--	3	3	4	--	2	4	--	3	2	--
	Mercury	--	--	--	130	125	125	--	19	20	--	16	16	--
	Vanadium	--	--	--	6	6	5	--	6	7	--	5	5	--
Spotted Sandpiper - 1	tPCB-mid	--	--	13	--	--	--	32	--	--	22	--	--	10
	tPCB-high	--	--	145	--	--	--	347	--	--	242	--	--	104
	Barium [2]	--	--	2	--	--	--	1	--	--	1	--	--	1
	Chromium	--	--	2	--	--	--	1	--	--	1	--	--	2
	Cobalt [2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	8	--	--	--	5	--	--	2	--	--	5
	Mercury	--	--	21	--	--	--	28	--	--	39	--	--	26
	Vanadium	--	--	13	--	--	--	7	--	--	6	--	--	6
Aquatic+Terrestrial Mammals														
Mink - 1	tPCB-mink	--	--	97	--	--	--	64	--	--	12	--	--	17
	Barium [2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt [2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0
Raccoon - 1	tPCB	7	36	7	4	3	3	8	2	5	4	2	2	2
	Barium [2]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [2]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	0	0	0	0	0	1	1	1	0	0	1
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	16	--	--	--	10	--	--	1	--	--	3
	Barium [2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt [2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	2	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0

Table 6-7a. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA
Exposure Subarea→		Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	
Aquatic+Terrestrial Birds											
Carolina Wren - 2	tPCB-mid	8	--	1	1	--	1	1	--	1	--
	tPCB-high	83	--	11	13	--	9	14	--	12	--
	Barium [2]	1	--	2	1	--	1	1	--	1	--
	Chromium	1	--	2	2	--	2	2	--	2	--
	Cobalt [2]	1	--	1	1	--	1	1	--	1	--
	Lead	3	--	3	5	--	4	3	--	4	--
	Mercury	31	--	10	10	--	13	17	--	10	--
	Vanadium	5	--	12	12	--	11	9	--	11	--
Spotted Sandpiper - 1	tPCB-mid	--	10	--	--	3	--	--	2	--	2
	tPCB-high	--	112	--	--	30	--	--	25	--	26
	Barium [2]	--	1	--	--	2	--	--	1	--	2
	Chromium	--	1	--	--	3	--	--	2	--	3
	Cobalt [2]	--	0	--	--	1	--	--	1	--	1
	Lead	--	4	--	--	6	--	--	5	--	6
	Mercury	--	24	--	--	12	--	--	16	--	13
	Vanadium	--	6	--	--	10	--	--	10	--	10
Aquatic+Terrestrial Mammals											
Mink - 1	tPCB-mink	--	27	--	--	6	--	--	2	--	6
	Barium [2]	--	0	--	--	0	--	--	0	--	0
	Chromium	--	0	--	--	1	--	--	1	--	1
	Cobalt [2]	--	0	--	--	0	--	--	0	--	0
	Lead	--	0	--	--	0	--	--	0	--	0
	Mercury	--	0	--	--	0	--	--	0	--	0
	Vanadium	--	0	--	--	0	--	--	0	--	0
Raccoon - 1	tPCB	0	3	0	0	1	0	0	0	0	1
	Barium [2]	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0
	Cobalt [2]	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	4	--	--	1	--	--	0	--	1
	Barium [2]	--	0	--	--	0	--	--	0	--	0
	Chromium	--	0	--	--	0	--	--	0	--	0
	Cobalt [2]	--	0	--	--	0	--	--	0	--	0
	Lead	--	0	--	--	0	--	--	0	--	0
	Mercury	--	0	--	--	0	--	--	0	--	0
	Vanadium	--	0	--	--	0	--	--	0	--	0

Table 6-7a. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C7	C7	C7	C8	C8	C8	C9	C9	C9	C10[1]	Lower AA	Lower AA
Exposure Subarea→		North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Aquatic+Terrestrial Birds													
Carolina Wren - 2	tPCB-mid	1	1	--	2	1	--	1	0	--	--	1	--
	tPCB-high	10	13	--	17	14	--	9	2	--	--	12	--
	Barium [2]	1	0	--	1	1	--	1	1	--	--	1	--
	Chromium	1	1	--	1	1	--	1	1	--	--	2	--
	Cobalt [2]	1	0	--	0	1	--	0	1	--	--	1	--
	Lead	2	1	--	1	1	--	1	2	--	--	2	--
	Mercury	9	14	--	25	10	--	14	9	--	--	12	--
	Vanadium	6	6	--	5	6	--	5	7	--	--	7	--
Spotted Sandpiper - 1	tPCB-mid	--	--	2	--	--	2	--	--	2	2	--	2
	tPCB-high	--	--	27	--	--	23	--	--	22	18	--	19
	Barium [2]	--	--	1	--	--	1	--	--	1	1	--	1
	Chromium	--	--	1	--	--	1	--	--	1	1	--	1
	Cobalt [2]	--	--	0	--	--	0	--	--	0	0	--	0
	Lead	--	--	2	--	--	2	--	--	2	3	--	2
	Mercury	--	--	22	--	--	32	--	--	14	27	--	27
	Vanadium	--	--	4	--	--	7	--	--	5	8	--	7
Aquatic+Terrestrial Mammals													
Mink - 1	tPCB-mink	--	--	6	--	--	6	--	--	3	5	--	6
	Barium [2]	--	--	0	--	--	0	--	--	0	0	--	0
	Chromium	--	--	0	--	--	0	--	--	0	0	--	0
	Cobalt [2]	--	--	0	--	--	0	--	--	0	0	--	0
	Lead	--	--	0	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	--	0	--	--	0	0	--	0
	Vanadium	--	--	0	--	--	0	--	--	0	0	--	0
Raccoon - 1	tPCB	0	0	1	0	0	1	0	0	0	0	0	0
	Barium [2]	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [2]	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	1	0	1	0	0	0	1	0	1
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	1	--	--	1	--	--	0	1	--	1
	Barium [2]	--	--	0	--	--	0	--	--	0	0	--	0
	Chromium	--	--	0	--	--	0	--	--	0	0	--	0
	Cobalt [2]	--	--	0	--	--	0	--	--	0	0	--	0
	Lead	--	--	0	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	--	0	--	--	0	0	--	0
	Vanadium	--	--	0	--	--	0	--	--	0	0	--	0

Table 6-7a. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain so

[2] Barium and cobalt are COPCs in sediment only. Soil exposures were estimated for these metals so that the complete aquatic + terrestrial dose could be estimated.

AA: assessment area
COPCs: constituent of potential concern
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:

East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-7b. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4
Exposure Subarea→		East Floodplain Soil, Riparian Soil & Sediment	West Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Central Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Aquatic+Terrestrial Birds														
Carolina Wren - 2	tPCB-mid	12	26	--	11	11	11	--	12	13	--	12	11	--
	tPCB-high	127	280	--	122	118	119	--	128	140	--	125	122	--
	Barium[2]	--	--	--	1	2	2	--	2	2	--	2	2	--
	Chromium	--	--	--	2	1	1	--	1	2	--	2	1	--
	Cobalt[2]	--	--	--	0	0	1	--	0	1	--	0	0	--
	Lead	--	--	--	9	9	9	--	9	10	--	9	9	--
	Mercury	--	--	--	30	28	28	--	33	33	--	31	31	--
	Vanadium	--	--	--	6	6	5	--	5	6	--	6	5	--
Spotted Sandpiper - 1	tPCB-mid	--	--	10	--	--	--	11	--	--	10	--	--	10
	tPCB-high	--	--	108	--	--	--	114	--	--	107	--	--	103
	Barium[2]	--	--	2	--	--	--	1	--	--	1	--	--	1
	Chromium	--	--	1	--	--	--	1	--	--	1	--	--	1
	Cobalt[2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	8	--	--	--	8	--	--	7	--	--	8
	Mercury	--	--	25	--	--	--	43	--	--	28	--	--	26
	Vanadium	--	--	7	--	--	--	5	--	--	5	--	--	4
Aquatic+Terrestrial Mammals														
Mink - 1	tPCB-mink	--	--	18	--	--	--	18	--	--	18	--	--	18
	Barium[2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt[2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0
Raccoon - 1	tPCB	2	4	2	2	2	2	2	2	2	2	2	2	2
	Barium[2]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0
	Cobalt[2]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	1	0	0	0	0	1	1	1	1	1	1
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	3	--	--	--	2	--	--	2	--	--	2
	Barium[2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt[2]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0

Table 6-7b. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7
Exposure Subarea→		Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ		NOAEL HQ	NOAEL HQ	NOAEL HQ
Aquatic+Terrestrial Birds														
Carolina Wren - 2	tPCB-mid	12	--	1	1	--	1	1	--	1	--	1	1	--
	tPCB-high	125	--	14	14	--	14	15	--	14	--	15	15	--
	Barium [2]	2	--	2	2	--	1	1	--	2	--	2	2	--
	Chromium	2	--	1	1	--	1	1	--	1	--	1	2	--
	Cobalt [2]	0	--	0	0	--	0	0	--	0	--	1	0	--
	Lead	9	--	9	9	--	9	8	--	9	--	9	9	--
	Mercury	31	--	17	17	--	18	20	--	17	--	13	15	--
	Vanadium	5	--	6	6	--	6	5	--	6	--	6	6	--
Spotted Sandpiper - 1	tPCB-mid	--	10	--	--	1	--	--	1	--	1	--	--	1
	tPCB-high	--	103	--	--	15	--	--	14	--	14	--	--	14
	Barium [2]	--	1	--	--	2	--	--	1	--	2	--	--	1
	Chromium	--	1	--	--	1	--	--	1	--	1	--	--	1
	Cobalt [2]	--	0	--	--	0	--	--	0	--	0	--	--	0
	Lead	--	7	--	--	8	--	--	8	--	8	--	--	7
	Mercury	--	28	--	--	15	--	--	16	--	15	--	--	14
	Vanadium	--	5	--	--	6	--	--	6	--	6	--	--	4
Aquatic+Terrestrial Mammals														
Mink - 1	tPCB-mink	--	18	--	--	15	--	--	15	--	15	--	--	15
	Barium [2]	--	0	--	--	0	--	--	0	--	0	--	--	0
	Chromium	--	0	--	--	0	--	--	0	--	0	--	--	0
	Cobalt [2]	--	0	--	--	0	--	--	0	--	0	--	--	0
	Lead	--	0	--	--	0	--	--	0	--	0	--	--	0
	Mercury	--	0	--	--	0	--	--	0	--	0	--	--	0
	Vanadium	--	0	--	--	0	--	--	0	--	0	--	--	0
Raccoon - 1	tPCB	0	2	1	1	1	1	1	1	0	1	1	1	1
	Barium [2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [2]	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	1	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	2	--	--	2	--	--	2	--	2	--	--	2
	Barium [2]	--	0	--	--	0	--	--	0	--	0	--	--	0
	Chromium	--	0	--	--	0	--	--	0	--	0	--	--	0
	Cobalt [2]	--	0	--	--	0	--	--	0	--	0	--	--	0
	Lead	--	0	--	--	0	--	--	0	--	0	--	--	0
	Mercury	--	0	--	--	0	--	--	0	--	0	--	--	0
	Vanadium	--	0	--	--	0	--	--	0	--	0	--	--	0

Table 6-7b. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C8	C8	C8	C9	C9	C9	C10[a]	Lower AA	Lower AA
Exposure Subarea→		North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Aquatic+Terrestrial Birds										
Carolina Wren - 2	tPCB-mid	1	1	--	1	1	--	--	1	--
	tPCB-high	15	15	--	15	14	--	--	15	--
	Barium [2]	2	2	--	1	2	--	--	2	--
	Chromium	1	1	--	1	1	--	--	1	--
	Cobalt [2]	0	1	--	0	0	--	--	0	--
	Lead	9	9	--	8	8	--	--	9	--
	Mercury	19	13	--	15	13	--	--	14	--
	Vanadium	6	6	--	4	6	--	--	6	--
Spotted Sandpiper - 1	tPCB-mid	--	--	1	--	--	1	1	--	1
	tPCB-high	--	--	14	--	--	14	14	--	14
	Barium [2]	--	--	1	--	--	1	1	--	1
	Chromium	--	--	1	--	--	1	1	--	1
	Cobalt [2]	--	--	0	--	--	0	0	--	0
	Lead	--	--	7	--	--	7	7	--	7
	Mercury	--	--	15	--	--	13	15	--	15
	Vanadium	--	--	5	--	--	4	5	--	5
Aquatic+Terrestrial Mammals										
Mink - 1	tPCB-mink	--	--	15	--	--	15	15	--	15
	Barium [2]	--	--	0	--	--	0	0	--	0
	Chromium	--	--	0	--	--	0	0	--	0
	Cobalt [2]	--	--	0	--	--	0	0	--	0
	Lead	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	--	0	0	--	0
	Vanadium	--	--	0	--	--	0	0	--	0
Raccoon - 1	tPCB	1	1	1	1	1	1	1	0	1
	Barium [2]	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0
	Cobalt [2]	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	2	--	--	2	2	--	2
	Barium [2]	--	--	0	--	--	0	0	--	0
	Chromium	--	--	0	--	--	0	0	--	0
	Cobalt [2]	--	--	0	--	--	0	0	--	0
	Lead	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	--	0	0	--	0
	Vanadium	--	--	0	--	--	0	0	--	0

Table 6-7b. Summary of NOAEL Hazard Quotients by Exposure Unit for Receptors Exposed to Terrestrial + Aquatic Media (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number
[1] Riparian soil in reaches C1 and
[2] Barium and cobalt are

AA: assessment area
COPCs: constituent of potential concern
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:
C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:
East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-8a. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA
Exposure Subarea→		East Floodplain Soil, Riparian Soil & Sediment	West Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Central Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds															
Carolina Wren - 2	tPCB-mid	6	37	--	3	3	3	--	2	5	--	2	2	--	3
	tPCB-high	64	402	--	37	28	31	--	26	52	--	23	17	--	28
	Barium [3]	--	--	--	1	1	1	--	0	0	--	0	0	--	0
	Chromium	--	--	--	2	1	1	--	1	2	--	2	1	--	1
	Cobalt [3]	--	--	--	0	1	1	--	1	1	--	0	0	--	0
	Lead	--	--	--	1	1	2	--	1	2	--	1	1	--	1
	Mercury	--	--	--	43	42	42	--	6	7	--	5	5	--	10
	Vanadium	--	--	--	3	3	3	--	3	3	--	3	2	--	3
Spotted Sandpiper - 1	tPCB-mid	--	--	4	--	--	--	11	--	--	7	--	--	3	--
	tPCB-high	--	--	48	--	--	--	116	--	--	81	--	--	35	--
	Barium [3]	--	--	1	--	--	--	1	--	--	0	--	--	1	--
	Chromium	--	--	2	--	--	--	1	--	--	1	--	--	2	--
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Lead	--	--	4	--	--	--	2	--	--	1	--	--	2	--
	Mercury	--	--	7	--	--	--	9	--	--	13	--	--	9	--
	Vanadium	--	--	6	--	--	--	3	--	--	3	--	--	3	--
Aquatic+Terrestrial Mammals															
Mink - 1	tPCB-mink	--	--	48	--	--	--	32	--	--	6	--	--	9	--
Mink - 1 (Alternate TRV)[2]	tPCB-mink	--	--	97	--	--	--	64	--	--	12	--	--	17	--
	Barium [3]	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0	--
Raccoon - 1	tPCB	2	12	2	1	1	1	3	1	2	1	1	1	1	0
	Barium [3]	--	--	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [3]	--	--	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	5	--	--	--	4	--	--	1	--	--	1	--
	Barium [3]	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0	--
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0	--

Table 6-8a. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8	C8	C8
Exposure Subarea→		Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds																
Carolina Wren - 2	**tPCB-mid**	--	0	0	--	0	0	--	0	--	0	0	--	1	0	--
	tPCB-high	--	4	4	--	3	5	--	4	--	3	4	--	6	5	--
	Barium [3]	--	1	1	--	1	1	--	1	--	0	0	--	0	0	--
	Chromium	--	2	2	--	2	2	--	2	--	1	1	--	1	1	--
	Cobalt [3]	--	1	1	--	1	1	--	1	--	1	0	--	0	1	--
	Lead	--	2	2	--	2	2	--	2	--	1	1	--	1	1	--
	Mercury	--	3	3	--	4	6	--	3	--	3	5	--	8	3	--
	Vanadium	--	6	6	--	6	4	--	5	--	3	3	--	2	3	--
Spotted Sandpiper - 1	**tPCB-mid**	3	--	--	1	--	--	1	--	1	--	--	1	--	--	1
	tPCB-high	37	--	--	10	--	--	8	--	9	--	--	9	--	--	8
	Barium [3]	1	--	--	1	--	--	1	--	1	--	--	0	--	--	0
	Chromium	1	--	--	2	--	--	2	--	2	--	--	1	--	--	1
	Cobalt [3]	0	--	--	1	--	--	1	--	1	--	--	0	--	--	0
	Lead	2	--	--	3	--	--	2	--	3	--	--	1	--	--	1
	Mercury	8	--	--	4	--	--	5	--	4	--	--	7	--	--	11
	Vanadium	3	--	--	5	--	--	5	--	5	--	--	2	--	--	4
Aquatic+Terrestrial Mammals																
Mink - 1	**tPCB-mink**	14	--	--	3	--	--	1	--	3	--	--	3	--	--	3
Mink - 1 (Alternate TRV)[2]	**tPCB-mink**	27	--	--	6	--	--	2	--	6	--	--	6	--	--	6
	Barium [3]	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Chromium	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Cobalt [3]	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Lead	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Mercury	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Vanadium	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
Raccoon - 1	**tPCB**	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Barium [3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	**tPCB**	1	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Barium [3]	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Chromium	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Cobalt [3]	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Lead	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Mercury	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0
	Vanadium	0	--	--	0	--	--	0	--	0	--	--	0	--	--	0

Table 6-8a. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C9	C9	C9	C10[1]	Lower AA	Lower AA
Exposure Subarea→		North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds							
Carolina Wren - 2	tPCB-mid	0	0	--	--	0	--
	tPCB-high	3	1	--	--	4	--
	Barium [3]	0	0	--	--	0	--
	Chromium	1	1	--	--	1	--
	Cobalt [3]	0	1	--	--	1	--
	Lead	1	1	--	--	1	--
	Mercury	5	3	--	--	4	--
	Vanadium	2	3	--	--	3	--
Spotted Sandpiper - 1	tPCB-mid	--	--	1	1	--	1
	tPCB-high	--	--	7	6	--	6
	Barium [3]	--	--	0	0	--	0
	Chromium	--	--	1	1	--	1
	Cobalt [3]	--	--	0	0	--	0
	Lead	--	--	1	1	--	1
	Mercury	--	--	5	9	--	9
	Vanadium	--	--	2	4	--	4
Aquatic+Terrestrial Mammals							
Mink - 1	tPCB-mink	--	--	1	2	--	3
Mink - 1 (Alternate TRV)[2]	tPCB-mink	--	--	3	5	--	6
	Barium [3]	--	--	0	0	--	0
	Chromium	--	--	0	0	--	0
	Cobalt [3]	--	--	0	0	--	0
	Lead	--	--	0	0	--	0
	Mercury	--	--	0	0	--	0
	Vanadium	--	--	0	0	--	0
Raccoon - 1	tPCB	0	0	0	0	0	0
	Barium [3]	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0
	Cobalt [3]	0	0	0	0	0	0
	Lead	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	0	0	--	0
	Barium [3]	--	--	0	0	--	0
	Chromium	--	--	0	0	--	0
	Cobalt [3]	--	--	0	0	--	0
	Lead	--	--	0	0	--	0
	Mercury	--	--	0	0	--	0
	Vanadium	--	--	0	0	--	0

Table 6-8a. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Modeled Tissue)
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

[2] Alternate TRVs were selected from Restum et al. (1998) based on growth. The LOAEL TRV is 0.05 mg/kg-day.

[3] Barium and cobalt are COPCs in sediment only. Soil exposures were estimated for these metals so that the complete aquatic + terrestrial dose could be estimated.

AA: assessment area
COPCs: constituent of potential concern
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:
C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:
East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

References:

Restum, J., S. Bursian, J. Giesy, J. Render, W. Helferich, E. Shipp, D. Verbrugge, and R. Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink: 1. Effects on mink reproduction, kit growth, and survival, and selected biological parameters. J. Toxicol. Environ. Health Part A 54: 343 375.

Table 6-8b. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4
Exposure Subarea→		East Floodplain Soil, Riparian Soil & Sediment	West Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Central Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds														
Carolina Wren - 2	tPCB-mid	4	9	--	4	4	4	--	4	4	--	4	4	--
	tPCB-high	42	93	--	41	39	40	--	43	47	--	42	41	--
	Barium [3]	--	--	--	1	1	1	--	1	1	--	1	1	--
	Chromium	--	--	--	2	1	1	--	1	2	--	2	1	--
	Cobalt [3]	--	--	--	0	0	0	--	0	0	--	0	0	--
	Lead	--	--	--	4	4	5	--	4	5	--	5	5	--
	Mercury	--	--	--	10	9	9	--	11	11	--	10	10	--
	Vanadium	--	--	--	3	3	3	--	3	3	--	3	3	--
Spotted Sandpiper - 1	tPCB-mid	--	--	3	--	--	--	4	--	--	3	--	--	3
	tPCB-high	--	--	36	--	--	--	38	--	--	36	--	--	34
	Barium [3]	--	--	1	--	--	--	1	--	--	1	--	--	1
	Chromium	--	--	1	--	--	--	1	--	--	1	--	--	1
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	4	--	--	--	4	--	--	4	--	--	4
	Mercury	--	--	8	--	--	--	14	--	--	9	--	--	9
	Vanadium	--	--	3	--	--	--	2	--	--	2	--	--	2
Aquatic+Terrestrial Mammals														
Mink - 1	tPCB-mink	--	--	9	--	--	--	9	--	--	9	--	--	9
Mink - 1 (Alternate TRV)[2]	tPCB-mink	--	--	18	--	--	--	18	--	--	18	--	--	18
	Barium [3]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0
Raccoon - 1	tPCB	1	1	1	1	1	1	1	1	1	1	1	1	1
	Barium [3]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Chromium	--	--	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [3]	--	--	0	0	0	0	0	0	0	0	0	0	0
	Lead	--	--	0	0	0	0	0	0	0	0	0	0	0
	Mercury	--	--	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	--	--	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	--	1	--	--	--	1	--	--	1	--	--	1
	Barium [3]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Chromium	--	--	0	--	--	--	0	--	--	0	--	--	0
	Cobalt [3]	--	--	0	--	--	--	0	--	--	0	--	--	0
	Lead	--	--	0	--	--	--	0	--	--	0	--	--	0
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0
	Vanadium	--	--	0	--	--	--	0	--	--	0	--	--	0

Table 6-8b. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		Upper AA	Upper AA	C5	C5	C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8
Exposure Subarea→		Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds															
Carolina Wren - 2	tPCB-mid	4	--	0	0	--	0	0	--	0	--	0	0	--	0
	tPCB-high	42	--	5	5	--	5	5	--	5	--	5	5	--	5
	Barium [3]	1	--	1	1	--	1	1	--	1	--	1	1	--	1
	Chromium	1	--	1	1	--	1	1	--	1	--	1	1	--	1
	Cobalt [3]	0	--	0	0	--	0	0	--	0	--	1	0	--	0
	Lead	5	--	4	5	--	4	4	--	4	--	4	4	--	4
	Mercury	10	--	6	6	--	6	7	--	6	--	4	5	--	6
	Vanadium	3	--	3	3	--	3	2	--	3	--	3	3	--	3
Spotted Sandpiper - 1	tPCB-mid	--	3	--	--	0	--	--	0	--	0	--	--	0	--
	tPCB-high	--	34	--	--	5	--	--	5	--	5	--	--	5	--
	Barium [3]	--	1	--	--	1	--	--	1	--	1	--	--	1	--
	Chromium	--	1	--	--	1	--	--	1	--	1	--	--	1	--
	Cobalt [3]	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Lead	--	4	--	--	4	--	--	4	--	4	--	--	4	--
	Mercury	--	9	--	--	5	--	--	5	--	5	--	--	5	--
	Vanadium	--	2	--	--	3	--	--	3	--	3	--	--	2	--
Aquatic+Terrestrial Mammals															
Mink - 1	tPCB-mink	--	9	--	--	8	--	--	8	--	8	--	--	8	--
Mink - 1 (Alternate TRV)[2]	tPCB-mink	--	18	--	--	15	--	--	15	--	15	--	--	15	--
	Barium [3]	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Chromium	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Cobalt [3]	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Lead	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Mercury	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Vanadium	--	0	--	--	0	--	--	0	--	0	--	--	0	--
Raccoon - 1	tPCB	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Barium [3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cobalt [3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vanadium	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon - 2	tPCB	--	1	--	--	1	--	--	1	--	1	--	--	1	--
	Barium [3]	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Chromium	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Cobalt [3]	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Lead	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Mercury	--	0	--	--	0	--	--	0	--	0	--	--	0	--
	Vanadium	--	0	--	--	0	--	--	0	--	0	--	--	0	--

Table 6-8b. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C8	C8	C9	C9	C9	C10[1]	Upper AA	Upper AA
Exposure Subarea→		South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	North Floodplain Soil, Riparian Soil & Sediment	South Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment	Riparian Soil & Sediment	Floodplain Soil, Riparian Soil & Sediment	Riparian Soil & Sediment
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Aquatic+Terrestrial Birds									
Carolina Wren - 2	tPCB-mid	0	--	0	0	--	--	0	--
	tPCB-high	5	--	5	5	--	--	5	--
	Barium [3]	1	--	1	1	--	--	1	--
	Chromium	1	--	1	1	--	--	1	--
	Cobalt [3]	0	--	0	0	--	--	0	--
	Lead	4	--	4	4	--	--	4	--
	Mercury	4	--	5	4	--	--	5	--
	Vanadium	3	--	2	3	--	--	3	--
Spotted Sandpiper - 1	tPCB-mid	--	0	--	--	0	0	--	0
	tPCB-high	--	5	--	--	5	5	--	5
	Barium [3]	--	1	--	--	1	1	--	1
	Chromium	--	1	--	--	1	1	--	1
	Cobalt [3]	--	0	--	--	0	0	--	0
	Lead	--	4	--	--	4	4	--	4
	Mercury	--	5	--	--	4	5	--	5
	Vanadium	--	2	--	--	2	3	--	2
Aquatic+Terrestrial Mammals									
Mink - 1	tPCB-mink	--	8	--	--	8	8	--	8
Mink - 1 (Alternate TRV)[2]	tPCB-mink	--	15	--	--	15	15	--	15
	Barium [3]	--	0	--	--	0	0	--	0
	Chromium	--	0	--	--	0	0	--	0
	Cobalt [3]	--	0	--	--	0	0	--	0
	Lead	--	0	--	--	0	0	--	0
	Mercury	--	0	--	--	0	0	--	0
	Vanadium	--	0	--	--	0	0	--	0
Raccoon - 1	tPCB	0	0	0	0	0	0	0	0
	Barium [3]	0	0	0	0	0	0	0	0
	Chromium	0	0	0	0	0	0	0	0
	Cobalt [3]	0	0	0	0	0	0	0	0
	Lead	0	0	0	0	0	0	0	0
	Mercury	0	0	0	0	0	0	0	0
	Vanadium	0		0	0	0	0	0	0
Raccoon - 2	tPCB	--	1	--	--	1	1	--	1
	Barium [3]	--	0	--	--	0	0	--	0
	Chromium	--	0	--	--	0	0	--	0
	Cobalt [3]	--	0	--	--	0	0	--	0
	Lead	--	0	--	--	0	0	--	0
	Mercury	--	0	--	--	0	0	--	0
	Vanadium	--	0	--	--	0	0	--	0

Table 6-8b. Summary of LOAEL Hazard Quotients by Exposure Unit for Aquatic and Terrestrial Mixed Diet Receptors (Measured Tissue)
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

[2] Alternate TRVs were selected from Restum et al. (1998) based on growth. The LOAEL TRV is 0.05 mg/kg-day.

[3] Barium and cobalt are COPCs in sediment only. Soil exposures were estimated for these metals so that the complete aquatic + terrestrial dose could be estimated.

AA = assessment area
COPCs: constituent of potential concern
HQ: hazard quotient
mg/kg-day: milligrams per kilogram per day
NOAEL: no observed adverse effect level
tPCB: total polychlorinated biphenyl
TRV: toxicity reference value
--: not available

Exposure Units:
C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:
East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

References:

Restum, J., S. Bursian, J. Giesy, J. Render, W. Helferich, E. Shipp, D. Verbrugge, and R. Aulerich. 1998. Multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron, on mink: 1. Effects on mink reproduction, kit growth, and survival, and selected biological parameters. J. Toxicol. Environ. Health Part A 54: 343 375.

Table 6-9. Summary of Terrestrial and Aquatic Bird Egg Tissue NOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper AA	Upper AA	C5	C5
Exposure Subarea→		East	West	Riparian/ Aquatic	North	South	Central	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic	North	South
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Terrestrial Birds																		
Mourning Dove - mid	tPCB-med	0	3	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Mourning Dove - high	tPCB-high	2	42	--	1	0	0	--	3	6	--	2	1	--	2	--	0	0
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Blue Jay - mid	tPCB-med	0	4	--	0	0	0	--	0	1	--	0	0	--	0	--	0	0
Blue Jay - high	tPCB-high	3	56	--	2	0	0	--	4	8	--	3	2	--	3	--	0	0
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Carolina Wren - 1 - mid	tPCB-med	0	3	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Carolina Wren - 1 - high	tPCB-high	3	46	--	1	0	0	--	3	6	--	2	1	--	2	--	0	0
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Carolina Wren - 2 - mid	tPCB-med	0	1	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Carolina Wren - 2 - high	tPCB-high	3	20	--	2	1	2	--	1	3	--	1	1	--	1	--	0	0
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0
Hawk - mid	tPCB-med	23	28	--	14	14	14	--	3	3	--	4	4	--	6	--	1	1
Hawk - high	tPCB-high	305	367	--	190	184	186	--	34	41	--	55	53	--	86	--	15	15
	Mercury	--	--	--	1	1	1	--	0	0	--	0	0	--	0	--	0	0
Aquatic Birds																		
Tree Swallow	tPCB-mid	--	--	2	--	--	--	1	--	--	0	--	--	0	--	1	--	--
	tPCB-high	--	--	31	--	--	--	19	--	--	2	--	--	5	--	8	--	--
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--
Spotted Sandpiper - 1	tPCB-mid	--	--	0	--	--	--	1	--	--	1	--	--	0	--	0	--	--
	tPCB-high	--	--	5	--	--	--	12	--	--	9	--	--	4	--	4	--	--
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--
Spotted Sandpiper - 2	tPCB-mid	--	--	2	--	--	--	1	--	--	0	--	--	1	--	1	--	--
	tPCB-high	--	--	25	--	--	--	18	--	--	4	--	--	7	--	10	--	--
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--	0	--	--
Kingfisher - 1	tPCB-mid	--	--	9	--	--	--	6	--	--	1	--	--	1	--	2	--	--
	tPCB-high	--	--	118	--	--	--	74	--	--	8	--	--	18	--	30	--	--
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--	0	--	--
Kingfisher - 2	tPCB-mid	--	--	7	--	--	--	4	--	--	0	--	--	1	--	2	--	--
	tPCB-high	--	--	96	--	--	--	60	--	--	7	--	--	14	--	24	--	--
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--	0	--	--
Great Blue Heron	tPCB-mid	--	--	197	--	--	--	123	--	--	14	--	--	30	--	50	--	--
	tPCB-high	--	--	2625	--	--	--	1635	--	--	181	--	--	398	--	672	--	--
	Mercury	--	--	1	--	--	--	22	--	--	1	--	--	1	--	4	--	--
Osprey	tPCB-mid	--	--	57	--	--	--	36	--	--	4	--	--	9	--	15	--	--
	tPCB-high	--	--	765	--	--	--	477	--	--	52	--	--	116	--	196	--	--
	Mercury	--	--	0	--	--	--	6	--	--	0	--	--	0	--	1	--	--

Table 6-9. Summary of Terrestrial and Aquatic Bird Egg Tissue NOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C5	C6	C6	C6	Middle AA	Middle AA	C7	C7	C7	C8	C8	C8	C9	C9	C9	C10[1]	Lower AA	Lower AA
Exposure Subarea→		Riparian/ Aquatic	North	South	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic
Receptors↓		NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ	NOAEL HQ
Terrestrial Birds																			
Mourning Dove - mid	tPCB-med	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Mourning Dove - high	tPCB-high	--	0	1	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Blue Jay - mid	tPCB-med	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Blue Jay - high	tPCB-high	--	0	1	--	0	--	0	0	--	1	0	--	0	0	--	--	0	--
	Mercury	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 1 - mid	tPCB-med	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 1 - high	tPCB-high	--	0	1	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 2 - mid	tPCB-med	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 2 - high	tPCB-high	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	--	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Hawk - mid	tPCB-med	--	1	1	--	1	--	1	1	--	1	1	--	0	0	--	--	1	--
Hawk - high	tPCB-high	--	7	8	--	14	--	8	9	--	10	9	--	5	3	--	--	9	--
	Mercury	--	0	0	--	0	--	0	0	--	1	0	--	0	0	--	--	0	--
Aquatic Birds																			
Tree Swallow	tPCB-mid	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Spotted Sandpiper - 1	tPCB-mid	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	1	--	--	1	--	1	--	--	1	--	--	1	--	--	1	1	--	1
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Spotted Sandpiper - 2	tPCB-mid	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	4	--	--	1	--	3	--	--	4	--	--	4	--	--	2	3	--	4
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Kingfisher - 1	tPCB-mid	1	--	--	0	--	1	--	--	1	--	--	1	--	--	0	0	--	1
	tPCB-high	8	--	--	2	--	7	--	--	8	--	--	9	--	--	2	6	--	10
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Kingfisher - 2	tPCB-mid	0	--	--	0	--	0	--	--	0	--	--	1	--	--	0	0	--	1
	tPCB-high	6	--	--	1	--	6	--	--	6	--	--	7	--	--	2	5	--	7
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Great Blue Heron	tPCB-mid	11	--	--	2	--	10	--	--	11	--	--	13	--	--	3	9	--	14
	tPCB-high	143	--	--	29	--	131	--	--	147	--	--	167	--	--	42	120	--	182
	Mercury	1	--	--	1	--	1	--	--	1	--	--	1	--	--	1	1	--	2
Osprey	tPCB-mid	3	--	--	1	--	3	--	--	3	--	--	4	--	--	1	3	--	4
	tPCB-high	42	--	--	9	--	39	--	--	43	--	--	49	--	--	12	35	--	54
	Mercury	0	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0

Table 6-9. Summary of Terrestrial and Aquatic Bird Egg Tissue NOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
NOAEL HQ* > 1 and ≤ 10
NOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

HQ: hazard quotient

NOAEL: no observed adverse effect level

tPCB: total polychlorinated biphenyl

TRV: toxicity reference value

--: not available

Exposure Units:

C1: Oxford Lake Park

C2: Backwater Area

C3: Friendship Road to Highway 21

C4: Hwy 21 to Silver Run Road

C5: Silver Run Road to Mitchell Matson Road

C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road

C7: Upstream of Curry Station Road to Eastaboga Creek

C8: Eastaboga Creek to Jackson Shoals Dam

C9: Jackson Shoals Dam to Highway 77

C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:

East: East Subarea Floodplain Soil

West: West Subarea Floodplain Soil

North: North Subarea Floodplain Soil

South: South Subarea Floodplain Soil

Central: Central Subarea Floodplain Soil

Table 6-10. Summary of Terrestrial and Aquatic Bird Egg Tissue LOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C1[1]	C1[1]	C1[1]	C2	C2	C2	C2	C3	C3	C3	C4	C4	C4	Upper	Upper	C5	C5	C5
Exposure Subarea→		East	West	Riparian/ Aquatic	North	South	Central	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic	North	South	Riparian/ Aquatic
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Terrestrial Birds																			
Mourning Dove - mid	**tPCB-med**	0	1	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Mourning Dove - high	**tPCB-high**	1	20	--	1	0	0	--	1	3	--	1	1	--	1	--	0	0	--
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Blue Jay - mid	**tPCB-med**	0	2	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Blue Jay - high	**tPCB-high**	1	26	--	1	0	0	--	2	4	--	1	1	--	1	--	0	0	--
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Carolina Wren - 1 - mid	**tPCB-med**	0	1	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Carolina Wren - 1 - high	**tPCB-high**	1	22	--	1	0	0	--	1	3	--	1	1	--	1	--	0	0	--
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Carolina Wren - 2 - mid	**tPCB-med**	0	1	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Carolina Wren - 2 - high	**tPCB-high**	1	9	--	1	1	1	--	1	1	--	1	0	--	1	--	0	0	--
	Mercury	--	--	--	0	0	0	--	0	0	--	0	0	--	0	--	0	0	--
Hawk - mid	**tPCB-med**	10	12	--	6	6	6	--	1	1	--	2	2	--	3	--	0	0	--
Hawk - high	**tPCB-high**	142	171	--	89	86	87	--	16	19	--	26	25	--	40	--	7	7	--
	Mercury	--	--	--	1	1	1	--	0	0	--	0	0	--	0	--	0	0	--
Aquatic Birds																			
Tree Swallow	**tPCB-mid**	--	--	1	--	--	--	1	--	--	0	--	--	0	--	0	--	--	0
	tPCB-high	--	--	14	--	--	--	9	--	--	1	--	--	2	--	4	--	--	0
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--	0
Spotted Sandpiper - 1	**tPCB-mid**	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--	0
	tPCB-high	--	--	2	--	--	--	6	--	--	4	--	--	2	--	2	--	--	0
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--	0
Spotted Sandpiper - 2	**tPCB-mid**	--	--	1	--	--	--	1	--	--	0	--	--	0	--	0	--	--	0
	tPCB-high	--	--	12	--	--	--	8	--	--	2	--	--	3	--	5	--	--	2
	Mercury	--	--	0	--	--	--	1	--	--	0	--	--	0	--	0	--	--	0
Kingfisher - 1	**tPCB-mid**	--	--	4	--	--	--	2	--	--	0	--	--	1	--	1	--	--	0
	tPCB-high	--	--	55	--	--	--	34	--	--	4	--	--	8	--	14	--	--	4
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--	0
Kingfisher - 2	**tPCB-mid**	--	--	3	--	--	--	2	--	--	0	--	--	0	--	1	--	--	0
	tPCB-high	--	--	45	--	--	--	28	--	--	3	--	--	7	--	11	--	--	3
	Mercury	--	--	0	--	--	--	0	--	--	0	--	--	0	--	0	--	--	0
Great Blue Heron	**tPCB-mid**	--	--	84	--	--	--	52	--	--	6	--	--	13	--	21	--	--	5
	tPCB-high	--	--	1225	--	--	--	763	--	--	84	--	--	186	--	314	--	--	67
	Mercury	--	--	0	--	--	--	12	--	--	0	--	--	0	--	2	--	--	1
Osprey	**tPCB-mid**	--	--	24	--	--	--	15	--	--	2	--	--	4	--	6	--	--	1
	tPCB-high	--	--	357	--	--	--	222	--	--	24	--	--	54	--	91	--	--	20
	Mercury	--	--	0	--	--	--	3	--	--	0	--	--	0	--	1	--	--	0

Table 6-10. Summary of Terrestrial and Aquatic Bird Egg Tissue LOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Exposure Unit→		C6	C6	C6	Middle	Middle	C7	C7	C7	C8	C8	C8	C9	C9	C9	C10[1]	Lower	Lower
Exposure Subarea→		North	South	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	North	South	Riparian/ Aquatic	Riparian/ Aquatic	Soil Combined	Riparian/ Aquatic
Receptors↓		LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ	LOAEL HQ
Terrestrial Birds																		
Mourning Dove - mid	tPCB-med	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Mourning Dove - high	tPCB-high	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Blue Jay - mid	tPCB-med	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Blue Jay - high	tPCB-high	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 1 - mid	tPCB-med	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 1 - high	tPCB-high	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 2 - mid	tPCB-med	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Carolina Wren - 2 - high	tPCB-high	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Hawk - mid	tPCB-med	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Hawk - high	tPCB-high	3	4	--	7	--	4	4	--	5	4	--	3	1	--	--	4	--
	Mercury	0	0	--	0	--	0	0	--	0	0	--	0	0	--	--	0	--
Aquatic Birds																		
Tree Swallow	tPCB-mid	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Spotted Sandpiper - 1	tPCB-mid	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Spotted Sandpiper - 2	tPCB-mid	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	--	--	1	--	2	--	--	2	--	--	2	--	--	1	2	--	2
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Kingfisher - 1	tPCB-mid	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	--	--	1	--	3	--	--	4	--	--	4	--	--	1	3	--	4
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Kingfisher - 2	tPCB-mid	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
	tPCB-high	--	--	1	--	3	--	--	3	--	--	3	--	--	1	2	--	3
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0
Great Blue Heron	tPCB-mid	--	--	1	--	4	--	--	5	--	--	5	--	--	1	4	--	6
	tPCB-high	--	--	14	--	61	--	--	69	--	--	78	--	--	19	56	--	85
	Mercury	--	--	1	--	1	--	--	1	--	--	1	--	--	1	1	--	1
Osprey	tPCB-mid	--	--	0	--	1	--	--	1	--	--	2	--	--	0	1	--	2
	tPCB-high	--	--	4	--	18	--	--	20	--	--	23	--	--	6	17	--	25
	Mercury	--	--	0	--	0	--	--	0	--	--	0	--	--	0	0	--	0

Table 6-10. Summary of Terrestrial and Aquatic Bird Egg Tissue LOAEL Hazard Quotients by Exposure Unit
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ* ≤ 1
LOAEL HQ* ≤ 1
LOAEL HQ* > 1 and ≤ 10
LOAEL HQ* > 10

* All HQs rounded to the nearest whole number

[1] Riparian soil in reaches C1 and C10 is based on the applicable assessment area (i.e., Upper for C1 and Lower for C10). Reach C10 was not evaluated for terrestrial receptors due to lack of floodplain soil.

HQ: hazard quotient

LOAEL: lowest observed adverse effect level

tPCB: total polychlorinated biphenyls

TRV: toxicity reference value

"--": not available

Exposure Units:

C1: Oxford Lake Park
C2: Backwater Area
C3: Friendship Road to Highway 21
C4: Hwy 21 to Silver Run Road
C5: Silver Run Road to Mitchell Matson Road
C6: Mitchell Matson Road to 2,000 feet upstream of Curry Station Road
C7: Upstream of Curry Station Road to Eastaboga Creek
C8: Eastaboga Creek to Jackson Shoals Dam
C9: Jackson Shoals Dam to Highway 77
C10: Highway 77 Bridge to Lake Logan Martin

Exposure Subareas:

East: East Subarea Floodplain Soil
West: West Subarea Floodplain Soil
North: North Subarea Floodplain Soil
South: South Subarea Floodplain Soil
Central: Central Subarea Floodplain Soil

Table 6-11. Hazard Quotients Based on Measured Tissue and Critical Tissue Concentrations
Anniston PCB Site, Anniston, Alabama

Assessment Area	Matrix	Detects	Total Samples	Minimum	Maximum	Mean	95% UCL	EPC	Critical Tissue Concentration		Hazard Quotients	
									NOAEL CTC	LOAEL CTC	NOAEL HQ	LOAEL HQ
PCBs												
Upper Assessment Area	**Aquatic**											
	aquatic plants	9	9	0.414	1.194	0.823	0.978	0.978	NA	NA	NA	NA
	benthic invertebrates	9	9	0.864	3.51	1.70	2.65	2.65	158	422	0	0
	crayfish	7	7	1.288	3.80	2.46	--	3.80 m	21	57	0	0
	emergent insects	9	9	0.305	27	16	23	23	21	NA	1	NA
	frogs	7	7	2.531	38	15	--	38 m	NA	NA	NA	NA
	mollusks	9	9	5.905	17	12	14	14	1263	1875	0	0
	snake	2	2	26	167	96	--	167 m	NA	NA	NA	NA
	bottom fish	9	9	34	68	53	61	61	7.0	34	9	2
	forage fish	27	27	6.77	44	21	24	24	7.0	34	3	1
	predator fish	9	9	22	175	84	111	111	7.0	34	16	3
	all fish	45	45	6.77	175	40	50	50	7.0	34	7	1
	Terrestrial											
	small mammals	14	16	0.319	13.53	3.22	6.36	6.36	10	23	1	0
	terrestrial insects	0	6	N/A	N/A	N/A	--	N/A m	307	480	NA	NA
	terrestrial plants	18	18	0.033	0.257	0.108	0.145	0.145	NA	NA	NA	NA
	worm	6	9	14	85	40	45	45	78	83	1	1
Middle Assessment Area	**Aquatic**											
	aquatic plants	6	9	0.39	1.69	0.867	0.978	0.978	NA	NA	NA	NA
	benthic invertebrates	9	9	1.18	1.99	1.62	1.83	1.83	158	422	0	0
	crayfish	7	7	0.892	2.62	1.81	--	2.62 m	21	57	0	0
	emergent insects	9	9	0.31	1.011	0.685	0.806	0.806	21	NA	0	NA
	frogs	7	7	2.42	4.58	3.39	--	4.58 m	NA	NA	NA	NA
	mollusks	9	9	4.60	11.88	7.74	9.48	9.48	1263	1875	0	0
	snake	2	2	19	122	71	--	122 m	NA	NA	NA	NA
	bottom fish	9	9	18	51	32	39	39	7.0	34	6	1
	forage fish	27	27	18	51	33	36	36	7.0	34	5	1
	predator fish	9	9	37	127	74	95	95	7.0	34	14	3
	all fish	45	45	18	127	41	46	46	7.0	34	7	1
	Terrestrial											
	small mammals	8	11	0.13	20	4	15	15	10	23	1	1
	terrestrial insects	0	6	N/A	N/A	N/A	--	N/A m	307	480	NA	NA
	terrestrial plants	5	18	0.0344	0.437	0.182	0.13	0.13	NA	NA	NA	NA
	worm	5	9	0.913	11.08	3.95	4.64	4.64	78	83	0	0
Lower Assessment Area	**Aquatic**											
	aquatic plants	6	9	0.244	0.631	0.402	0.427	0.427	NA	NA	NA	NA
	benthic invertebrates	9	9	0.614	1.57	0.922	1.09	1.09	158	422	0	0
	crayfish	9	9	0.235	1.28	0.833	1.05	1.05	21	57	0	0
	emergent insects	9	9	0.67	1.38	0.957	1.11	1.11	21	NA	0	NA
	frogs	2	2	5.29	5.43	5.36	--	5.43 m	NA	NA	NA	NA
	mollusks	9	9	6.076	14	11	12	12	1263	1875	0	0
	snake	7	7	26	55	39	--	55 m	NA	NA	NA	NA
	bottom fish	9	9	22	84	53	66	66	7.0	34	9	2
	forage fish	27	27	16	47	31	34	34	7.0	34	5	1
	predator fish	9	9	42	127	83	102	102	7.0	34	15	3
	all fish	45	45	16	127	46	53	53	7.0	34	8	2
	Terrestrial											
	small mammals	8	17	0.195	38	8	15	15	10	23	1	1
	terrestrial insects	0	6	N/A	N/A	N/A	--	N/A m	307	480	NA	NA
	terrestrial plants	0	18	N/A	N/A	N/A	--	N/A m	NA	NA	NA	NA
	worm	5	9	3.30	7.90	5.59	5.23	5.23	78	83	0	0

Table 6-11. Hazard Quotients Based on Measured Tissue and Critical Tissue Concentrations
Anniston PCB Site, Anniston, Alabama

Assessment Area	Matrix	Detects	Total Samples	Minimum	Maximum	Mean	95% UCL	EPC	Critical Tissue Concentration		Hazard Quotients	
									NOAEL CTC	LOAEL CTC	NOAEL HQ	LOAEL HQ
Mercury												
Upper Assessment Area	**Aquatic**											
	aquatic plants	7	9	0.0457	0.113	0.0787	0.0859	0.0859	NA	NA	NA	NA
	benthic invertebrates	9	9	0.128	0.311	0.192	0.232	0.232	56	90	0	0
	crayfish	6	7	0.115	0.19	0.136	--	0.19 m	0.92	16	0	0
	emergent insects	9	9	0.105	0.417	0.25	0.321	0.321	24	NA	0	NA
	frogs	7	7	0.122	1.03	0.646	--	1.03 m	NA	NA	NA	NA
	mollusks	9	9	0.14	0.377	0.24	0.292	0.292	7.5	150	0	0
	snake	2	2	0.609	0.875	0.742	--	0.875 m	NA	NA	NA	NA
	bottom fish	9	9	0.262	0.75	0.463	0.567	0.567	0.85	0.93	1	1
	forage fish	26	27	0.0607	0.277	0.165	0.182	0.182	0.85	0.93	0	0
	predator fish	9	9	0.856	1.95	1.24	1.47	1.47	0.85	0.93	2	2
	all fish	44	45	0.0607	1.949	0.446	0.736	0.736	0.85	0.93	1	1
	Terrestrial											
	small mammals	8	16	0.0203	0.0906	0.0526	0.0468	0.0468	NA	NA	NA	NA
	terrestrial insects	4	6	0.0207	0.0377	0.0314	--	0.0377 m	NA	NA	NA	NA
	terrestrial plants	0	18	N/A	N/A	N/A	--	N/A m	NA	NA	NA	NA
	worm	9	9	0.11	7.36	3.76	5.58	5.58	15	NA	0	NA
Middle Assessment Area	**Aquatic**											
	aquatic plants	5	9	0.0625	0.376	0.134	0.258	0.258	NA	NA	NA	NA
	benthic invertebrates	9	9	0.22	0.444	0.301	0.35	0.35	56	90	0	0
	crayfish	7	7	0.119	0.206	0.167	--	0.206 m	0.92	16	0	0
	emergent insects	9	9	0.0337	0.318	0.134	0.188	0.188	24	NA	0	NA
	frogs	7	7	0.235	1.76	0.566	--	1.76 m	NA	NA	NA	NA
	mollusks	9	9	0.136	0.424	0.3	0.36	0.36	7.5	150	0	0
	snake	2	2	0.54	1.71	1.12	--	1.71 m	NA	NA	NA	NA
	bottom fish	9	9	0.157	0.466	0.326	0.399	0.399	0.85	0.93	0	0
	forage fish	27	27	0.239	0.761	0.471	0.512	0.512	0.85	0.93	1	1
	predator fish	9	9	0.97	1.97	1.40	1.59	1.59	0.85	0.93	2	2
	all fish	45	45	0.16	1.97	0.63	0.74	0.74	0.85	0.93	1	1
	Terrestrial											
	small mammals	5	11	0.02	0.28	0.13	0.12	0.12	NA	NA	NA	NA
	terrestrial insects	0	6	N/A	N/A	N/A	--	N/A m	NA	NA	NA	NA
	terrestrial plants	2	18	0.02	0.06	0.04	--	0.06 m	NA	NA	NA	NA
	worm	9	9	0.53	4.40	1.31	3.16	3.16	15	NA	0	NA
Lower Assessment Area	**Aquatic**											
	aquatic plants	7	9	0.03	0.09	0.06	0.07	0.07	NA	NA	NA	NA
	benthic invertebrates	9	9	0.25	0.70	0.38	0.48	0.48	56	90	0	0
	crayfish	8	9	0.11	0.29	0.19	0.23	0.23	0.92	16	0	0
	emergent insects	9	9	0.08	0.25	0.17	0.21	0.21	24	NA	0	NA
	frogs	2	2	0.32	0.56	0.44	--	0.56 m	NA	NA	NA	NA
	mollusks	9	9	0.52	1.01	0.77	0.86	0.86	7.5	150	0	0
	snake	7	7	0.42	2.12	1.24	--	2.12 m	NA	NA	NA	NA
	bottom fish	9	9	0.35	1.41	0.68	0.90	0.90	0.85	0.93	1	1
	forage fish	27	27	0.21	1.09	0.57	0.65	0.65	0.85	0.93	1	1
	predator fish	9	9	1.47	3.04	2.04	2.35	2.35	0.85	0.93	3	3
	all fish	45	45	0.21	3.04	0.89	1.07	1.07	0.85	0.93	1	1
	Terrestrial											
	small mammals	5	17	0.05	0.75	0.24	0.17	0.17	NA	NA	NA	NA
	terrestrial insects	0	6	N/A	N/A	N/A	--	N/A m	NA	NA	NA	NA
	terrestrial plants	0	18	N/A	N/A	N/A	--	N/A m	NA	NA	NA	NA
	worm	9	9	0.14	3.71	1.58	2.39	2.39	15	NA	0	NA

Table 6-11. Hazard Quotients Based on Measured Tissue and Critical Tissue Concentrations
Anniston PCB Site, Anniston, Alabama

Assessment Area	Matrix	Detects	Total Samples	Minimum	Maximum	Mean	95% UCL	EPC	Critical Tissue Concentration		Hazard Quotients	
									NOAEL CTC	LOAEL CTC	NOAEL HQ	LOAEL HQ
Lead												
Upper Assessment Area	**Aquatic**											
	bottom fish	1	1	0.375	0.375	0.375	--	0.375 m	9.3	15	0	0
	forage fish	2	4	0.195	2.07	1.13	--	2.07 m	9.3	15	0	0
	predator fish	--	--	--	--	--	--	-- m	9.3	15	NA	NA
	all fish	3	5	0.195	2.07	0.88	--	2.07 m	9.3	15	0	0
Middle Assessment Area	**Aquatic**											
	bottom fish	1	1	0.265	0.265	0.265	--	0.265 m	9.3	15	0	0
	forage fish	--	--	--	--	--	--	-- m	9.3	15	NA	NA
	predator fish	1	1	0.0959	0.0959	0.0959	--	0.0959 m	9.3	15	0	0
	all fish	2	2	0.0959	0.265	0.18	--	0.265 m	9.3	15	0	0
Lower Assessment Area	**Aquatic**											
	bottom fish	1	2	0.216	0.216	0.216	--	0.216 m	9.3	15	0	0
	forage fish	2	2	0.155	0.177	0.166	--	0.177 m	9.3	15	0	0
	predator fish	1	3	0.214	0.214	0.214	--	0.214 m	9.3	15	0	0
	all fish	4	7	0.155	0.216	0.191	--	0.216 m	9.3	15	0	0
Vanadium												
Upper Assessment Area	**Aquatic**											
	bottom fish	0	1	N/A	N/A	N/A	--	N/A m	0.09	2.1	NA	NA
	forage fish	1	4	1.188	1.19	1.19	--	1.19 m	0.09	2.1	13	1
	predator fish	--	--	--	--	--	--	-- m	0.09	2.1	NA	NA
	all fish	1	5	1.188	1.19	1.19	--	1.19 m	0.09	2.1	13	1
Middle Assessment Area	**Aquatic**											
	bottom fish	0	1	N/A	N/A	N/A	--	N/A m	0.09	2.1	NA	NA
	forage fish	--	--	--	--	--	--	-- m	0.09	2.1	NA	NA
	predator fish	0	1	N/A	N/A	N/A	--	N/A m	0.09	2.1	NA	NA
	all fish	0	2	N/A	N/A	N/A	--	N/A m	0.09	2.1	NA	NA
Lower Assessment Area	**Aquatic**											
	bottom fish	1	2	0.258	0.258	0.258	--	0.258 m	0.09	2.1	3	0
	forage fish	0	2	N/A	N/A	N/A	--	N/A m	0.09	2.1	NA	NA
	predator fish	1	3	0.148	0.148	0.148	--	0.148 m	0.09	2.1	2	0
	all fish	2	7	0.148	0.258	0.203	--	0.258 m	0.09	2.1	3	0

Notes:
All units in mg/kg dw
CTC: critical tissue concentration
EPC: exposure point concentration
HQ: hazard quotient
LOAEL: lowest observed adverse effect level
m: maximum
N/A: Measured tissue concentrations were not detected
NA: CTC not available
NOAEL: no observed adverse effect level
PCB: polychlorinated biphenyl
UCL: upper confidence limit on arithmetic mean

0 values indicated HQ is <1
Tissue CTCs are presented in Table 5-2b.

NOAEL and LOAEL HQ ≤ 1*
NOAEL HQ > 1 and LOAEL HQ ≤ 1*
NOAEL or LOAEL HQ > 1 and < 10*
LOAEL HQ > 10*

* All HQs rounded to the nearest whole number

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Media	Receptor Community	COPC	Water EPC (mg/L)	Toxicity Benchmarks[a] (mg/L)			Hazard Quotients	
				Chronic	Acute	Source	Chronic	Acute
Sitewide	Aquatic Life	PCB	0.00016	0.000014	0.00060	b,d	11	0
		Barium	0.12	0.0040	0.11	c	30	1
		Chromium	0.018	0.13	1.0	b,d	0	0
		Cobalt	0.012	0.023	1.5	c	1	0
		Lead	0.067	0.0050	0.14	b,d	13	0
		Mercury	0.00043	0.000012	0.0024	b,e	36	0
		Mercury	0.00043	0.00077	0.0014	d,f	1	0
		Vanadium	0.017	0.020	0.28	c	1	0
	Aquatic Plants	PCB	0.00016	0.00014	NA	c	1	--
		Barium	0.12	NA	NA		--	--
		Chromium	0.018	0.40	NA	c	0	--
		Cobalt	0.012	NA	NA		--	--
		Lead	0.067	0.50	NA	c	0	--
		Mercury	0.00043	0.0050	NA	c	0	--
		Vanadium	0.017	NA	NA		--	--
	Aquatic Invertebrates	PCB	0.00016	0.0012	NA	c	0	--
		Barium	0.12	NA	NA		--	--
		Chromium	0.018	NA	NA		--	--
		Cobalt	0.012	0.0044	NA	c	3	--
		Lead	0.067	NA	NA		--	--
		Mercury	0.00043	0.00087	NA	c	0	--
		Vanadium	0.017	0.43	NA	c	0	--
	Fish	PCB	0.00016	0.00040	NA	c	0	--
		Barium	0.12	NA	NA		--	--
		Chromium	0.018	0.089	NA	c	0	--
		Cobalt	0.012	0.81	NA	c	0	--
		Lead	0.067	0.022	NA	c	3	--
		Mercury	0.00043	0.00087	NA	c	0	--
		Vanadium	0.017	0.041	NA	c	0	--

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Media	Receptor Community	COPC	Water EPC (mg/L)	Toxicity Benchmarks[a] (mg/L)			Hazard Quotients	
				Chronic	Acute	Source	Chronic	Acute
C1 - Snow Creek	Aquatic Life	PCB	4.9800E-4	0.000014	0.00060	b,d	36	1
		Barium	0.20	0.0040	0.11	c	50	2
		Chromium	0.033	0.13	1.0	b,d	0	0
		Cobalt	0.012	0.023	1.5	c	1	0
		Lead	0.096	0.0050	0.14	b,d	19	1
		Mercury	0.00043	0.000012	0.0024	b,e	36	0
		Mercury	0.000	0.00077	0.0014	d,f	1	0
		Vanadium	0.03390	0.020	0.28	c	2	0
	Aquatic Plants	PCB	4.9800E-4	0.00014	NA	c	4	--
		Barium	0.20100	NA	NA		--	--
		Chromium	0.03290	0.40	NA	c	0	--
		Cobalt	0.01220	NA	NA		--	--
		Lead	0.09640	0.50	NA	c	0	--
		Mercury	0.00043	0.0050	NA	c	0	--
		Vanadium	0.03390	NA	NA		--	--
	Aquatic Invertebrates	PCB	4.9800E-4	0.0012	NA	c	0	--
		Barium	0.20100	NA	NA		--	--
		Chromium	0.03290	NA	NA		--	--
		Cobalt	0.01220	0.0044	NA	c	3	--
		Lead	0.09640	NA	NA		--	--
		Mercury	0.00043	0.00087	NA	c	0	--
		Vanadium	0.03390	0.43	NA	c	0	--
	Fish	PCB	4.9800E-4	0.00040	NA	c	1	--
		Barium	0.20100	NA	NA		--	--
		Chromium	0.03290	0.089	NA	c	0	--
		Cobalt	0.01220	0.81	NA	c	0	--
		Lead	0.09640	0.022	NA	c	4	--
		Mercury	0.00043	0.00087	NA	c	0	--
		Vanadium	0.03390	0.041	NA	c	1	--

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Media	Receptor Community	COPC	Water EPC (mg/L)	Toxicity Benchmarks[a] (mg/L)			Hazard Quotients	
				Chronic	Acute	Source	Chronic	Acute
Upper Assessment Area	Aquatic Life	PCB	0.00008	0.000014	0.00060	b,d	6	0
		Barium	0.03	0.0040	0.11	c	8	0
		Chromium	0.002	0.13	1.0	b,d	0	0
		Cobalt	<0.01	0.023	1.5	c	--	--
		Lead	0.001	0.0050	0.14	b,d	0	0
		Mercury	<0.000068	0.000012	0.0024	b,e	--	--
		Mercury	<0.000068	0.00077	0.0014	d,f	--	--
		Vanadium	0.001	0.020	0.28	c	0	0
	Aquatic Plants	PCB	0.00008	0.00014	NA	c	1	--
		Barium	0.03	NA	NA		--	--
		Chromium	0.002	0.40	NA	c	0	--
		Cobalt	<0.01	NA	NA		--	--
		Lead	0.001	0.50	NA	c	0	--
		Mercury	<0.000068	0.0050	NA	c	--	--
		Vanadium	0.001	NA	NA		--	--
	Aquatic Invertebrates	PCB	0.00008	0.0012	NA	c	0	--
		Barium	0.03	NA	NA		--	--
		Chromium	0.002	NA	NA		--	--
		Cobalt	<0.01	0.0044	NA	c	--	--
		Lead	0.001	NA	NA		--	--
		Mercury	<0.000068	0.00087	NA	c	--	--
		Vanadium	0.001	0.43	NA	c	0	--
	Fish	PCB	0.00008	0.00040	NA	c	0	--
		Barium	0.03	NA	NA		--	--
		Chromium	0.002	0.089	NA	c	0	--
		Cobalt	<0.01	0.81	NA	c	--	--
		Lead	0.001	0.022	NA	c	0	--
		Mercury	<0.000068	0.00087	NA	c	--	--
		Vanadium	0.001	0.041	NA	c	0	--

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Media	Receptor Community	COPC	Water EPC (mg/L)	Toxicity Benchmarks[a] (mg/L)			Hazard Quotients	
				Chronic	Acute	Source	Chronic	Acute
Middle Assessment Area	Aquatic Life	PCB	0.00011	0.000014	0.00060	b,d	8	0
		Barium	0.04	0.0040	0.11	c	11	0
		Chromium	0.004	0.13	1.0	b,d	0	0
		Cobalt	0.002	0.023	1.5	c	0	0
		Lead	0.005	0.0050	0.14	b,d	1	0
		Mercury	<0.000068	0.000012	0.0024	b,e	--	--
		Mercury	<0.000068	0.00077	0.0014	d,f	--	--
		Vanadium	0.003	0.020	0.28	c	0	0
	Aquatic Plants	PCB	0.00011	0.00014	NA	c	1	--
		Barium	0.04	NA	NA		--	--
		Chromium	0.004	0.40	NA	c	0	--
		Cobalt	0.002	NA	NA		--	--
		Lead	0.005	0.50	NA	c	0	--
		Mercury	<0.000068	0.0050	NA	c	--	--
		Vanadium	0.003	NA	NA		--	--
	Aquatic Invertebrates	PCB	0.00011	0.0012	NA	c	0	--
		Barium	0.04	NA	NA		--	--
		Chromium	0.004	NA	NA		--	--
		Cobalt	0.002	0.0044	NA	c	1	--
		Lead	0.005	NA	NA		--	--
		Mercury	<0.000068	0.00087	NA	c	--	--
		Vanadium	0.003	0.43	NA	c	0	--
	Fish	PCB	0.00011	0.00040	NA	c	0	--
		Barium	0.04	NA	NA		--	--
		Chromium	0.004	0.089	NA	c	0	--
		Cobalt	0.002	0.81	NA	c	0	--
		Lead	0.005	0.022	NA	c	0	--
		Mercury	<0.000068	0.00087	NA	c	--	--
		Vanadium	0.003	0.041	NA	c	0	--

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Media	Receptor Community	COPC	Water EPC (mg/L)	Toxicity Benchmarks[a] (mg/L)			Hazard Quotients	
				Chronic	Acute	Source	Chronic	Acute
Lower Assessment Area	Aquatic Life	PCB	0.00016	0.000014	0.00060	b,d	11	0
		Barium	0.02	0.0040	0.11	c	6	0
		Chromium	0.001	0.13	1.0	b,d	0	0
		Cobalt	<0.01	0.023	1.5	c	--	--
		Lead	0.000	0.0050	0.14	b,d	0	0
		Mercury	0.00007	0.000012	0.0024	b,e	6	0
		Mercury	0.00007	0.00077	0.0014	d,f	0	0
		Vanadium	0.000	0.020	0.28	c	0	0
	Aquatic Plants	PCB	0.00016	0.00014	NA	c	1	--
		Barium	0.02	NA	NA		--	--
		Chromium	0.001	0.40	NA	c	0	--
		Cobalt	<0.01	NA	NA		--	--
		Lead	0.000	0.50	NA	c	0	--
		Mercury	0.00007	0.0050	NA	c	0	--
		Vanadium	0.000	NA	NA		--	--
	Aquatic Invertebrates	PCB	0.00016	0.0012	NA	c	0	--
		Barium	0.02	NA	NA		--	--
		Chromium	0.001	NA	NA		--	--
		Cobalt	<0.01	0.0044	NA	c	--	--
		Lead	0.000	NA	NA		--	--
		Mercury	0.00007	0.00087	NA	c	0	--
		Vanadium	0.000	0.43	NA	c	0	--
	Fish	PCB	0.00016	0.00040	NA	c	0	--
		Barium	0.02	NA	NA		--	--
		Chromium	0.001	0.089	NA	c	0	--
		Cobalt	<0.01	0.81	NA	c	--	--
		Lead	0.000	0.022	NA	c	0	--
		Mercury	0.00007	0.00087	NA	c	0	--
		Vanadium	0.000	0.041	NA	c	0	--

Table 6-12. Summary of Risk Estimates For Aquatic Life Exposed to Surface Water
Anniston PCB Site, Anniston, Alabama

Notes:

NOAEL HQ ≤ 1*
NOAEL HQ > 1 and LOAEL HQ ≤ 1*
NOAEL or LOAEL HQ > 1 and < 10*
LOAEL HQ > 10*

* HQs rounded to the nearest whole number

COPC: constituent of potential concern

EPC: exposure point concentration

HQ: hazard quotient

mg/L: milligrams per liter

NA: toxicity value not available

PCB: polychlorinated biphenyl

[a] Water quality standards selected as indicated in Table 5-2b.

[b] ADEM (2015)

[c] Suter and Tsao (1996)

[d] NAWQC (2016)

[e] Value based on methylmercury but applies to total mercury

[f] Value based on total mercury but also applies to methylmercury

References:

Alabama Department of Environmental Management (ADEM). 2015. Water Division – Water Quality Program. Volume 1. ADEM Admin. Code r. 335-6-x-xx. Available at: http://www.adem.state.al.us/alEnviroRegLaws/files/Division6Vol1.pdf

USEPA. 2016. National Ambient Water Quality Criteria (NAWQC). Available online: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

Suter, G.W. II and C.L. Tsao. 1996. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104 pp. ES/ER/TM-96/R2

Table 6-13. Summary of ANOVA Analysis for Sediment
Anniston PCB Site, Anniston, Alabama

Parameter	Area	N	N (detects)	Frequency of Detection	Mean (Std. Dev.)	Dunnett's p-value [a]	Pairwise among AAs [b]
Barium	C1	2	2	100%	190 (42)	**0.023**	No difference
	Lower	14	14	100%	74.5 (42)	0.752	
	Middle	4	4	100%	85.5 (110)	0.641	
	Upper	8	8	100%	69.7 (50)	0.809	
	Reference	5	5	100%	70.6 (35)	--	--
Chromium	C1	2	2	100%	44 (2.8)	**0.013**	C1 > Upper
	Lower	14	14	100%	19.3 (10)	0.563	
	Middle	4	4	100%	19.1 (24)	0.636	
	Upper	8	8	100%	13.1 (5.5)	0.903	
	Reference	5	5	100%	15.7 (12)	--	--
Cobalt	C1	2	2	100%	18.5 (3.5)	0.081	No difference
	Lower	14	14	100%	7.09 (3.2)	0.910	
	Middle	4	4	100%	10.7 (16)	0.575	
	Upper	8	8	100%	5.95 (2.5)	0.954	
	Reference	5	5	100%	8.42 (4)	--	--
Lead	C1	2	2	100%	83.5 (37)	**<.0001**	C1 > Lower=Middle= Upper
	Lower	14	14	100%	17.8 (11)	0.424	
	Middle	4	4	100%	22.3 (32)	0.335	
	Upper	8	7	88%	15.6 (15)	0.558	
	Reference	5	5	100%	10.2 (2.9)	--	--
Mercury	C1	2	2	100%	0.545 (0.049)	**0.0001**	No difference
	Lower	40	40	100%	0.75 (1)	**<0.0001**	
	Middle	25	25	100%	0.711 (0.3)	**<0.0001**	
	Upper	24	23	96%	2.67 (9.4)	**<0.0001**	
	Reference	21	9	43%	0.0204 (0.024)	--	--
Total PCBs	C1	16	15	94%	5.25 (9.8)	**<0.0001**	C1 > Lower=Middle= Upper
	Lower	122	103	84%	0.76 (0.93)	**<0.0001**	
	Middle	52	45	87%	0.777 (1.1)	**<0.0001**	
	Upper	78	57	73%	3.36 (12)	**<0.0001**	
	Reference	21	0	0%	0.0283 (0.01)	--	--
Vanadium	C1	2	2	100%	52.5 (0.71)	**0.0002**	C1 > Lower=Middle= Upper
	Lower	14	14	100%	14.9 (8.3)	0.864	
	Middle	4	4	100%	13.7 (20)	0.898	
	Upper	8	8	100%	9.93 (4.3)	0.983	
	Reference	5	5	100%	16.1 (11)	--	--

Notes:

All units in milligrams per kilogram dry weight.

Half detection limit was used for non-detects.

Mercury and Total PCBs were log transformed to meet assumptions of ANOVA.

a. Dunnett's test was used to compare the individual OU-4 assessment areas to the reference area. A significant difference is indicated by p-values < 0.05.

b. Pairwise comparisons were conducted between the OU-4 assessment areas only, and are summarized in this column. Differences were considered signficiant for p-values < 0.05 (not shown).

AA: assessment area

ANOVA: analysis of variance

OU-4: Operable Unit 4

PCB: polychlorinated biphenyl

Table 6-14. Summary of ANOVA Analysis for Soil - PCBs and Mercury
Anniston PCB Site, Anniston, Alabama

Parameter Group	Parameter	Assessment Area	N	N (detects)	Frequency of Detection	Mean (Std. Dev.)	Dunnett's p-value [a]	Pairwise among AAs [b]
Metals	Mercury	UAA	446	444	100%	1.63 (2.7)	**<0.0001**	UAA> MAA>LAA
Metals	Mercury	MAA	259	259	100%	0.565 (0.99)	**0.0006**	
Metals	Mercury	LAA	140	130	93%	0.48 (1.2)	**0.0188**	
Metals	Mercury	REF	14	14	100%	0.0424 (0.024)		
PCBs-Total	Total PCBs	C1	100	81	81%	11.5 (24)	**<0.0001**	C1>UAA> MAA >LAA
PCBs-Total	Total PCBs	UAA	539	392	73%	5.17 (10)	**<0.0001**	
PCBs-Total	Total PCBs	MAA	275	151	55%	0.924 (1.8)	**0.0019**	
PCBs-Total	Total PCBs	LAA	288	132	46%	0.487 (1.3)	**0.0375**	
PCBs-Total	Total PCBs	REF	14	0	0%	0.022 (0.0018)		

Notes:

All units in milligrams per kilogram dry weight.

Half detection limit was used for non-detects.

Mercury and Total PCBs were log transformed to meet assumptions of ANOVA.

a. Dunnett's test was used to compare the individual OU-4 assessment areas to the reference area. A significant difference is indicated by p-values < 0.05.

b. Pairwise comparisons were conducted between the OU-4 assessment areas only, and are summarized in this column.
Differences were considered signficiant for p-values < 0.05 (not shown).

AA: assessment area

ANOVA: analysis of variance

LAA: lower assessment area

MAA: middle assessment area

PCB: polychlorinated biphenyl

REF: reference

UAA: upper assessment area

Table 6-15. Summary of ANOVA Analysis for Tissue
Anniston PCB Site, Anniston, Alabama

Matrix	Area	N	N (Detects)	Frequency of Detection	Mean (Std. Dev.)	Dunnett's p-value [b]	Pairwise among AAs [c]
Total PCBs							
Aquatic Plants	Lower	9	6	67%	0.281 (0.22)	0.1	No difference
	Middle	9	6	67%	0.595 (0.59)	**0.02**	
	Upper	9	9	100%	0.823 (0.25)	**0.0003**	
	Reference	9	1	11%	0.6 (1.7)	--	--
Benthic Invertebrates (Odonate larvae)	Lower	9	9	100%	0.922 (0.27)	**<0.0001**	Upper = Middle>Lower
	Middle	9	9	100%	1.62 (0.34)	**<0.0001**	
	Upper	9	9	100%	1.7 (0.98)	**<0.0001**	
	Reference	9	0	0%	0.141 (0.032)	--	--
Crayfish	Lower	9	9	100%	0.833 (0.34)	**<0.0001**	Upper = Middle>Lower
	Middle	7	7	100%	1.81 (0.67)	**<0.0001**	
	Upper	7	7	100%	2.46 (0.98)	**<0.0001**	
	Reference	3	0	0%	0.0594 (0.0072)	--	--
Emergent Insects	Lower	9	9	100%	0.957 (0.25)	**0.0003**	Upper > Middle=Lower
	Middle	9	9	100%	0.685 (0.2)	**0.003**	
	Upper	9	9	100%	15.6 (11)	**<0.0001**	
	Reference	9	0	0%	0.146 (0.053)	--	--
Bottom Fish	Lower	9	9	100%	53.5 (21)	**<0.0001**	No difference
	Middle	9	9	100%	32.3 (11)	**<0.0001**	
	Upper	9	9	100%	52.7 (13)	**<0.0001**	
	Reference	9	5	56%	0.358 (0.28)	--	--
Forage Fish	Lower	27	27	100%	30.7 (8.5)	**<0.0001**	No difference
	Middle	27	27	100%	32.8 (9.7)	**<0.0001**	
	Upper	27	27	100%	20.9 (8.6)	**<0.0001**	
	Reference	27	22	81%	1.83 (3.9)	--	--
Predator Fish	Lower	9	9	100%	83.2 (30)	**<0.0001**	No difference
	Middle	9	9	100%	74 (34)	**<0.0001**	
	Upper	9	9	100%	84 (44)	**<0.0001**	
	Reference	9	9	100%	3.5 (4.5)	--	--
All Fish	Lower	45	45	100%	45.8 (27)	**<0.0001**	No difference
	Middle	45	45	100%	41 (24)	**<0.0001**	
	Upper	45	45	100%	39.9 (33)	**<0.0001**	
	Reference	45	36	80%	1.87 (3.7)	--	--
Frog	Lower	2	2	100%	5.36 (0.1)	**<0.0001**	Upper > Middle
	Middle	7	7	100%	3.39 (0.83)	**<0.0001**	
	Upper	7	7	100%	15.1 (12)	**<0.0001**	
	Reference	4	1	25%	0.0885 (0.038)	--	--
Snake	Lower	7	7	100%	39.2 (11)	**<0.0001**	No difference
	Middle	2	2	100%	70.6 (73)	**0.0009**	
	Upper	2	2	100%	96.2 (99)	**0.0005**	
	Reference	6	5	83%	1.23 (1.7)	--	--
Molluscs	Lower	9	9	100%	10.6 (2.2)	**<0.0001**	No difference
	Middle	9	9	100%	7.73 (2.8)	**<0.0001**	
	Upper	9	9	100%	11.7 (4.2)	**<0.0001**	
	Reference	9	0	0%	0.164 (0.064)	--	--
Small Mammals	Lower	17	8	47%	3.7 (9.2)	0.09	No difference
	Middle	11	8	73%	2.86 (6)	0.06	
	Upper	16	14	88%	2.82 (4)	**0.006**	
	Reference	10	1	10%	1.47 (4.5)	--	--
Terrestrial Insects (Grasshopper/Cricket)	Lower	6	0	0%	0.073 (0.023)	[a]	NA
	Middle	6	0	0%	0.0799 (0.0087)	[a]	
	Upper	6	0	0%	0.0739 (0.017)	[a]	
	Reference	6	0	0%	0.0737 (0.0064)	--	--

Table 6-15. Summary of ANOVA Analysis for Tissue
Anniston PCB Site, Anniston, Alabama

Matrix	Area	N	N (Detects)	Frequency of Detection	Mean (Std. Dev.)	Dunnett's p-value [b]	Pairwise among AAs [c]
Worm	Lower	9	5	56%	3.14 (3.2)	0.08	No difference
	Middle	9	5	56%	2.21 (3.7)	0.2	
	Upper	9	6	67%	26.6 (29)	**0.002**	
	Reference	9	0	0%	0.0997 (0.018)	--	--
Terrestrial Plants	Lower	18	0	0%	0.0548 (0.037)	0.25	Upper>Lower
	Middle	18	2	11%	0.0784 (0.11)	0.20	
	Upper	18	1	6%	0.0613 (0.057)	0.24	
	Reference	14	0	0%	0.0409 (0.032)	--	--
Mercury							
Aquatic Plants	Lower	9	7	78%	0.0545 (0.024)	**0.04**	No difference
	Middle	9	5	56%	0.0852 (0.11)	**0.02**	
	Upper	9	7	78%	0.0662 (0.031)	**0.01**	
	Reference	9	3	33%	0.0282 (0.017)	--	--
Benthic Invertebrates (Odonate larvae)	Lower	9	9	100%	0.382 (0.15)	**<0.001**	Lower=Middle> Upper
	Middle	9	9	100%	0.301 (0.079)	**<0.001**	
	Upper	9	9	100%	0.192 (0.065)	**0.0003**	
	Reference	9	9	100%	0.103 (0.048)	--	--
Crayfish	Lower	9	8	89%	0.213 (0.08)	**0.001**	No difference
	Middle	7	7	100%	0.167 (0.035)	**0.01**	
	Upper	7	6	86%	0.174 (0.1)	**0.02**	
	Reference	3	3	100%	0.0845 (0.021)	--	--
Emergent Insects	Lower	9	9	100%	0.17 (0.057)	**0.02**	No difference
	Middle	9	9	100%	0.134 (0.087)	0.3	
	Upper	9	9	100%	0.25 (0.11)	**0.001**	
	Reference	9	9	100%	0.0988 (0.076)	--	--
Bottom Fish	Lower	9	9	100%	0.678 (0.36)	**0.066**	Lower>Middle
	Middle	9	9	100%	0.326 (0.12)	1	
	Upper	9	9	100%	0.463 (0.17)	0.6	
	Reference	9	9	100%	0.439 (0.19)	--	--
Forage Fish	Lower	27	27	100%	0.573 (0.22)	**<0.0001**	Lower=Middle> Upper
	Middle	27	27	100%	0.471 (0.13)	**<0.0001**	
	Upper	27	26	96%	0.161 (0.066)	1	
	Reference	27	27	100%	0.273 (0.12)	--	--
Predator Fish	Lower	9	9	100%	2.03 (0.51)	**<0.0001**	Lower>Upper
	Middle	9	9	100%	1.4 (0.31)	**0.0190**	
	Upper	9	9	100%	1.24 (0.37)	0.12	
	Reference	9	9	100%	1.04 (0.61)	--	--
All Fish	Lower	45	45	100%	0.886 (0.66)	**<0.0001**	Lower=Middle> Upper
	Middle	45	45	100%	0.628 (0.43)	**0.0153**	
	Upper	45	44	98%	0.437 (0.46)	1	
	Reference	45	45	100%	0.459 (0.41)	--	--
Frog	Lower	2	2	100%	0.441 (0.17)	0.118	No difference
	Middle	7	7	100%	0.566 (0.54)	**0.0327**	
	Upper	7	7	100%	0.646 (0.38)	**0.0204**	
	Reference	4	4	100%	0.153 (0.085)	--	--
Snake	Lower	7	7	100%	1.24 (0.61)	**0.0270**	No difference
	Middle	2	2	100%	1.12 (0.82)	0.20	
	Upper	2	2	100%	0.742 (0.19)	0.4	
	Reference	6	6	100%	0.559 (0.25)	--	--
Molluscs	Lower	9	9	100%	0.769 (0.15)	**<0.0001**	Lower>Middle= Upper
	Middle	9	9	100%	0.3 (0.096)	0.9	
	Upper	9	9	100%	0.24 (0.083)	1	
	Reference	9	9	100%	0.365 (0.22)	--	--

Table 6-15. Summary of ANOVA Analysis for Tissue
Anniston PCB Site, Anniston, Alabama

Matrix	Area	N	N (Detects)	Frequency of Detection	Mean (Std. Dev.)	Dunnett's p-value [b]	Pairwise among AAs [c]
Small Mammals	Lower	17	5	29%	0.0774 (0.18)	0.2	No difference
	Middle	11	5	45%	0.0627 (0.091)	0.1	
	Upper	16	8	50%	0.0311 (0.029)	0.2	
	Reference	10	1	10%	0.0122 (0.01)	--	--
Terrestrial Insects (Grasshopper/Cricket)	Lower	7	1	14%	0.0196 (0.019)	0.1	No difference
	Middle	6	0	0%	0.0103 (0.00078)	0.7	
	Upper	7	4	57%	0.0227 (0.012)	**0.0204**	
	Reference	6	0	0%	0.0102 (0.0012)	--	--
Worm	Lower	9	9	100%	1.58 (1.3)	0.06	No difference
	Middle	9	9	100%	1.31 (1.3)	0.06	
	Upper	9	9	100%	3.76 (2.9)	**0.01**	
	Reference	9	9	100%	0.343 (0.11)	--	--
Terrestrial Plants	Lower	18	0	0%	0.0162 (0.0074)	0.8	No difference
	Middle	18	2	11%	0.0173 (0.013)	0.9	
	Upper	18	0	0%	0.0148 (0.0077)	1	
	Reference	14	2	14%	0.0199 (0.015)	--	--

Notes:
All units in milligrams per kilogram dry weight.
Half detection limit was used for non-detects.
Data were log transformed for ANOVA.
a. PCBs in grasshoppers and crickets were all non-detect so a test was not conducted.
b. Dunnett's test was used to compare the individual OU-4 assessment areas to the reference area.
A significant difference is indicated by p-values < 0.05.
c. Pairwise comparisons were conducted between the OU-4 assessment areas only, and are summarized in this column.
Differences were considered signficiant for p-values < 0.05 (not shown).
AA: assessment area
ANOVA: analysis of variance
NA: not applicable
PCB: polychlorinated biphenyl

Table 6-16a. Summary of PCB Risks to Aquatic Birds (Mid-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Tree Swallow	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2	Osprey	Great Blue Heron
	TRV/CTC Type	mid sens	mid sens	mid sens	mid sens	mid sens	mid sens
C1	Modeled HQ	55	22	30	24	18	43
	Measured HQ	4	≤ 1	3	2	3	6
	Tissue HQ	≤ 1	≤ 1	4	3	24	84
C2	Modeled HQ	34	16	19	15	11	27
	Measured HQ	4	≤ 1	3	2	3	6
	Tissue HQ	≤ 1	≤ 1	2	2	15	52
C3	Modeled HQ	4	4	2	2	≤ 1	3
	Measured HQ	4	≤ 1	3	2	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	2	6
C4	Modeled HQ	8	6	5	4	3	6
	Measured HQ	4	≤ 1	3	2	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	4	13
C5	Modeled HQ	≤ 1	3	2	2	≤ 1	2
	Measured HQ	≤ 1	≤ 1	4	3	2	5
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	5
C6	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	4	3	2	5
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C7	Modeled HQ	≤ 1	3	2	2	≤ 1	2
	Measured HQ	≤ 1	≤ 1	4	3	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	5
C8	Modeled HQ	≤ 1	4	2	2	≤ 1	3
	Measured HQ	≤ 1	≤ 1	4	3	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	2	5
C9	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	4	3	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C10	Modeled HQ	≤ 1	3	2	≤ 1	≤ 1	2
	Measured HQ	≤ 1	≤ 1	4	3	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	4
UAA	Modeled HQ	14	9	8	6	5	11
	Measured HQ	4	≤ 1	3	2	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	6	21
MAA	Modeled HQ	≤ 1	3	2	≤ 1	≤ 1	2
	Measured HQ	≤ 1	≤ 1	4	3	2	5
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	4
LAA	Modeled HQ	≤ 1	4	2	2	≤ 1	3
	Measured HQ	≤ 1	≤ 1	4	3	3	6
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	2	6

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-16b. Summary of PCB Risks to Aquatic Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Tree Swallow	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2	Osprey	Great Blue Heron
	TRV/CTC Type	high sens	high sens	high sens	high sens	high sens	high sens
C1	Modeled HQ	595	232	323	261	193	461
	Measured HQ	42	8	29	25	27	66
	Tissue HQ	14	12	55	45	357	1225
C2	Modeled HQ	371	171	201	162	120	287
	Measured HQ	42	6	29	25	27	66
	Tissue HQ	9	8	34	28	222	763
C3	Modeled HQ	41	41	22	18	13	32
	Measured HQ	42	4	29	25	27	66
	Tissue HQ	≤ 1	2	4	3	24	84
C4	Modeled HQ	90	69	49	40	29	70
	Measured HQ	42	4	29	25	27	66
	Tissue HQ	2	3	8	7	54	186
C5	Modeled HQ	≤ 1	35	22	17	11	25
	Measured HQ	≤ 1	3	44	34	25	59
	Tissue HQ	≤ 1	2	4	3	20	67
C6	Modeled HQ	≤ 1	13	4	3	2	5
	Measured HQ	≤ 1	3	44	34	25	59
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	4	14
C7	Modeled HQ	≤ 1	36	21	16	11	26
	Measured HQ	2	2	41	31	29	68
	Tissue HQ	≤ 1	2	4	3	20	69
C8	Modeled HQ	≤ 1	39	24	18	12	29
	Measured HQ	2	2	41	31	29	68
	Tissue HQ	≤ 1	2	4	3	23	78
C9	Modeled HQ	≤ 1	16	6	5	3	7
	Measured HQ	2	2	41	31	29	68
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	6	19
C10	Modeled HQ	≤ 1	32	17	13	9	21
	Measured HQ	2	2	41	31	29	68
	Tissue HQ	≤ 1	2	3	2	17	56
UAA	Modeled HQ	152	96	83	67	49	118
	Measured HQ	42	5	29	25	27	66
	Tissue HQ	4	5	14	11	91	314
MAA	Modeled HQ	≤ 1	33	20	16	10	23
	Measured HQ	≤ 1	3	44	34	25	59
	Tissue HQ	≤ 1	2	3	3	18	61
LAA	Modeled HQ	≤ 1	41	26	20	14	32
	Measured HQ	2	2	41	31	29	68
	Tissue HQ	≤ 1	2	4	3	25	85

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-16c. Summary of Mercury Risks to Aquatic Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Tree Swallow	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2	Osprey	Great Blue Heron
C1	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C2	Modeled HQ	32	50	10	9	7	19
	Measured HQ	≤ 1	14	2	2	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	3	12
C3	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C4	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C5	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C6	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C7	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	2	2	≤ 1	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C8	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	2	2	≤ 1	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C9	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	2	2	≤ 1	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C10	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	2	2	≤ 1	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
UAA	Modeled HQ	5	9	2	2	≤ 1	3
	Measured HQ	≤ 1	3	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
MAA	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
LAA	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	2
	Measured HQ	≤ 1	2	2	≤ 1	≤ 1	3
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-16d. Summary of Non-Mercury Metals Risks to Aquatic Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Barium	Chromium				Lead	Vanadium		
		Kingfisher - 2	Tree Swallow	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2	Spotted Sandpiper - 2	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2
C1	Modeled HQ	2	4	2	2	≤ 1	6	8	2	2
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
C2	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	3	2	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C3	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C4	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C5	Modeled HQ	2	5	2	2	2	4	7	2	2
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
C6	Modeled HQ	2	5	2	2	2	4	7	2	2
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
C9	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
C10	Modeled HQ	≤ 1	3	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2	≤ 1	≤ 1
UAA	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	2	2	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
MAA	Modeled HQ	2	5	2	2	2	4	7	2	2
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
LAA	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1	3	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	2	≤ 1	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations for PCBs and mercury only.
If all available HQs (modeled, measured, tissue) are less than 1, the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-17a. Summary of PCB Risks to Terrestrial Birds (Mid-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Mourning Dove	Blue Jay	Carolina Wren - 1	Hawk
	TRV/CTC Type	mid sens	mid sens	mid sens	mid sens
C1 East	Modeled HQ	≤ 1	≤ 1	5	10
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	10
C1 West	Modeled HQ	13	24	87	13
	Measured HQ	3	4	9	2
	Tissue HQ	≤ 1	2	≤ 1	12
C2 North	Modeled HQ	≤ 1	≤ 1	2	6
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	6
C2 South	Modeled HQ	≤ 1	≤ 1	≤ 1	6
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	6
C2 Central	Modeled HQ	≤ 1	≤ 1	≤ 1	6
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	6
C3 North	Modeled HQ	≤ 1	2	6	≤ 1
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C3 South	Modeled HQ	2	3	12	≤ 1
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C4 North	Modeled HQ	≤ 1	≤ 1	4	2
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	2
C4 South	Modeled HQ	≤ 1	≤ 1	3	2
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	2
C5 North	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C5 South	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C6 North	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C6 South	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
UAA	Modeled HQ	≤ 1	≤ 1	4	3
	Measured HQ	≤ 1	≤ 1	4	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	3
MAA	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect leve
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-17b. Summary of PCB Risks to Terrestrial Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Mourning Dove	Blue Jay	Carolina Wren - 1	Hawk
	TRV/CTC Type	high sens	high sens	high sens	high sens
C1 East	Modeled HQ	8	14	51	112
	Measured HQ	2	8	42	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	142
C1 West	Modeled HQ	142	258	938	135
	Measured HQ	31	40	93	25
	Tissue HQ	20	26	22	171
C2 North	Modeled HQ	4	7	25	70
	Measured HQ	≤ 1	7	41	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	89
C2 South	Modeled HQ	≤ 1	≤ 1	≤ 1	67
	Measured HQ	≤ 1	6	39	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	86
C2 Central	Modeled HQ	≤ 1	2	8	68
	Measured HQ	≤ 1	6	40	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	87
C3 North	Modeled HQ	9	17	61	12
	Measured HQ	2	8	43	17
	Tissue HQ	≤ 1	2	≤ 1	16
C3 South	Modeled HQ	20	35	128	15
	Measured HQ	5	11	46	18
	Tissue HQ	3	4	3	19
C4 North	Modeled HQ	7	12	42	20
	Measured HQ	2	8	42	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	26
C4 South	Modeled HQ	4	8	28	19
	Measured HQ	≤ 1	7	41	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	25
C5 North	Modeled HQ	≤ 1	≤ 1	4	5
	Measured HQ	≤ 1	≤ 1	4	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	7
C5 South	Modeled HQ	≤ 1	2	6	6
	Measured HQ	≤ 1	≤ 1	5	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	7
C6 North	Modeled HQ	≤ 1	2	8	2
	Measured HQ	≤ 1	≤ 1	5	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	3
C6 South	Modeled HQ	2	3	12	3
	Measured HQ	≤ 1	≤ 1	5	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	4
C7 North	Modeled HQ	≤ 1	≤ 1	3	3
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	4
C7 South	Modeled HQ	≤ 1	2	6	3
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	4
C8 North	Modeled HQ	≤ 1	2	8	4
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	5
C8 South	Modeled HQ	≤ 1	2	5	3
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	4

Table 6-17b. Summary of PCB Risks to Terrestrial Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Mourning Dove	Blue Jay	Carolina Wren - 1	Hawk
	TRV/CTC Type	high sens	high sens	high sens	high sens
C9 North	Modeled HQ	≤ 1	2	7	2
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	3
C9 South	Modeled HQ	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
UAA	Modeled HQ	7	12	43	32
	Measured HQ	2	8	42	17
	Tissue HQ	≤ 1	≤ 1	≤ 1	40
MAA	Modeled HQ	≤ 1	2	6	5
	Measured HQ	≤ 1	≤ 1	5	18
	Tissue HQ	≤ 1	≤ 1	≤ 1	7
LAA	Modeled HQ	≤ 1	≤ 1	3	3
	Measured HQ	≤ 1	≤ 1	5	13
	Tissue HQ	≤ 1	≤ 1	≤ 1	4

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect leve
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-17c. Summary of Mercury Risks to Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Mourning Dove	Blue Jay	Carolina Wren - 1	Hawk
C2 North	Modeled HQ	≤ 1	≤ 1	5	2
	Measured HQ	≤ 1	2	10	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C2 South	Modeled HQ	≤ 1	≤ 1	≤ 1	2
	Measured HQ	≤ 1	2	9	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C2 Central	Modeled HQ	≤ 1	≤ 1	2	2
	Measured HQ	≤ 1	2	9	2
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C3 North	Modeled HQ	≤ 1	2	10	≤ 1
	Measured HQ	≤ 1	2	11	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C3 South	Modeled HQ	≤ 1	3	10	≤ 1
	Measured HQ	≤ 1	3	11	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C4 North	Modeled HQ	≤ 1	2	7	≤ 1
	Measured HQ	≤ 1	2	10	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C4 South	Modeled HQ	≤ 1	2	8	≤ 1
	Measured HQ	≤ 1	2	10	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C5 North	Modeled HQ	≤ 1	≤ 1	3	≤ 1
	Measured HQ	≤ 1	≤ 1	6	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C5 South	Modeled HQ	≤ 1	≤ 1	4	≤ 1
	Measured HQ	≤ 1	≤ 1	6	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C6 North	Modeled HQ	≤ 1	≤ 1	5	≤ 1
	Measured HQ	≤ 1	≤ 1	6	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C6 South	Modeled HQ	≤ 1	2	9	≤ 1
	Measured HQ	≤ 1	2	7	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C7 North	Modeled HQ	≤ 1	≤ 1	3	≤ 1
	Measured HQ	≤ 1	≤ 1	4	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C7 South	Modeled HQ	≤ 1	≤ 1	6	≤ 1
	Measured HQ	≤ 1	≤ 1	5	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C8 North	Modeled HQ	2	4	14	≤ 1
	Measured HQ	≤ 1	2	6	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C8 South	Modeled HQ	≤ 1	≤ 1	3	≤ 1
	Measured HQ	≤ 1	≤ 1	4	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C9 North	Modeled HQ	≤ 1	≤ 1	6	≤ 1
	Measured HQ	≤ 1	≤ 1	5	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
C9 South	Modeled HQ	≤ 1	≤ 1	3	≤ 1
	Measured HQ	≤ 1	≤ 1	4	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1

Table 6-17c. Summary of Mercury Risks to Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Mourning Dove	Blue Jay	Carolina Wren - 1	Hawk
UAA	Modeled HQ	≤ 1	2	7	≤ 1
	Measured HQ	≤ 1	2	10	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
MAA	Modeled HQ	≤ 1	≤ 1	3	≤ 1
	Measured HQ	≤ 1	≤ 1	6	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1
LAA	Modeled HQ	≤ 1	≤ 1	4	≤ 1
	Measured HQ	≤ 1	≤ 1	5	≤ 1
	Tissue HQ	≤ 1	≤ 1	≤ 1	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect leve
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-17d. Summary of Non-Mercury Metals Risks to Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Chromium	Lead	Vanadium
		Carolina Wren - 1	Carolina Wren - 1	Carolina Wren - 1
C2 North	Modeled HQ	2	≤ 1	3
	Measured HQ	2	4	3
C2 South	Modeled HQ	≤ 1	≤ 1	3
	Measured HQ	≤ 1	4	3
C2 Central	Modeled HQ	≤ 1	2	3
	Measured HQ	≤ 1	4	2
C3 North	Modeled HQ	≤ 1	≤ 1	3
	Measured HQ	≤ 1	4	2
C3 South	Modeled HQ	3	4	4
	Measured HQ	2	5	3
C4 North	Modeled HQ	2	2	4
	Measured HQ	2	5	3
C4 South	Modeled HQ	2	2	3
	Measured HQ	≤ 1	5	3
C5 North	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
C5 South	Modeled HQ	2	2	5
	Measured HQ	≤ 1	5	3
C6 North	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
C6 South	Modeled HQ	≤ 1	≤ 1	2
	Measured HQ	≤ 1	4	2
C7 North	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
C7 South	Modeled HQ	2	≤ 1	5
	Measured HQ	≤ 1	4	3
C8 North	Modeled HQ	≤ 1	≤ 1	3
	Measured HQ	≤ 1	4	3
C8 South	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
C9 North	Modeled HQ	≤ 1	≤ 1	2
	Measured HQ	≤ 1	4	2
C9 South	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
UAA	Modeled HQ	2	2	3
	Measured HQ	≤ 1	4	3
MAA	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3
LAA	Modeled HQ	≤ 1	≤ 1	4
	Measured HQ	≤ 1	4	3

Notes:
LOAEL HQ values presented
Tissue HQs calculated for PCBs and mercury only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-18a. Summary of PCB Risks to Aquatic+Terrestrial Birds (Mid-Sensitivity HQs)

Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
	TRV/CTC Type	mid sens	mid sens
C1 East	Modeled HQ	6	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C1 West	Modeled HQ	37	--
	Measured HQ	9	--
	Tissue HQ	≤ 1	--
C1 Riparian	Modeled HQ	--	4
	Measured HQ	--	3
	Tissue HQ	--	≤ 1
C2 North	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C2 South	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C2 Central	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C2 Riparian	Modeled HQ	--	11
	Measured HQ	--	4
	Tissue HQ	--	≤ 1
C3 North	Modeled HQ	2	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C3 South	Modeled HQ	5	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C3 Riparian	Modeled HQ	--	7
	Measured HQ	--	3
	Tissue HQ	--	≤ 1
C4 North	Modeled HQ	2	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C4 South	Modeled HQ	2	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C4 Riparian	Modeled HQ	--	3
	Measured HQ	--	3
	Tissue HQ	--	≤ 1
UAA Soil	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
UAA Riparian	Modeled HQ	--	3
	Measured HQ	--	3
	Tissue HQ	--	≤ 1

Notes:

LOAEL HQ values presented

Tissue HQs for birds based on modeled egg concentrations.

If available HQs (modeled, measured, tissue) are less than 1, the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1

Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1

Yellow shadng indicates LOAEL HQ > 1

Orange shading indicates LOAEL HQ > 10

AA: assessment area

COPC: constituent of potential concern

CTC: critical tissue concentration

EU: exposure unit

HQ: hazard quotient

LAA: lower assessment area

LOAEL: lowest observed adverse effect level

MAA: middle assessment area

NOAEL: no observed adverse effect level

TRV: toxicity threshold value

UAA: upper assessment area

Table 6-18b. Summary of PCB Risks to Aquatic+Terrestrial Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
	TRV/CTC Type	high sens	high sens
C1 East	Modeled HQ	64	--
	Measured HQ	42	--
	Tissue HQ	≤ 1	--
C1 West	Modeled HQ	402	--
	Measured HQ	93	--
	Tissue HQ	9	--
C1 Riparian	Modeled HQ	--	48
	Measured HQ	--	36
	Tissue HQ	--	2
C2 North	Modeled HQ	37	--
	Measured HQ	41	--
	Tissue HQ	≤ 1	--
C2 South	Modeled HQ	28	--
	Measured HQ	39	--
	Tissue HQ	≤ 1	--
C2 Central	Modeled HQ	31	--
	Measured HQ	40	--
	Tissue HQ	≤ 1	--
C2 Riparian	Modeled HQ	--	116
	Measured HQ	--	38
	Tissue HQ	--	6
C3 North	Modeled HQ	26	--
	Measured HQ	43	--
	Tissue HQ	≤ 1	--
C3 South	Modeled HQ	52	--
	Measured HQ	47	--
	Tissue HQ	≤ 1	--
C3 Riparian	Modeled HQ	--	81
	Measured HQ	--	36
	Tissue HQ	--	4
C4 North	Modeled HQ	23	--
	Measured HQ	42	--
	Tissue HQ	≤ 1	--
C4 South	Modeled HQ	17	--
	Measured HQ	41	--
	Tissue HQ	≤ 1	--
C4 Riparian	Modeled HQ	--	35
	Measured HQ	--	34
	Tissue HQ	--	2
C5 North	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C5 South	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C5 Riparian	Modeled HQ	--	10
	Measured HQ	--	5
	Tissue HQ	--	≤ 1

Table 6-18b. Summary of PCB Risks to Aquatic+Terrestrial Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
	TRV/CTC Type	high sens	high sens
C6 North	Modeled HQ	3	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C6 South	Modeled HQ	5	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C6 Riparian	Modeled HQ	--	8
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C7 North	Modeled HQ	3	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C7 South	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C7 Riparian	Modeled HQ	--	9
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C8 North	Modeled HQ	6	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C8 South	Modeled HQ	5	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C8 Riparian	Modeled HQ	--	8
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C9 North	Modeled HQ	3	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C9 South	Modeled HQ	≤ 1	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C9 Riparian	Modeled HQ	--	7
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C10 Riparian	Modeled HQ	--	6
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
UAA Soil	Modeled HQ	28	--
	Measured HQ	42	--
	Tissue HQ	≤ 1	--
UAA Riparian	Modeled HQ	--	37
	Measured HQ	--	34
	Tissue HQ	--	2
MAA Soil	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--

Table 6-18b. Summary of PCB Risks to Aquatic+Terrestrial Birds (High-Sensitivity HQs)
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
	TRV/CTC Type	high sens	high sens
MAA Riparian	Modeled HQ	--	9
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
LAA Soil	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
LAA Riparian	Modeled HQ	--	6
	Measured HQ	--	5
	Tissue HQ	--	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-18c. Summary of Mercury Risks to Aquatic+Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
C1 East	Modeled HQ	--	--
	Measured HQ	--	--
	Tissue HQ	--	--
C1 West	Modeled HQ	--	--
	Measured HQ	--	--
	Tissue HQ	--	--
C1 Riparian	Modeled HQ	--	7
	Measured HQ	--	8
	Tissue HQ	--	≤ 1
C2 North	Modeled HQ	43	--
	Measured HQ	10	--
	Tissue HQ	≤ 1	--
C2 South	Modeled HQ	42	--
	Measured HQ	9	--
	Tissue HQ	≤ 1	--
C2 Central	Modeled HQ	42	--
	Measured HQ	9	--
	Tissue HQ	≤ 1	--
C2 Riparian	Modeled HQ	--	9
	Measured HQ	--	14
	Tissue HQ	--	≤ 1
C3 North	Modeled HQ	6	--
	Measured HQ	11	--
	Tissue HQ	≤ 1	--
C3 South	Modeled HQ	7	--
	Measured HQ	11	--
	Tissue HQ	≤ 1	--
C3 Riparian	Modeled HQ	--	13
	Measured HQ	--	9
	Tissue HQ	--	≤ 1
C4 North	Modeled HQ	5	--
	Measured HQ	10	--
	Tissue HQ	≤ 1	--
C4 South	Modeled HQ	5	--
	Measured HQ	10	--
	Tissue HQ	≤ 1	--
C4 Riparian	Modeled HQ	--	9
	Measured HQ	--	9
	Tissue HQ	--	≤ 1
C5 North	Modeled HQ	3	--
	Measured HQ	6	--
	Tissue HQ	≤ 1	--
C5 South	Modeled HQ	3	--
	Measured HQ	6	--
	Tissue HQ	≤ 1	--
C5 Riparian	Modeled HQ	--	4
	Measured HQ	--	5
	Tissue HQ	--	≤ 1

Table 6-18c. Summary of Mercury Risks to Aquatic+Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
C6 North	Modeled HQ	4	--
	Measured HQ	6	--
	Tissue HQ	≤ 1	--
C6 South	Modeled HQ	6	--
	Measured HQ	7	--
	Tissue HQ	≤ 1	--
C6 Riparian	Modeled HQ	--	5
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C7 North	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C7 South	Modeled HQ	5	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C7 Riparian	Modeled HQ	--	7
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C8 North	Modeled HQ	8	--
	Measured HQ	6	--
	Tissue HQ	≤ 1	--
C8 South	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C8 Riparian	Modeled HQ	--	11
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
C9 North	Modeled HQ	5	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
C9 South	Modeled HQ	3	--
	Measured HQ	4	--
	Tissue HQ	≤ 1	--
C9 Riparian	Modeled HQ	--	5
	Measured HQ	--	4
	Tissue HQ	--	≤ 1
C10 Riparian	Modeled HQ	--	9
	Measured HQ	--	5
	Tissue HQ	--	≤ 1
UAA Soil	Modeled HQ	10	--
	Measured HQ	10	--
	Tissue HQ	≤ 1	--
UAA Riparian	Modeled HQ	--	8
	Measured HQ	--	9
	Tissue HQ	--	≤ 1
MAA Soil	Modeled HQ	3	--
	Measured HQ	6	--
	Tissue HQ	≤ 1	--
MAA Riparian	Modeled HQ	--	4
	Measured HQ	--	5
	Tissue HQ	--	≤ 1

Table 6-18c. Summary of Mercury Risks to Aquatic+Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Carolina Wren - 2	Spotted Sandpiper - 1
LAA Soil	Modeled HQ	4	--
	Measured HQ	5	--
	Tissue HQ	≤ 1	--
LAA Riparian	Modeled HQ	--	9
	Measured HQ	--	5
	Tissue HQ	--	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs for birds based on modeled egg concentrations.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-18d. Summary of Non-Mercury Metals Risks to Aquatic+Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Chromium		Lead		Vanadium	
		Carolina Wren - 2	Spotted Sandpiper -	Carolina Wren - 2	Spotted Sandpiper -	Carolina Wren - 2	Spotted Sandpiper -
C1	Modeled HQ	--	--	--	--	--	--
East	Measured HQ	--	--	--	--	--	--
C1	Modeled HQ	--	--	--	--	--	--
West	Measured HQ	--	--	--	--	--	--
C1	Modeled HQ	--	2	--	4	--	6
Riparian	Measured HQ	--	≤ 1	--	4	--	3
C2	Modeled HQ	2	--	≤ 1	--	3	--
North	Measured HQ	2	--	4	--	3	--
C2	Modeled HQ	≤ 1	--	≤ 1	--	3	--
South	Measured HQ	≤ 1	--	4	--	3	--
C2	Modeled HQ	≤ 1	--	2	--	3	--
Central	Measured HQ	≤ 1	--	5	--	3	--
C2	Modeled HQ	--	≤ 1	--	2	--	3
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C3	Modeled HQ	≤ 1	--	≤ 1	--	3	--
North	Measured HQ	≤ 1	--	4	--	3	--
C3	Modeled HQ	2	--	2	--	3	--
South	Measured HQ	2	--	5	--	3	--
C3	Modeled HQ	--	≤ 1	--	≤ 1	--	3
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C4	Modeled HQ	2	--	≤ 1	--	3	--
North	Measured HQ	2	--	5	--	3	--
C4	Modeled HQ	≤ 1	--	≤ 1	--	2	--
South	Measured HQ	≤ 1	--	5	--	3	--
C4	Modeled HQ	--	2	--	2	--	3
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C5	Modeled HQ	2	--	2	--	6	--
North	Measured HQ	≤ 1	--	4	--	3	--
C5	Modeled HQ	2	--	2	--	6	--
South	Measured HQ	≤ 1	--	5	--	3	--
C5	Modeled HQ	--	2	--	3	--	5
Riparian	Measured HQ	--	≤ 1	--	4	--	3
C6	Modeled HQ	2	--	2	--	6	--
North	Measured HQ	≤ 1	--	4	--	3	--
C6	Modeled HQ	2	--	2	--	4	--
South	Measured HQ	≤ 1	--	4	--	2	--
C6	Modeled HQ	--	2	--	2	--	5
Riparian	Measured HQ	--	≤ 1	--	4	--	3
C7	Modeled HQ	≤ 1	--	≤ 1	--	3	--
North	Measured HQ	≤ 1	--	4	--	3	--
C7	Modeled HQ	≤ 1	--	≤ 1	--	3	--
South	Measured HQ	≤ 1	--	4	--	3	--
C7	Modeled HQ	--	≤ 1	--	≤ 1	--	2
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C8	Modeled HQ	≤ 1	--	≤ 1	--	2	--
North	Measured HQ	≤ 1	--	4	--	3	--
C8	Modeled HQ	≤ 1	--	≤ 1	--	3	--
South	Measured HQ	≤ 1	--	4	--	3	--
C8	Modeled HQ	--	≤ 1	--	≤ 1	--	4
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C9	Modeled HQ	≤ 1	--	≤ 1	--	2	--
North	Measured HQ	≤ 1	--	4	--	2	--
C9	Modeled HQ	≤ 1	--	≤ 1	--	3	--
South	Measured HQ	≤ 1	--	4	--	3	--
C9	Modeled HQ	--	≤ 1	--	≤ 1	--	2
Riparian	Measured HQ	--	≤ 1	--	4	--	2
C10	Modeled HQ	--	≤ 1	--	≤ 1	--	4
Riparian	Measured HQ	--	≤ 1	--	4	--	3
UAA	Modeled HQ	≤ 1	--	≤ 1	--	3	--
Soil	Measured HQ	≤ 1	--	5	--	3	--
UAA	Modeled HQ	--	≤ 1	--	2	--	3

Table 6-18d. Summary of Non-Mercury Metals Risks to Aquatic+Terrestrial Birds
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Chromium		Lead		Vanadium	
		Carolina Wren - 2	Spotted Sandpiper -	Carolina Wren - 2	Spotted Sandpiper -	Carolina Wren - 2	Spotted Sandpiper -
Riparian	Measured HQ	--	≤ 1	--	4	--	2
MAA	Modeled HQ	2	--	2	--	5	--
Soil	Measured HQ	≤ 1	--	4	--	3	--
MAA	Modeled HQ	--	2	--	3	--	5
Riparian	Measured HQ	--	≤ 1	--	4	--	3
LAA	Modeled HQ	≤ 1	--	≤ 1	--	3	--
Soil	Measured HQ	≤ 1	--	4	--	3	--
LAA	Modeled HQ	--	≤ 1	--	≤ 1	--	4
Riparian	Measured HQ	--	≤ 1	--	4	--	2

Notes:
LOAEL HQ values presented
Tissue HQs calculated for PCBs and mercury only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-19a. Summary of PCB Risks to Aquatic Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Bat	Mink - 2	Mink - 2	Otter	Otter
	TRV/CTC Type	Mammal	Mink, repro	Mink, growth	Mink, repro	Mink, growth
C1	Modeled HQ	84	116	232	186	372
	Measured HQ	6	11	22	19	39
C2	Modeled HQ	52	73	145	116	232
	Measured HQ	6	11	22	19	39
C3	Modeled HQ	6	8	17	13	26
	Measured HQ	6	11	22	19	39
C4	Modeled HQ	13	18	36	28	56
	Measured HQ	6	11	22	19	39
C5	Modeled HQ	≤ 1	8	16	8	16
	Measured HQ	≤ 1	16	32	19	38
C6	Modeled HQ	≤ 1	2	3	2	3
	Measured HQ	≤ 1	16	32	19	38
C7	Modeled HQ	≤ 1	8	15	9	19
	Measured HQ	≤ 1	15	30	20	40
C8	Modeled HQ	≤ 1	9	17	11	22
	Measured HQ	≤ 1	15	30	20	40
C9	Modeled HQ	≤ 1	2	4	3	5
	Measured HQ	≤ 1	15	30	20	40
C10	Modeled HQ	≤ 1	6	12	8	15
	Measured HQ	≤ 1	15	30	20	40
UAA	Modeled HQ	21	30	60	48	95
	Measured HQ	6	11	22	19	39
MAA	Modeled HQ	≤ 1	7	14	7	15
	Measured HQ	≤ 1	16	32	19	38
LAA	Modeled HQ	≤ 1	9	19	12	23
	Measured HQ	≤ 1	15	30	20	40

Notes:
LOAEL HQ values presented
Tissue HQs calculated by AA only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-19b. Summary of Mercury Risks to Aquatic Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Bat	Otter
C2	Modeled HQ	11	3
	Measured HQ	≤ 1	≤ 1
UAA	Modeled HQ	2	≤ 1
	Measured HQ	≤ 1	≤ 1
	Tissue HQ	NA	

Notes:
LOAEL HQ values presented
Tissue HQs calculated by AA only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NA: not applicable
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-20a. Summary of PCB Risks to Terrestrial Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Shrew - 1	Shrew - 2	Deer	Weasel	Fox - 1	Fox - 2
C1 East	Modeled HQ	7	9	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
C1 West	Modeled HQ	119	115	2	4	5	3
	Measured HQ	6	7	≤ 1	≤ 1	≤ 1	≤ 1
C2 North	Modeled HQ	3	5	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
C2 South	Modeled HQ	≤ 1	2	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	5	≤ 1	≤ 1	≤ 1	≤ 1
C2 Central	Modeled HQ	≤ 1	3	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	5	≤ 1	≤ 1	≤ 1	≤ 1
C3 North	Modeled HQ	8	8	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
C3 South	Modeled HQ	16	16	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
C4 North	Modeled HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	5	≤ 1	≤ 1	≤ 1	≤ 1
C4 South	Modeled HQ	4	4	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	5	≤ 1	≤ 1	≤ 1	≤ 1
C6 South	Modeled HQ	2	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
UAA	Modeled HQ	5	6	≤ 1	≤ 1	≤ 1	≤ 1
	Measured HQ	5	5	≤ 1	≤ 1	≤ 1	≤ 1
	Tissue HQ	≤ 1		NA			

Notes:
LOAEL HQ values presented
Tissue HQs calculated by AA only.
If available HQs (modeled, measured, tissue) are less than 1, the EU/Reach/AA is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NA: not applicable
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-20b. Summary of Mercury Risks to Terrestrial Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Shrew - 1	Shrew - 2
	TRV/CTC Type	Mammal	Mammal
C1 East	Modeled HQ	--	--
	Measured HQ	--	--
C1 West	Modeled HQ	--	--
	Measured HQ	--	--
C2 North	Modeled HQ	≤ 1	2
	Measured HQ	3	4
C2 South	Modeled HQ	≤ 1	≤ 1
	Measured HQ	3	4
C2 Central	Modeled HQ	≤ 1	≤ 1
	Measured HQ	3	4
C3 North	Modeled HQ	3	3
	Measured HQ	3	3
C3 South	Modeled HQ	3	3
	Measured HQ	3	3
C4 North	Modeled HQ	2	2
	Measured HQ	3	3
C4 South	Modeled HQ	2	2
	Measured HQ	3	3
C5 North	Modeled HQ	≤ 1	≤ 1
	Measured HQ	2	2
C5 South	Modeled HQ	≤ 1	≤ 1
	Measured HQ	2	2
C6 North	Modeled HQ	2	≤ 1
	Measured HQ	2	2
C6 South	Modeled HQ	2	2
	Measured HQ	2	2
C7 South	Modeled HQ	2	2
	Measured HQ	≤ 1	≤ 1
C8 North	Modeled HQ	4	4
	Measured HQ	≤ 1	≤ 1
C9 North	Modeled HQ	2	2
	Measured HQ	≤ 1	≤ 1
UAA	Modeled HQ	2	2
	Measured HQ	3	3
MAA	Modeled HQ	≤ 1	≤ 1
	Measured HQ	2	2

Notes:
LOAEL HQ values presented
Tissue HQs calculated by AA only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NA: not applicable
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-20c. Summary of Non-Mercury Metals Risks to Terrestrial Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Chromium	
		Shrew - 1	Shrew - 2
	TRV/CTC Type	Mammal	Mammal
C3 South	Modeled HQ	2	2
	Measured HQ	≤ 1	≤ 1

Notes:
LOAEL HQ values presented
Tissue HQs calculated for PCBs and mercury only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.
a. Only sediment evaluated in reach C10. No terrestrial exposure.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-21. Summary of PCB Risks to Aquatic+Terrestrial Mammals
Anniston PCB Site, Anniston, Alabama

Reach	HQ Type	Raccoon - 1	Raccoon - 2	Mink - 1	Mink - 1
	TRV/CTC Type	Mammal	Mammal	Mink, repro	Mink, growth
C1 East	Modeled HQ	2	--	--	--
	Measured HQ	< 1	--	--	--
C1 West	Modeled HQ	12	--	--	--
	Measured HQ	< 1	--	--	--
C1 Riparian	Modeled HQ	2	5	48	97
	Measured HQ	≤ 1	≤ 1	9	18
C2 Riparian	Modeled HQ	3	4	32	64
	Measured HQ	≤ 1	≤ 1	9	18
C3 South	Modeled HQ	2	--	--	--
	Measured HQ	≤ 1	--	--	--
C3 Riparian	Modeled HQ	≤ 1	≤ 1	6	12
	Measured HQ	≤ 1	≤ 1	9	18
C4 Riparian	Modeled HQ	≤ 1	≤ 1	9	17
	Measured HQ	≤ 1	≤ 1	9	18
C5 Riparian	Modeled HQ	≤ 1	≤ 1	3	6
	Measured HQ	≤ 1	≤ 1	8	15
C6 Riparian	Modeled HQ	≤ 1	≤ 1	≤ 1	2
	Measured HQ	≤ 1	≤ 1	8	15
C7 Riparian	Modeled HQ	≤ 1	≤ 1	3	6
	Measured HQ	≤ 1	≤ 1	8	15
C8 Riparian	Modeled HQ	≤ 1	≤ 1	3	6
	Measured HQ	≤ 1	≤ 1	8	15
C9 Riparian	Modeled HQ	≤ 1	≤ 1	≤ 1	3
	Measured HQ	≤ 1	≤ 1	8	15
C10 Riparian	Modeled HQ	≤ 1	≤ 1	2	5
	Measured HQ	≤ 1	≤ 1	8	15
UAA Riparian	Modeled HQ	≤ 1	≤ 1	14	27
	Measured HQ	≤ 1	≤ 1	9	18
MAA Riparian	Modeled HQ	≤ 1	≤ 1	3	6
	Measured HQ	≤ 1	≤ 1	8	15
LAA Riparian	Modeled HQ	≤ 1	≤ 1	3	6
	Measured HQ	≤ 1	≤ 1	8	15

Table 6-21. Summary of PCB Risks to Aquatic+Terrestrial Mammals
Anniston PCB Site, Anniston, Alabama

Notes:
LOAEL HQ values presented
Tissue HQs calculated by AA only.
If available HQs (modeled, measured, tissue) are less than 1,
the EU/Reach/AA/COPC/Receptor is not shown.

Gray shading indicates NOAEL HQ ≤ 1
Green shading indicates NOAEL HQ > 1 and LOAEL HQ ≤ 1
Yellow shadng indicates LOAEL HQ > 1
Orange shading indicates LOAEL HQ > 10

AA: assessment area
COPC: constituent of potential concern
CTC: critical tissue concentration
EU: exposure unit
HQ: hazard quotient
LAA: lower assessment area
LOAEL: lowest observed adverse effect level
MAA: middle assessment area
NOAEL: no observed adverse effect level
TRV: toxicity threshold value
UAA: upper assessment area

Table 6-22. Percentage of Methylmercury in Various Prey Species
Anniston PCB Site, Anniston, Alabama

Prey Group	Approximate Trophic Level	% MeHg	Source
Terrestrial Plants	1	3	Newman et al. (2011) Average of honeysuckle, violet and grass.
Grasshoppers	1.3	41	Newman et al. (2011) Average of caterpillar & ladybug.
Earthworms	1.6	6	Newman et al. (2011) and Rieder et al. (2011)
Wolf Spiders	3.1	55	Average Edmonds et al. (2012) & Newman et al. (2011)
Frogs	2.9	28	Edmonds et al. (2012) Bank et al. (2007) Edwards et al. (2014) Chumchal et al. (2011)
Snakes	3.2	85	Bergeron et al. (2007) & Chumchal et al. (2011)
Shrews	2.4	96	Newman et al. (2011) value for short-tailed shrew muscle
Cotton Mice	2	60	Newman et al. (2011) value for deer mice
Pine Voles	2.1	52	Newman et al. (2011) value for pine vole
Aquatic Plants	1	2	Newman et al. (2011) value for periphyton; Tom et al. (2010)
Dragonfly/Damselfly	2.2	86	Edmonds et al. (2012)
Cranefly	2.8	68	Edmonds et al. (2012)
Benthic Invertebrates	2.8	84	Chumchal et al. (2011)
Lumbriculus variagatus	3	6	Rieder et al. (2011)
Mollusks	3.3	32	Tom et al. (2010)
Crayfish	2.9	70	Chumchal et al. (2011)
Forage Fish	4.1	90	Chumchal et al. (2011); Tom et al. (2010) value for bluegill sunfish & longnose dance
Bottom Fish	4.2	90	Tom et al. (2010) Bluntnose minnow, fallfish & white sucker
Piscivorous Fish	4.8	90	Tom et al. (2010) value for smallmouth bass

Notes:
Table reproduced from USEPA (2016) Directed Comment Table 3.
MeHg: methylmercury

References:

Bank, M.S., Crocker, J. Connery, B., and A. Amirbahman. 2007. Mercury bioaccumulation in green frog (*Rana clamitans*) and bullfrog (*Rana catesbeiana*) tadpoles from Acadia National Park Maine, USA. Environ. Tox. Chem. 26(1): 118-125.

Bergeron, C. M., Husak, J. F., Unrine, J. M., Romanek, C. S. and Hopkins, W. A. (2007), Influence of feeding ecology on blood mercury concentrations in four species of turtles. Environ. Tox. Chem. 26: 1733–1741. doi:10.1897/06-594R.1

Chumchal, M.M., Rainwater, T.R., Osborn, S.C., Roberts, A.P., Abel, M.T., Cobb, G.P., Smith, P.N., and F.C. Bailey. 2011. Mercury speciation and biomagnification in the food web of Caddo Lake, Texas and Louisiana, USA, A subtropical freshwater ecosystem. Environ. Tox. Chem. 30:1-10.

Edmonds, S.T., O'Driscoll, N.J., Hillier, N.K., Atwood, J.L., and D.C. Evers. 2012. Factors regulating the bioavailability of methylmercury to breeding rusty blackbirds in northeastern wetlands. Environ. Pollut. 171: 148-154.

Edwards, P. G., et al. (2014). "Trophic dynamics of U, Ni, Hg and other contaminants of potential concern on the Department of Energy's Savannah River Site." Environ. Monitor. Assess. 186: 481-500

Newman, M.C., Xu, X, Condon, A. and L. Liang. 2011. Floodplain methylmercury biomagnification factor higher than that of contiguous river (South River, Virginia USA). Environ. Pollut. 159: 2840-2844.

Rieder, S.R., Brunner, I., Horvat, M., Jacobs, A., and B. Frey. 2011. Accumulation of mercury and methylmercury by mushrooms and earthworms from forest soils. Environ. Pollut. 159: 2861-2869.

Tom, K.R., Newman, M.C., and J. Schmerfeld. 2010. Modeling mercury biomagnification (South River, Virginia, USA) to inform river management decision making. Environ. Tox. Chem. 29(4): 1013-1020.

Table 6-23. Mercury Risk Calculations for Carolina Wren Based on Measured Tissue and Dietary Toxicity Reference Values for Terrestrial Receptors

Anniston PCB Site, Anniston, Alabama

Terrestrial Receptors	COPC	Total Mercury Soil EPC (mg/kg) (Assumed 50% MeHg) [3]	Percent Diet (%)					Measured Tissue [4] (mg/kg dry weight)				Body Weight (kg)	Intake Estimates (kg dw/kg-day)		Dose From Dietary Components (mg/kg-day)					Total Dose (mg/kg-day)	Toxicity Reference Values [5] (mg/kg-day)			Hazard Quotients	
			Terrestrial Plants	Terrestrial Insects	Worms	Terrestrial Spiders / Detritivores	Soil	Terrestrial Plants (3% MeHg)	Terrestrial Insects (41% MeHg)	Worms (6% MeHg)	Terrestrial Spiders / Detritivores (55% MeHg)	Body Weight (kg)	Food Ingestion Rate	Soil Ingestion Rate	Terrestrial Plants	Terrestrial Insects	Worms	Terrestrial Spiders / Detritivores	Soil	Soil + Prey	NOAEL TRV	LOAEL TRV	TRV Basis	NOAEL HQ (excluding water)	LOAEL HQ (excluding water)
Carolina Wren -1 [1]	**Total Mercury**	**1.42E+00**	9.00E-02	4.50E-01	1.50E-01	3.10E-01	1.40E-01	5.98E-02	3.77E-02	5.58E+00	5.58E+00	2.00E-02	2.44E-01	3.41E-02	1.31E-03	4.13E-03	2.04E-01	4.22E-01	4.86E-02	6.80E-01	2.27E-02	6.80E-02	MeHg	**3E+01**	**1E+01**
Carolina Wren -1 [2]	**Methyl Mercury**	**7.12E-01**	9.00E-02	4.50E-01	1.50E-01	3.10E-01	1.40E-01	1.79E-03	1.55E-02	3.35E-01	3.07E+00	2.00E-02	2.44E-01	3.41E-02	3.94E-05	1.70E-03	1.22E-02	2.32E-01	2.43E-02	2.70E-01	2.27E-02	6.80E-02	MeHg	**1E+01**	**4E+00**
	Inorganic Mercury	**7.12E-01**	9.00E-02	4.50E-01	1.50E-01	3.10E-01	1.40E-01	5.80E-02	2.22E-02	5.25E+00	2.51E+00	2.00E-02	2.44E-01	3.41E-02	1.27E-03	2.44E-03	1.92E-01	1.90E-01	2.43E-02	4.10E-01	4.50E-01	9.00E-01	inorganic	9E-01	5E-01
	Total Mercury																							**1E+01**	**4E+00**

Notes:

1. Methylmercury Scenario: HQ estimates for total mercury calculated in the OU-4 BERA assuming 100% methylmercury.
2. Speciated Scenario: HQs estimated assuming a fraction of mercury in soil and prey tissue is inorganic mercury. Methylmercury HQ and inorganic mercury HQ summed to calculated total mercury HQ.
3. Soil conservatively assumed to contain 50% methylmercury and 50% inorganic mercury.
4. The fraction of mercury present in prey tissue was taken from Table 6-22.
5. The methylmercury TRVs are based on data from Spalding et al. (2000) and were used to evalaute total mercury in the OU-4 BERA.
   The inorganic mercury TRVs are from Hill and Shaffner (1976), as cited in Sample et al. (1998)

BERA: baseline ecological risk assessment
COPC: constituent of potential concern
dw: dry weight
EPC: exposure point concentration
HQ: hazard quotient
kg: kilogram
LOAEL: low observed adverse effect level
MeHg: methylmercury
mg/kg: milligram per kilogram
NOAEL: no-observed-adverse-effect-level
OU-4: Operable Unit 4
TRV: toxicity reference value

Table 6-24. Summary of Potential Risks to Lower Trophic Receptors from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Population Risk	Confidence in Risk Prediction	Basis
Aquatic Plants/Aquatic Life					
Compare surface water EPC to Alabama and/or National Water Quality Standards	C1, LAA	High	Moderate	Moderate/ Low	- Use of conservative Alabama water quality standards. - Considered to be adequately and sufficiently protective of aquatic life (including aquatic plants). - EPC exceeds chronic criteria but not acute.
	UAA, MAA	Moderate			
Compare surface water EPC to plant-specific benchmarks	UAA, MAA, LAA	Negligible	Moderate	**Moderate/ Low**	- Benchmark is receptor-specific. - Benchmark is literature-based and confidence is moderate.
	C1	Moderate			
Terrestrial Plants					
Compare Soil EPCs to plant benchmark	C1 East and C2 (all EUs) through C9 (all EUs)	Negligible	Moderate	**Low**	- Conservative literature-based benchmarks based on laboratory tests. The applicability of this benchmark is highly uncertain.
	C1 West	Moderate	High	**Low**	- C1 West EPC based on the maximum detected concentration.
Terrestrial Plant Community Evaluation	UAA, MAA, LAA	No impairment indicated	NA	Low	- Based on site-specific observations. - Evaluation indicated no upstream to downstream trend. - Overall, the results suggest no adverse effect of PCBs or other COPCs on the terrestrial plant community.

Table 6-24. Summary of Potential Risks to Lower Trophic Receptors from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Population Risk	Confidence in Risk Prediction	Basis
Benthic Invertebrates/Aquatic Invertebrates					
Compare individual sediment samples to site-specific dry weight reproduction-based toxicity thresholds[1]	C4, C5, C6, C9 and C10	Negligible	Moderate	**Moderate/ High**	- EC values based on site-specific toxicity tests. - Impacts on population from reproductive endpoints could impact population - high uncertainty in results due to high control variability in test
	C3	Low			
	C7	Moderate			
	C1 and C2	Moderate to High			
Compare individual sediment samples to dry weight site-specific survival-based toxicity thresholds[1]	All reaches	Negligible	Low	**Moderate/ High**	- EC values based on site-specific toxicity tests. - Survival endpoints are directly related to population sustainability.
Compare individual sediment samples to consensus-based toxicity benchmarks[2]	C9	Low	High	Low	Uncertainties associated with derivation of these benchmarks: - do not reflect contaminant-specific response thresholds. - do not account for site-specific factors that could influence bioavailability.
	C1 through C8, and C10	Moderate/High			
Compare measured site tissue concentrations to CTCs	UAA, MAA, LAA	Negligible	Moderate	Moderate	- CTCs are based on relatively small toxicity datasets and results in some cases had high variability - values are species-specific - low end selected when multiple values
Benthic Invertebrate Community Evaluation	UAA, MAA, LAA	No impairment indicated	NA	Moderate	- Based on 158 site-specific observations. - Evaluation indicated some differences in abundance, taxa richness, and diversity, they were not considered significant. - Overall, the results suggest no adverse effect of PCBs or other COPCs on benthic invertebrate community.
Compare surface water EPC to Alabama and/or National Water Quality Standards (applies to aquatic invertebrates rather than benthic invertebrates specifically)	C1, LAA	High	Moderate	Low	- Use of conservative Alabama water quality standards. - Considered to be adequately and sufficiently protective of aquatic life. - EPC exceeds chronic criteria but not acute. - WQS not derived for protection of benthic species.
	UAA, MAA	Moderate			
Compare surface water EPC to aquatic invertebrate-specific benchmarks (applies to aquatic invertebrates rather than benthic invertebrates specifically)	C1, UAA, MAA, LAA	Negligible	Moderate	Low	- Benchmark is not receptor-specific. - Benchmark is literature-based and confidence is moderate.

Table 6-24. Summary of Potential Risks to Lower Trophic Receptors from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Population Risk	Confidence in Risk Prediction	Basis
Terrestrial Invertebrates					
Compare Soil EPCs to terrestrial invertebrate benchmark	C1 East and C2 (all EUs) through C9 (all EUs)	Low to Negligible	High	Low	- Conservative literature-based benchmarks based on laboratory tests. The applicability of this benchmark is highly uncertain. - C1 West EPC based on the maximum detected concentration.
	C1 West	Moderate			
Compare Earthworm tissue EPCs to worm-based CTCs	UAA, MAA, LAA	Negligible	Moderate	**Moderate**	- CTCs are based on relatively small toxicity datasets and results in some cases had high variability - low end selected when multiple values
Compare Site and reference invertebrate communities	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations - Evaluation indicated that mean abundance, taxa diversity, and taxa dominance did not significantly differ by location (P>0.05). Taxa richness is significantly higher in the Site than in the reference area.

Table 6-24. Summary of Potential Risks to Lower Trophic Receptors from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Population Risk	Confidence in Risk Prediction	Basis
Fish/Aquatic Life					
Compare surface water EPC to Alabama Water Quality Standards	C1, UAA, MAA, LAA	High	Moderate	Moderate	- Use of conservative Alabama water quality standards. - Considered to be adequately and sufficiently protective of aquatic life (including fish). - EPC exceeds chronic criteria but not acute.
Compare surface water EPCs to fish-specific benchmarks	C1, UAA, MAA, LAA	Negligible	Moderate	Moderate	- Benchmark is receptor-specific. - Benchmark is literature-based and confidence is moderate.
Compare fish tissue EPCs to fish-based CTCs	Predator - all; bottom, UAA and LAA	Moderate	Moderate	**Moderate**	- Modeled tissue concentrations using on site-specific BAFs; BAFs shown to be good predictors of the central tendency of the measured concentrations. - Toxicity values are very conservative and based on whole body concentrations in sheepshead minnows (ecologically relevant species).
	Bottom - MAA; Forage - All	Low			
Compare Site and reference fish communities	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations. - Abundance and species richness did not significantly differ by location. - Overall, the results suggest no adverse effect of PCBs or other COPCs on the fish community.

Notes:

[1]Toxicity thresholds include EC0*, EC10*, EC20* for reproduction. Risk was considered negligible when 80% of samples or greater indicated negligible risk. For the low, moderate and high risk, categories assigned based on the largest percent in a particular category. Result category shown is when approximately 20% (or greater) of samples in a reach fell into a particular risk category. The complete endpoint-specific results are shown in Table 6-4a and Figure 6-1.

[2] Reach category reflects when greater than 20 percent of samples fall into the specified category.

For TEC and PEC comparisons, < TEC = negligible; between TEC and PEC = low; greater than PEC = high

Line of evidence with the relatively highest level of confidence in predicting potential risk for the receptor populations is in **bold.**

BAF: bioaccumulation factor
COPC: constituent of potential concern
CTC: critical tissue concentration
EPC: exposure point concentration
EU: exposure unit
LAA: lower assessment area
MAA: middle assessment area
NA: not applicable
OU-4: Operable Unit-4
P-value indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PEC: probable effects concentration
TEC: threshold effect concentration
UAA: upper assessment area

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
AQUATIC BIRDS					
All Aquatic Birds					
Community Metric: Compare OU-4 and reference community data and/or comparison among OU-4 assessment areas	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations. - Mean bird abundance, richness, diversity, and dominance did not differ significantly among reaches. - Overall, the results suggest no effect of PCBs or other COPCs on the aquatic bird community. - High uncertainty with findings due to low sample size and lack of co-located COPC concentration data.
Reference Comparison: Compare OU-4 and reference sediment and prey tissues and/or comparison among OU-4 assessment areas	OU-4	Site elevated compared to reference conditions in all assessment areas	NA	NA	This LOE indicates potential for exposure but does not speak to estimated risk.
Piscivores (belted kingfisher, great blue heron, and osprey)					
HQ: Modeled diet - high-sensitivity TRV	C6 and C9	Moderate	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled fish tissue using BAFs for which no significant relationship found between sediment and tissue given lower weight than dose based on measured fish tissue.
	C1 through C5, C7, C8, and C10	High			
HQ: Measured diet - high-sensitivity TRVs	All Reaches	High	High	Low/Moderate	
HQ: Modeled diet - mid-sensitivity TRV	C6	Negligible	Moderate	Moderate	
	C9	Low			
	C3, C4, C5, C7, C8, and C10	Moderate			
	C1 and C2	High			
HQ: Measured diet - mid-sensitivity TRVs	All Reaches	Moderate	Moderate	**Moderate/High**	
HQ: Modeled egg - high-sensitivity egg TRVs	C6 and C9	Moderate	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C1 through C5, C7, C8, and C10	High			
HQ: Modeled egg - mid-sensitivity egg TRVs	C3 and C5 through C10	Negligible	Moderate	Low	
	C4	Low			
	C1 and C2	Moderate			

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
Aquatic Insectivores (spotted sandpiper-2)					
HQ: Modeled diet - high-sensitivity TRV	All Reaches	High	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled tissue (i.e.,50% lumbriculus from lab study) and 50% filed BAF for which no significant relationship found between sediment and invertebrate tissue) given equal weight to dose based on all measured tissue. - Good relationship between lumbriculus and sediment identified; model applied across full range of OU-4 concentrations. - Uncertainty with extrapolation from lab to field conditions - Uncertainty with representativeness of field collected invertebrates to full range of possible prey species.
HQ: Measured diet - high-sensitivity TRVs	All Reaches	Moderate	High	Low/Moderate	
HQ: Modeled diet - mid-sensitivity TRV	C6	Low	Moderate	Moderate/High	
	C3, C4, C5, C7, C8, C9, and C10	Moderate			
	C1 and C2	High			
HQ: Measured diet - mid-sensitivity TRVs	C3 through C10	Negligible	Moderate	**Moderate/High**	
	C1 and C2	Low			
HQ: Modeled egg - high-sensitivity egg TRVs	C1 through C10	Negligible	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 through C10	Negligible	Moderate	Low	
Aerial Invertivores (tree swallow)					
HQ: Modeled diet - high-sensitivity TRV	C6 and C9	Negligible	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled emergent insect tissue using BAFs for which no significant relationship found between sediment and tissue given lower weight than dose based on measured prey tissue.
	C5, C7, C8, and C10	Low			
	C1 through C4	High			
HQ: Measured diet - high-sensitivity TRVs	C5, C6	Low	Moderate	Low/Moderate	
	C7 through C10	Moderate			
	C1 through C4	High			
HQ: Modeled diet - mid-sensitivity TRV	C5 through C10	Negligible	High	Moderate	
	C3 and C4	Moderate			
	C1 and C2	High			
HQ: Measured diet - mid-sensitivity TRVs	C5 through C10	Negligible	Moderate	**Moderate**	
	C1 through C4	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C1 through C10	Negligible	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 through C10	Negligible	Moderate	Low	

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
TERRESTRIAL BIRDS					
All Terrestrial Birds					
Community Metric: Compare OU-4 and reference community data and/or comparison among OU-4 assessment areas	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations. - Mean abundance and species richness were significantly higher in the Site than reference area. - Diversity and dominance did not significantly differ by location (P>0.05). - Overall, the results suggest no effect of PCBs or other COPCs on the terrestrial bird community. - High uncertainty with findings due to low sample size and lack of co-located COPC concentration data.
Reference Comparison: Compare OU-4 and reference sediment and prey tissues and/or comparison among OU-4 assessment areas	OU-4	Site elevated compared to reference conditions in all assessment areas	NA	NA	This LOE indicates potential for exposure but does not speak to estimated risk.
Herbivores (mourning dove)					
HQ: Modeled diet - high-sensitivity TRV	C2 South, C9 South	Negligible	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled plant tissue using BAFs for which no significant relationship found between soil and tissue given lower weight than dose based on measured prey tissue. - C1 West soil EPC based on the maximum detected concentration - this EPC is given lower weight than UCL-based EPCs.
	C2 Central, C5 North and South, C6 North, C7 North and South, C8 North and South and C9 North	Low			
	C1 East, C2 North, C3 North and C4 North and South, C6 South	Moderate			
	C1 West, C3 South	High			
HQ: Measured diet - high-sensitivity TRVs	C2 South and Central, C5 North and South, C6 North, C7 North and South, C8 North and South, and C9 North and South	Negligible	High	Low/Moderate	
	C2 North, C4 South,C6 South	Low			
	C1 East, C3 North and South, and C4 North	Moderate			
	C1 West	High			
HQ: Modeled diet - mid-sensitivity TRV	C2 (all EUs), C4 South through C9 (all EUs)	Negligible	Moderate	Moderate	
	C1 East, C3 North, C4 North	Low			
	C3 (South)	Moderate			
	C1 West	High		Low/Moderate	
HQ: Measured diet - mid-sensitivity TRVs	All EUs except C1 West	Negligible	Moderate	**Moderate/High**	
	C1 West	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C1 (East), C2 (all EUs) through C9 (all EUs)	Negligible	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C1 West	Moderate		Low	
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 (all EUs) through C9 (all EUs)	Negligible	Moderate	Low	

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
Terrestrial Insectivores/Invertivores (Carolina wren-1)					
HQ: Modeled diet - high-sensitivity TRV	C2 South, C9 South	Low	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled tissue given lower weight than dose based on measured prey tissue. Modeled tissue based over 50% on BAFs for which no significant relationship found between soil and tissue (i.e., 45% grasshoppers and 9% plants) and 31% on terrestrial spiders for which earthworms used as surrogate for estimate.
	C2 Central, C5 North and South, C6 North, C7 North and South, C8 North and South and C9 North	Moderate			
	C1 East and West, C2 North, C3 North and South, C4 North and South, C6 South	High			
HQ: Measured diet - high-sensitivity TRVs	C5 through C9 (all EUs)	Moderate	High	Low/Moderate	
	C1 through C4 (all EUs)	High			
HQ: Modeled diet - mid-sensitivity TRV	C2 South, C5 North, C7 North, C9 South	Negligible	Moderate	Moderate	
	C2 Central, C5 South, C6 North and South, C7 South, C8 North and South, C9	Low			
	C1 East, C2 North, C3 North, C4 North and South	Moderate			
	C1 West, C3 South	High			
HQ: Measured diet - mid-sensitivity TRVs	C5 through C9 (all EUs)	Negligible	Moderate	**Moderate**	
	C1 through C4 (all EUs)	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C1 East and C2 (all EUs) through C9 (all EUs)	Negligible	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C1 West	Moderate			
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 (all EUs) through C9 (all EUs)	Negligible	Moderate	Low	

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
Terrestrial Omnivores (blue jay)					
HQ: Modeled diet - high-sensitivity TRV	C9 South	Negligible	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled tissue given lower weight than dose based on measured prey tissue. Modeled tissue based over 78% on BAFs for plants which no significant relationship found between soil and tissue.
	C2 South, C5 North, C7 North	Low			
	C2 North and Central, C4 South, C5 South, C6 North and South, C7 South, C8 North and South, C9 North	Moderate			
	C1 East and West, C3 North and South, C4 North	High			
HQ: Measured diet - high-sensitivity TRVs	C5 through C9 (all EUs)	Low	High	Low/Moderate	
	C1 East, C2 (all EUs), C3 North, C4 North and South	Moderate			
	C1 West, C3 South	High			
HQ: Modeled diet - mid-sensitivity TRV	C2 South and Central, C5 through C9 (all EUs)	Negligible	Moderate	Moderate	
	C1 East, C2 North, C4 North and South	Low			
	C1 West, C3 North and South	Moderate			
	C1 West	High			
HQ: Measured diet - mid-sensitivity TRVs	C5 - C9 (All EUs)	Negligible	Moderate	**Moderate/High**	
	C1 East, C2 (All EUs), C3 North and South, C4 North and South	Low			
	C1 West	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C1 East and C2 (all EUs) through C9 (all EUs)	Negligible	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C1 West	Negligible			
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 through C9 (all EUs)	Negligible	Moderate	Low	

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
Carnivores (red-tailed hawk)					
HQ: Modeled diet - high-sensitivity TRV	C9 South	Low	High	Low/Moderate	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based modeled tissue given higher weight than dose based on measured prey tissue. Hawk diet assumed to contain 87% small mammal tissue. Modeled small mammal tissue based regression for which a statistically significant relationship between site-specific soil and tissue was identified. - Modeled tissue provides greater coverage for risk estimates across OU-4.
	C5 through C8 (all EUs), C9 North	Moderate			
	C1 through C4 (all EUs)	High			
HQ: Measured diet - high-sensitivity TRVs	C1 through C9 (all EUs)	High	High	Low/Moderate	
HQ: Modeled diet - mid-sensitivity TRV	C5 North, C6 through C9 (all EUS)	Negligible	Moderate	**Moderate/High**	
	C3 (all EUs), C5 South	Low			
	C1 East, C2 (all EUs), C4 (all EUs)	Moderate			
	C1 West	High			
HQ: Measured diet - mid-sensitivity TRVs	C7 through C9 (all EUs)	Low	Moderate	Moderate	
	C1 through C6 (all EUs)	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C2 South and Central, C3 (all EUs) through C8 (all EUs)	Moderate	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C1 (all EUs) and C2 North	High			
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 East, C2 (all EUs) through C9 (all EUs)	Negligible	High	Low	
	C1 West	Low		Low	- EPC based on the maximum detected concentration.

Table 6-25. Summary of Potential Risks to Birds from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential	Confidence in Risk Prediction	Basis
BIRDS WITH MIXED AQUATIC AND TERRESTRIAL DIET					
Mixed Diet Omnivores (Carolina wren-2, spotted sandpiper - 1)					
HQ: Modeled diet - high-sensitivity TRV	C9 South	Low	High	Low	- High sensitivity TRVs based on chicken data, not ecologically relevant. Results given lower weight than mid sensitivity TRV results. - Mid sensitivity TRVs based on mourning doves, ecologically relevant species. - Dose based on modeled tissue given lower weight than dose based on measured prey tissue. Modeled tissue based over 50% on BAFs for which no significant relationship found between soil and tissue (i.e., 45% grasshoppers and 9% plants) and 31% on aquatic spiders for which earthworms used as surrogate for estimate.
	C5 through C8 (all EUs), C9 North	Moderate			
	C1 East and West, C2 (all EUs), C3 and C4 North and South	High			
HQ: Measured diet - high-sensitivity TRVs	C5 through C9 (all EUs)	Moderate	High	Low	
	C1 through C4 (all EUs)	High			
HQ: Modeled diet - mid-sensitivity TRV	C5 through C7 (all EUs), C8 South, C9 North and South	Negligible	Moderate	Low	
	C8 North	Low			
	C1 East, C2 through C4 (all EUs)	Moderate			
	C1 West	High			
HQ: Measured diet - mid-sensitivity TRVs	C5 through C9 (all EUs)	Negligible	Moderate	**Low/Moderate**	
	C1 through C4 (all EUs)	Moderate			
HQ: Modeled egg - high-sensitivity egg TRVs	C9 (all EUs)	Low	High	Low	- Egg tissue concentrations were estimated using transfer coefficient factors and not measured. Egg-based HQs given lower weight than dietary HQs. - High sensitivity TRVs based on chicken data, not ecologically relevant. - Mid sensitivity TRVs based on kestrels and mallards, ecologically relevant species.
	C2 South and Central, C3 (all EUs) through C8 (all EUs)	Moderate			
	C1 (all EUs) and C2 North	High			
HQ: Modeled egg - mid-sensitivity egg TRVs	C1 East, C2 (all EUs) through C9 (all EUs)	Negligible	High	Low	
	C1 West	Low		Low	- EPC based on the maximum detected concentration.

Notes:
Weight of evidence presented for receptor within each feeding guild that had highest predicted risk. (Receptors noted in blue)
Line of evidence with the relatively highest level of confidence in predicting potential risk for the receptor populations is in **bold**.
BAF: bioaccumulation factor
COPC: constituent of potential concern
EPC: exposure point concentration
EU: exposure unit
HQ: hazard quotient
LOE: Line of evidence
NA: not applicable
OU-4: Operable Unit 4
P-value indicates statistical significance at a selected probability, in this case 95% (or $P < 0.05$)
PCBs: polychlorinated biphenyls
TRVs: toxicity reference values

Table 6-26. Summary of Potential Risks to Mammals from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Risk	Confidence in Risk Prediction	Basis
AQUATIC MAMMALS					
All Aquatic Mammals					
Compare Site and Reference community data and/or comparison among OU-4 assessment areas	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations. - Mean mammal richness, diversity, and dominance did not differ significantly among reaches. - Abundance was significantly lower in the MAA than in UAA and LAA. - Overall, the results suggest no effect of PCBs or other COPCs on the aquatic mammal community. - High uncertainty with findings due to low sample size and lack of co-located COPC concentration data.
Reference Comparison: Compare OU-4 and reference sediment and prey tissues and/or comparison among OU-4 assessment areas	OU-4	Site elevated compared to reference conditions in all assessment areas	NA	NA	This LOE indicates potential for exposure but does not speak to estimated risk.
Piscivores (mink and river otter)					
HQ: Modeled diet - growth-based mink TRV	C6 and C9	Moderate	High	Low/Moderate	- TRVs based on mink, uncertain as study based on co-contaminated compounds and considered artificially low. - Reproduction TRV given higher weight for potential population-level effects than growth TRV - Dose based on modeled fish tissue using BAFs for which no significant relationship found between sediment and tissue given lower weight than dose based on measured fish tissue - Habitat suitability is limited, this species and other piscivorous mammals not directly observed onsite, but evidence of mink and river otter was observed.
	C1 through C5, C7, C8, C10	High			
HQ: Measured diet - growth-based mink TRV	All Reaches	High	High	Low/Moderate	
HQ: Modeled diet - reproduction-based mink TRV	C5 through C7, C9 and C10	Moderate	Moderate	Moderate	
	C1 thorough C4	High			
HQ: Measured diet - reproduction-based mink TRV	All Reaches	High	Moderate	**Moderate/High**	
Aerial Invertivores (brown bat)					
HQ: Modeled diet - reproduction-based small mammal TRV	C5 through C10	Negligible	Moderate	Moderate	- TRVs considered appropriate for small mammals (based on multigenerational mice studies). - Dose based on modeled emergent insect tissue using BAFs for which no significant relationship found between sediment and tissue given lower weight than dose based on measured prey tissue. - Two special status bat species (Indianan bat and grey bat) may be present in Calhoun County but have not been observed in OU-4.
	C3	Moderate			
	C1, C2, and C4	High			
HQ: Measured diet - reproduction-based small mammal TRV	C5 through C10	Negligible	Moderate	**Moderate/High**	
	C1 through C4	Moderate			

Table 6-26. Summary of Potential Risks to Mammals from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Risk	Confidence in Risk Prediction	Basis
TERRESTRIAL MAMMALS					
All Terrestrial Mammals					
Compare Site and Reference community data	OU-4	No impairment indicated	NA	Low	- Based on site-specific observations. - Mean abundance, species richness, diversity, and dominance did not significantly differ between Site and reference locations. - Overall, the results suggest no effect of PCBs or other COPCs on the aquatic mammal community. High uncertainty with findings due to low sample size and lack of co-located COPC concentration data.
Reference Comparison: Compare OU-4 and reference sediment and prey tissues and/or comparison among OU-4 assessment areas	OU-4	Site elevated compared to reference conditions in all assessment areas	NA	NA	This LOE indicates potential for exposure but does not speak to estimated risk.
Herbivores (white-tailed deer)					
HQ: Modeled diet - reproduction-based small mammal TRV	C1 East and C2 through C9 (all EUs)	Negligible	Moderate	Moderate	- TRVs considered appropriate for small mammals (based on multigenerational mice studies). - Dose based on modeled plant tissue using BAFs for which no significant relationship found between soil and tissue given lower weight than dose based on measured terrestrial plant tissue.
	C1 West	Moderate			
HQ: Measured diet - reproduction-based small mammal TRV	All EUs	Negligible	Moderate	**Moderate/High**	
Terrestrial Insectivores/Invertivores (short-tailed shrew)					
HQ: Modeled diet - reproduction-based small mammal TRV	C2 South, C7 North, and C9 South	Negligible	Moderate	Moderate	- TRVs considered appropriate for small mammals (based on multigenerational mice studies). - Dose based on modeled tissue given lower weight than dose based on measured prey tissue. Modeled tissue based 25% on BAFs for which no significant relationship found between soil and tissue (i.e.,26% grasshoppers) and 26% on terrestrial spiders for which earthworms used as surrogate for estimate. - Tissue-based exposure model given higher weight than dietary models due to uncertainties associated with estimating the prey exposure.
	C2 Central, C5 North and South, C6 North, C7 South, C8 North and South, C9 North	Low			
	C1 East, C2 North, C3 North, C4 North and South, C6 South	Moderate			
	C1 West and C3 South	High			
HQ: Measured diet - reproduction-based small mammal TRV	C5 to C9 (all EUs)	Low	Moderate	Moderate/High	
	C1 to C4 (all EUs)	Moderate			
HQ: Measured tissue - reproduction-based small mammal CTC	All AAs	Negligible	Moderate	**High**	- Measured site-specific tissue is a direct measure of exposure. - TRVs based on multigenerational studies for small mammals.

Table 6-26. Summary of Potential Risks to Mammals from PCBs Weighted by Ecological Relevance and Confidence in the Predicted Risk
Anniston PCB Site, Anniston, Alabama

Line of Evidence	Exposure Unit	Potential Risk	Level of Conservatism/ Potential Overestimation of Risk	Confidence in Risk Prediction	Basis
Carnivores (long-tailed weasel and red fox)					
HQ: Modeled diet - reproduction-based small mammal TRV	C2 (all EUs), C5 through C9 (all EUs)	Negligible	Moderate	**Moderate/High**	'- TRVs considered appropriate for small mammals (based on multigenerational mice studies). - Dose based modeled tissue given higher weight than dose based on measured prey tissue. Weasel diet assumed to contain 100% small mammal tissue. Modeled small mammal tissue based regression for which a statistically significant relationship between site-specific soil and tissue was identified. - Modeled tissue provides greater coverage for risk estimates across OU-4.
	C1 East, C3 and C4 (all EUs)	Low			
	C1 West	Moderate		**Moderate/High**	
HQ: Measured diet - reproduction-based small mammal TRV	C1 through C9 (all EUs)	Low	Moderate	Moderate	
MAMMALS WITH MIXED AQUATIC AND TERRESTRIAL DIET					
Mixed Diet Omnivores exposed to riparian soil and sediment (raccoon-2 and mink-1)					
HQ: Modeled diet - reproduction-based small mammal TRV	C5 through C10 Riparian and Floodplain EUs	Negligible	Moderate	Moderate	- TRVs considered appropriate for small mammals (based on multigenerational mice studies). - Dose based on modeled tissue using BAFs for which no significant relationship found between soil/sediment and tissue given lower weight than dose based on measured tissue.
	C2 and C3 North Floodplain EUs, C4 All EUs; C3 Riparian	Low			
	C1 and C2 Riparian; C1 East and C3 South Floodplain EUs	Moderate			
	C1 West Floodplain EU	High			
HQ: Measured diet - reproduction-based small mammal TRV	C1 through C10 Riparian; C1 through C4 Floodplain EUs	Low	High	**Moderate/High**	
	C5 through C10 Floodplain EUs	Negligible	High	**Moderate/High**	

Notes:
Weight of evidence presented for receptor within each feeding guild that had highest predicted risk. (Receptors noted in blue)
Line of evidence with the relatively highest level of confidence in predicting potential risk for the receptor populations is in **bold**.

BAF: bioaccumulation factor
COPC: constituent of potential concern
EPC: exposure point concentration
EU: exposure unit
LAA: lower assessment area
LOE: line of evidence
MAA: middle assessment area
NA: not applicable
OU-4: Operable Unit 4
P-value indicates statistical significance at a selected probability, in this case 95% (or P < 0.05)
PCBs: polychlorinated biphenyls
TRVs: toxicity reference values
UAA: upper assessment area

Table 7-1. Polychlorinated Biphenyl and Mercury Remedial Goal Options[1] for Benthic Invertebrates
Anniston PCB Site, Anniston Alabama

	Basis	*Chironomus dilutus*		*Hyalella azteca*	
		Reproduction	Survival	Reproduction	Survival
		Remedial Goal Options[2] for Benthic Invertebrates			
PCBs	EC0*	2.0	14	1.4	31
	EC10*	6.8	76	2.6	105
	EC20*	14	123	4.4	152
Mercury	EC0*	0.9	3.6	0.4	2.4
	EC10*	3.0	9.2	0.7	8.1
	EC20*	4.7	13	1.0	11

Notes:

[1]All Values are mg/kg sediment dry weight.

[2]RGOs represent the value for the most sensitive endpoint within each category from site-specific toxicity testing.

EC0*, EC10*, EC20*: the regression-predicted PCB concentrations that would cause an additional 0%, 10%, or 20% effect beyond the lowest response measured in the reference sediments (i.e., 1×, 0.9×, and 0.8× the response at the "bottom" of the reference envelope).

mg/kg: milligram per kilogram

PCB: polychlorinated biphenyl

RGO: remedial goal option

Table 7-2. Summary of Aquatic Remedial Goal Options
Anniston PCB Site, Anniston, Alabama

COPC	Lower Trophic Levels	Based on Dietary TRVs										
		Birds						Mammals				
	Benthic Invertebrates	Tree Swallow	Spotted Sandpiper - 2	Kingfisher - 1	Kingfisher - 2	Great Blue Heron [1]	Osprey	Bat	Mink - 2 [1]	Mink - 2 (Alternative TRV)[2]	Otter	Otter (Alternative TRV)[2]
		Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ	Measured HQ
NOAEL-Based Remedial Goal Options (mg/kg)												
PCB (mid-range sensitivity)	See Table 7-1	1.4	7.6	1.0	1.2	0.6	1.4	0.9	--	--	--	--
PCB (high sensitivity)		0.1	0.7	0.09	0.1	0.06	0.1	--	0.4	--	0.3	--
Barium	NA	1313	221	624	331	964	3426	4431	4699	--	12561	--
Chromium	43	13	35	24	27	45	132	16	76	--	185	--
Cobalt	NA	871	57	19	20	399	1846	1136	65	--	268	--
Lead	36	506	31	169	153	271	2122	1977	2271	--	7288	--
Mercury	0.18	12	0.7	4.0	4.1	2.7	11	53	101	--	67	--
Vanadium	NA	34	5.3	20	20	18	56	552	1006	--	1704	--
LOAEL-Based Remedial Goal Options (mg/kg)												
PCB (mid-range sensitivity)	See Table 7-1	4.2	23	2.9	3.7	1.8	4.3	2.8	--	--	--	--
PCB (high sensitivity)		0.4	2.1	0.3	0.3	0.2	0.4	--	0.8	0.4	0.6	0.3
Barium	NA	2633	443	1251	664	1932	6869	10351	10977	--	29342	--
Chromium	111	14	37	25	29	48	139	19	90	--	218	--
Cobalt	NA	893	58	20	21	408	1893	1550	89	--	366	--
Lead	128	1012	61	338	305	542	4243	3744	4300	--	13801	--
Mercury	1.1	36	2.0	12	12	8.1	34	107	201	--	133	--
Vanadium	NA	69	11	42	40	37	114	1102	2010	--	3404	--

Notes:
[1] This receptor has a small proportion of dietary exposure from soil, however, RGO calculated from sediment dietary dose only.
[2] Alternate LOAEL-based TRVs were selected from Restum et al. (1998) based on growth.
COPC: constituent of potential concern
HQ: hazard quotient
LOAEL: lowest observed adverse effect level
mg/kg: milligram per kilogram
NA: not available
NOAEL: no observed adverse effect level
PCB: polychlorinated biphenyl
RGO: remedial goal option
TRV: toxicity reference value
--": not applicable

Table 7-3. Summary of Terrestrial Remedial Goal Options
Anniston PCB Site, Anniston, Alabama

NOAEL Site-Specific Risk-Based Concentrations (mg/kg)

	Based on Dietary TRVs						
	Birds				Mammals		
Constituent	**Mourning Dove**	**Blue Jay**	**Carolina Wren - 1**	**Hawk [2]**	**Weasel**	**Fox - 1**	**Fox - 2**
	Measured HQ	**Measured HQ**	**Measured HQ**	**Modeled HQ**	**Modeled HQ**	**Modeled HQ**	**Modeled HQ**
NOAEL-based Remedial Goal Options (mg/kg)							
tPCB (mid-range sensitivity)	21	5.1	0.9	7.5	3.0	5.9	7.0
tPCB (high sensitivity)	2.0	0.5	0.09	0.1	--	--	--
Chromium	90	62	22	105	118	202	200
Lead	81	19	3.5	143	563	952	1026
Mercury	0.9	0.3	0.1	4.3	15	20	29
Vanadium	17	12	4	15	222	410	382
LOAEL-based Remedial Goal Options (mg/kg)							
tPCB (mid-range sensitivity)	64	15	2.8	47	20	27	45
tPCB (high sensitivity)	6.0	1.4	0.3	0.8	--	--	--
Chromium	95	65	23	110	139	237	235
Lead	162	38	7	286	1066	1802	1943
Mercury	2.7	1.0	0.2	13	31	41	58
Vanadium	34	24	9	30	443	818	763

Notes:

[1] Unacceptable risk not predicted for terrestrial plants and soil invertebrates; RGOs not calculated.

[2] This receptor has a small proportion of dietary exposure from sediment, however, RGO calculated from soil dietary dose only.

COPC: constituent of potential concern

LOAEL: lowest observed adverse effect level

mg/kg: milligram per kilogram

NOAEL: no observed adverse effect level

tPCB: total polychlorinated biphenyls

TRV: toxicity reference value

--: not applicable

NA: not available

Table 7-4. Summary of Remedial Goal Options
Anniston PCB Site, Anniston Alabama

Constituent	Range of Sediment RGOs (mg/kg dw)			Range of Soil RGOs (mg/kg dw)	
	Benthic Invertebrates	Birds	Mammals [1,2]	Birds	Mammals
NOAEL-Based Remedial Goal Options (mg/kg)					
Total PCB (mid-range sensitivity) [1]	1.4 - 152	0.6 - 7.6	0.9 - 0.9	0.9 - 21	3.0 - 7.0
Total PCB (high sensitivity) [2]	--	0.06 - 0.7	0.3 - 0.4	0.09 - 2.0	--
Mercury	0.4 - 13	0.7 - 12	53 - 101	0.08 - 4.3	15 - 29
Barium	NC	221 - 3426	4431 - 12561	--	--
Chromium	43	13 - 132	16 - 185	22 - 105	118 - 202
Cobalt	NC	19 - 1846	65 - 1136	--	--
Lead	36	31 - 2122	1977 - 7288	3.5 - 143	563 - 1026
Vanadium	NC	5.3 - 56	552 - 1704	4.2 - 17	222 - 410
LOAEL-Based Remedial Goal Options (mg/kg)					
Total PCB (mid-range sensitivity)	1.4 - 152	1.8 - 23	2.8 - 2.8	2.8 - 64	20 - 45
Total PCB (high sensitivity)	--	0.2 - 2.1	0.3 - 0.8	0.3 - 6.0	--
Mercury	0.4 - 13	2.0 - 36	107 - 201	0.2 - 13	31 - 58
Barium	NC	443 - 6869	10351 - 29342	--	--
Chromium	111	14 - 139	19 - 218	23 - 110	139 - 237
Cobalt	NC	20 - 1893	89 - 1550	--	--
Lead	128	61 - 4243	3744 - 13801	7.0 - 286	1066 - 1943
Vanadium	NC	11 - 114	1102 - 3404	8.6 - 34	443 - 818

Notes:

[1]. For aquatic mammals, the PCB RGOs listed in the mid-sensitivity rows are for bat based on the small mammal TRVs.

[2]. For aquatic mammals, the PCB RGOs listed in the high-sensitivity rows are for mink and otter based on the mink reproduction and growth endpoint TRVs.

-- : RGO not calculated; risk not predicted for this receptor group

LOAEL: lowest observed adverse effect level

mg/kg: milligrams per kilogram

mg/kg dw: milligrams per kilogram dry weight

NA: not applicable; constituent not evaluated in soil

NC: toxicity criteria unavailable; value not calculated

NOAEL: no observed adverse effect level

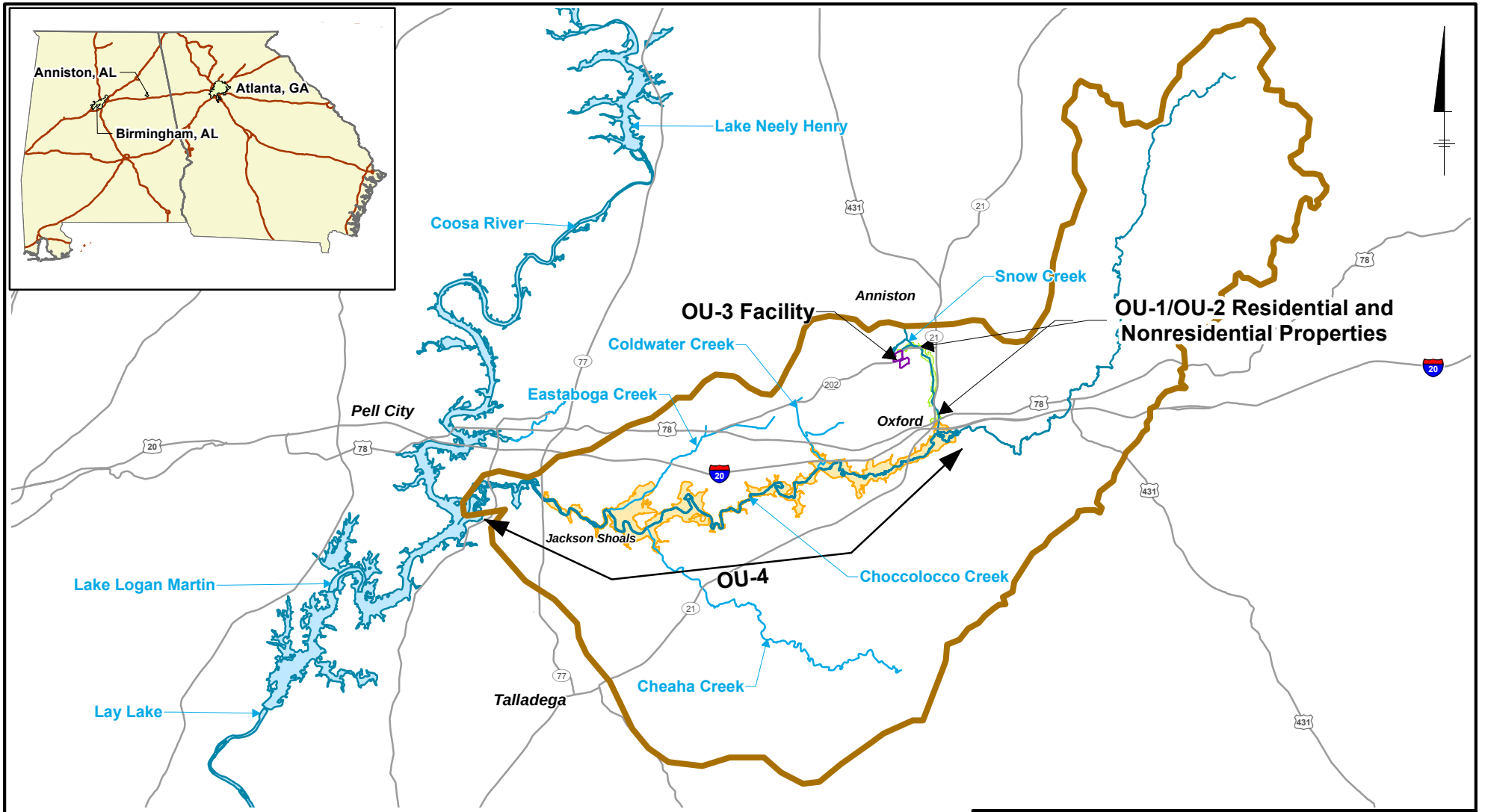
PCB: polychlorinated biphenyl

RGO: remedial goal option

TRV: toxicity reference value

FIGURES

City: SYR Div/Group: SWG Created By: Last Saved By: Kives
Anniston (B0010291.2010.00001)
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\SitePlan.mxd 10/12/2016 9:30:37 AM



Legend

- Approximate Choccolocco Creek Watershed Boundary as Delineated in Basins 2.0
- OU-4 100-Year Floodplain
- OU-1/OU-2 Downgradient Floodplain
- OU-3 Boundary

Acronym:
OU: operable unit

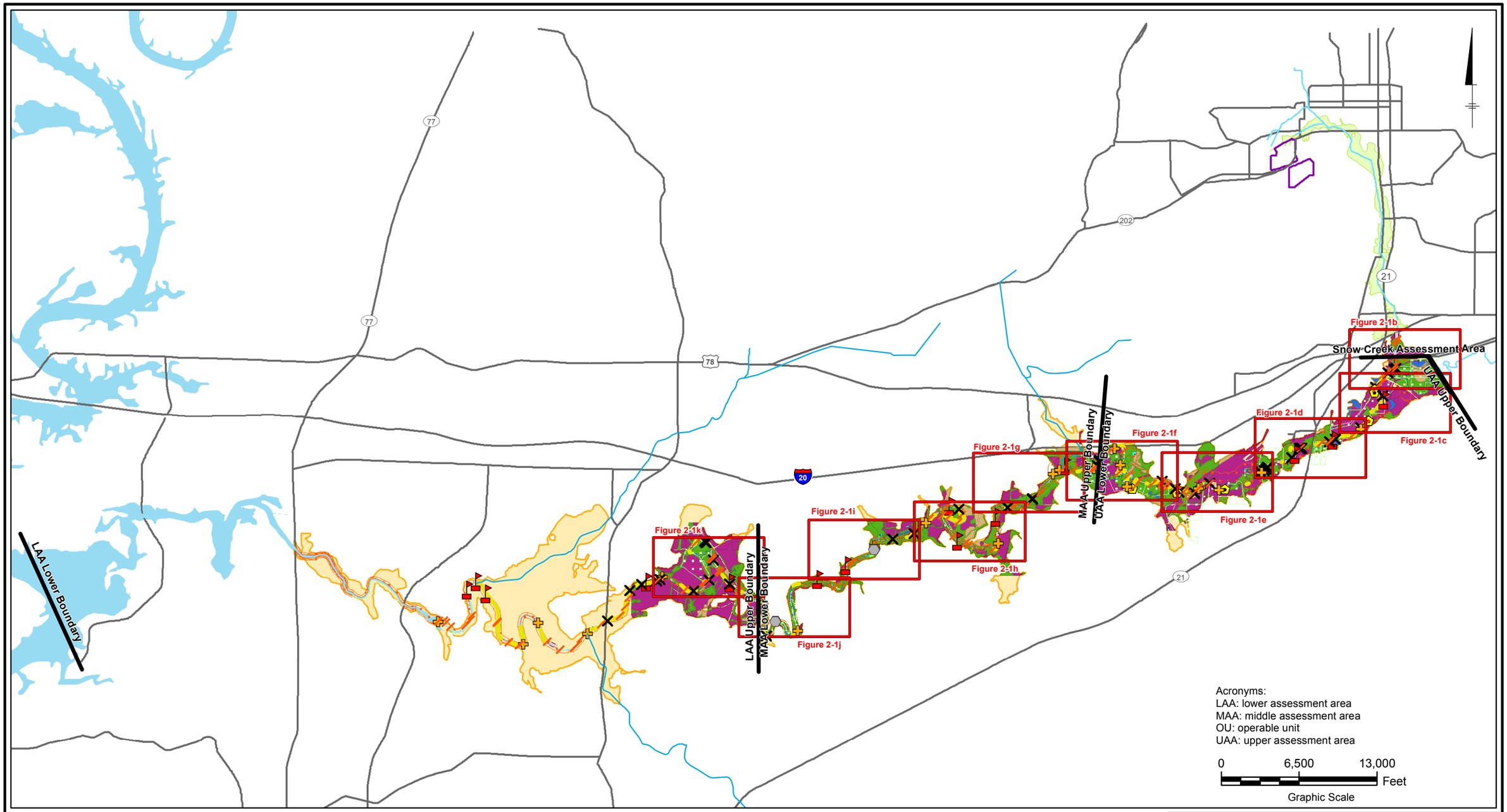
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Site Location Map

Solutia

Figure
1-1



Legend

- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Bank Erosion
- Open Area
- Major Road
- OU-1/OU-2 (Snow Creek) Downgradient Floodplain
- OU-4 100-Year Floodplain
- OU-3 Boundary
- Choccolocco Creek
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle
- Open Water
- Forested Floodplain
- Maintained Field
- Successional Field
- Wetland
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Key for Floodplain and Riparian Habitat Figures

Solutia

Figure
2-1a

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALLMXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_KeyMap_CC.mxd 10/18/2016 5:25:33 PM

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.
2. Wildlife includes mammals, birds, reptiles and amphibians.

Acronyms:
BW: backwater
CH: Choccolocco Creek
EAV: emergent aquatic vegetation
FF: forested floodplain
OU: operable unit
R: run
SF: successional field
SN: Snow Creek
UAA: upper assessment area

0 600 1,200 Feet
Graphic Scale

Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- 2010 Sediment Toxicity Collection Location
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey
- Open Water
- Wetland

- Forested Floodplain
  - A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
  - B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
  - C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
  - D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.
- Successional Field
  - Early - Herbacous plants dominant with little or no scrub/shrub layer.
  - Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.
- Maintained Field
  - A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
  - B. Dominant land use is for agriculture/silverculture/hay; no grazing.
  - C. Dominant land use is for grazing by livestock or horses.
- –26– River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

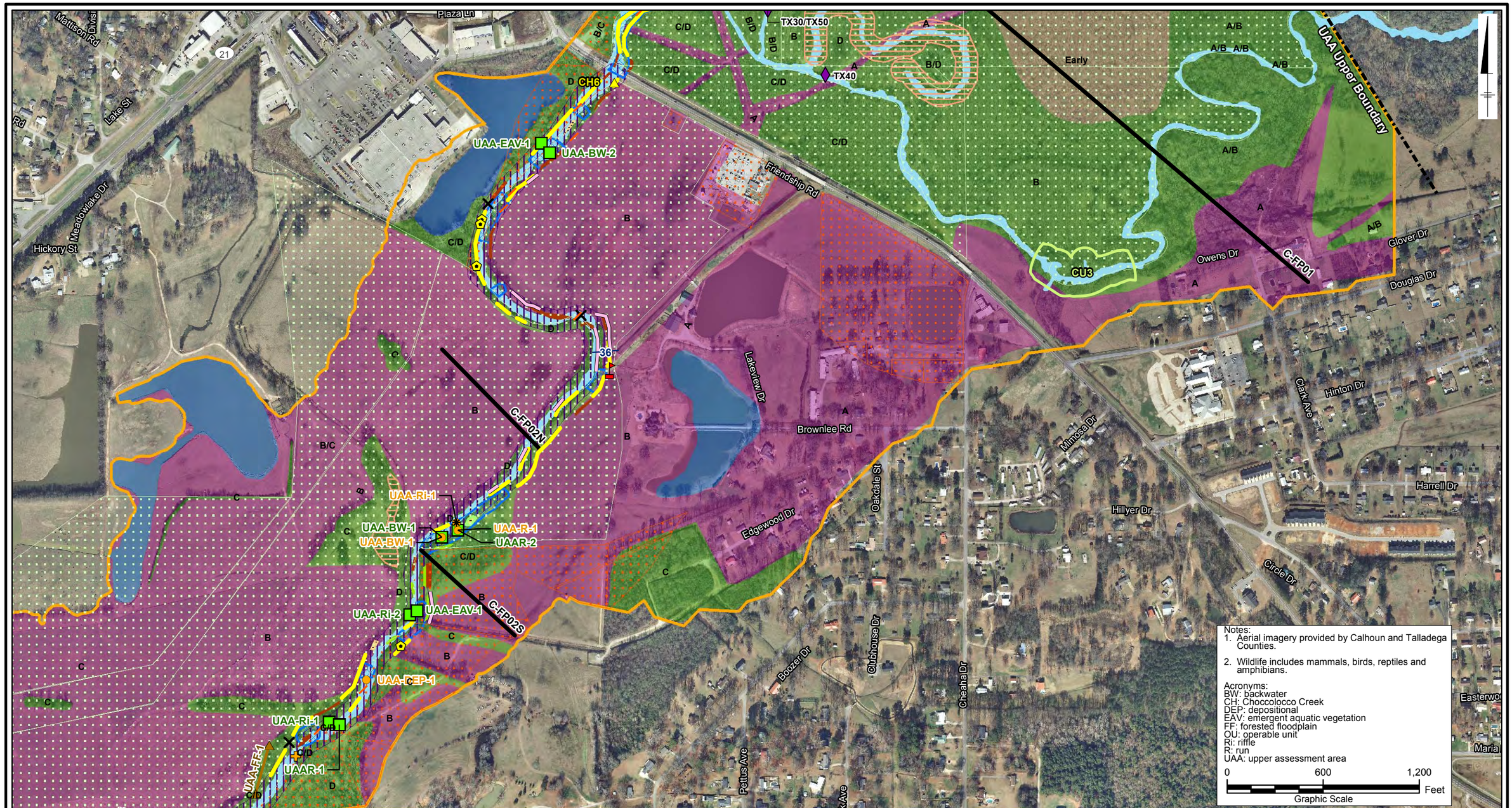
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure **2-1b**

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map1_CC.mxd 9/13/2016 1:43:30 PM



Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.
2. Wildlife includes mammals, birds, reptiles and amphibians.

Acronyms:
BW: backwater
CH: Choccolocco Creek
DEP: depositional
EAV: emergent aquatic vegetation
FF: forested floodplain
OU: operable unit
Ri: riffle
R: run
UAA: upper assessment area

0 600 1,200 Feet
Graphic Scale

Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- 2010 Sediment Toxicity Collection Location
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey
- Open Water
- Wetland

Forested Floodplain
- A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
- B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
- C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
- D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field
- Early - Herbacous plants dominant with little or no scrub/shrub layer.
- Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

Maintained Field
- A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
- B. Dominant land use is for agriculture/silverculture/hay; no grazing.
- C. Dominant land use is for grazing by livestock or horses.

- River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALI\MXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map2_CC.mxd 9/9/2016 4:51:15 PM

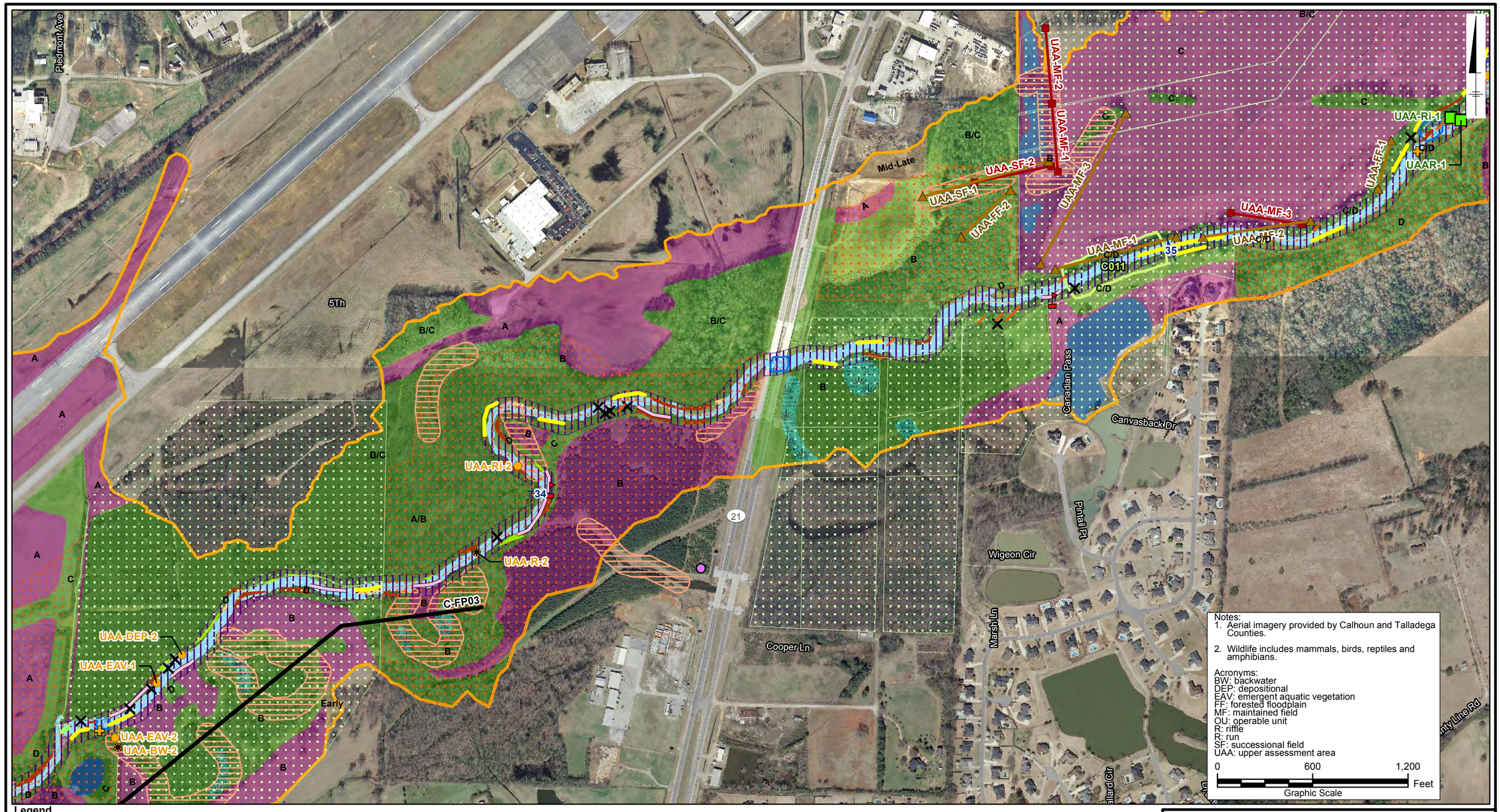
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1c



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland

Forested Floodplain

- A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
- B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
- C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
- D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field

- Early - Herbacous plants dominant with little or no scrub/shrub layer.
- Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

Maintained Field

- A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
- B. Dominant land use is for agriculture/silverculture/hay; no grazing.
- C. Dominant land use is for grazing by livestock or horses.

–26– River Mile

- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

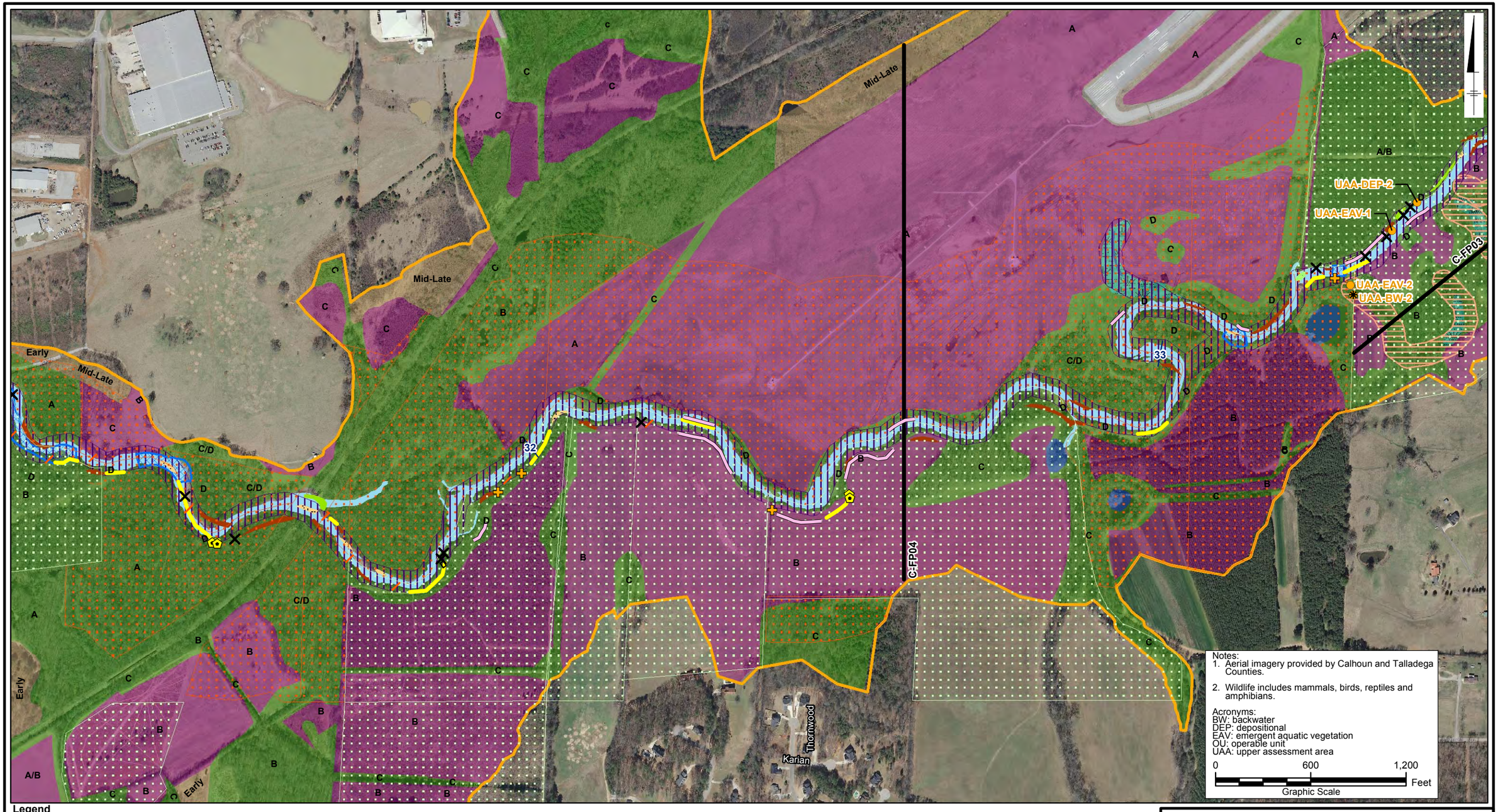
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1d

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map3_CC.mxd 5/26/2015 12:44:03 PM



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland

Forested Floodplain

- A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
- B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
- C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
- D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field

- Early - Herbacous plants dominant with little or no scrub/shrub layer.
- Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

Maintained Field

- A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
- B. Dominant land use is for agriculture/silverculture/hay; no grazing.
- C. Dominant land use is for grazing by livestock or horses.

—26— River Mile

- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

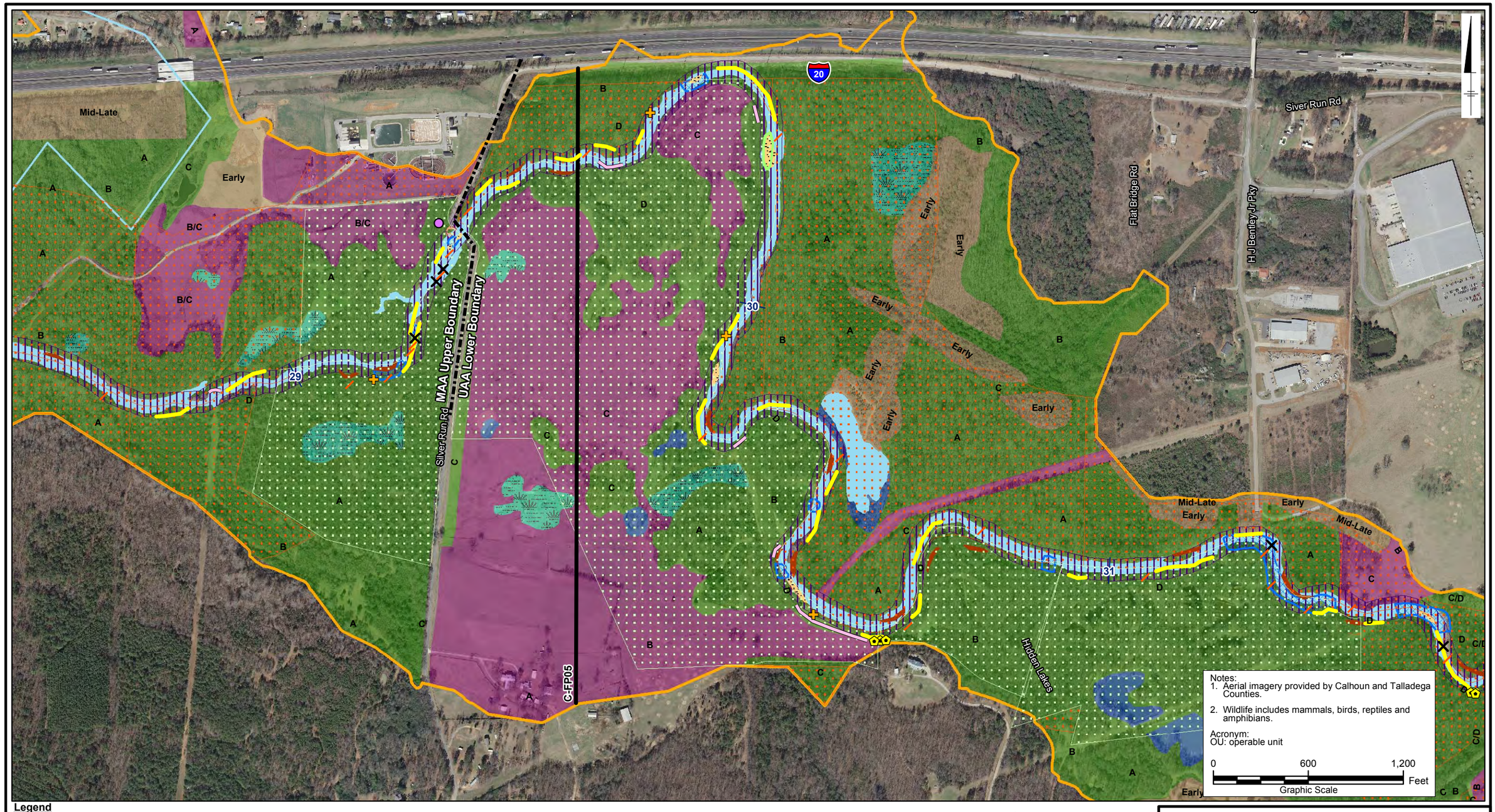
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1e

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: k.ives
Anniston
Q:\Anniston_PCB_site\Anniston\ALL\MXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map4_CC.mxd 5/26/2015 12:44:00 PM



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland

Forested Floodplain

- A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
- B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
- C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
- D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field

- Early - Herbacous plants dominant with little or no scrub/shrub layer.
- Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

Maintained Field

- A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
- B. Dominant land use is for agriculture/silverculture/hay; no grazing.
- C. Dominant land use is for grazing by livestock or horses.

–26– River Mile

- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

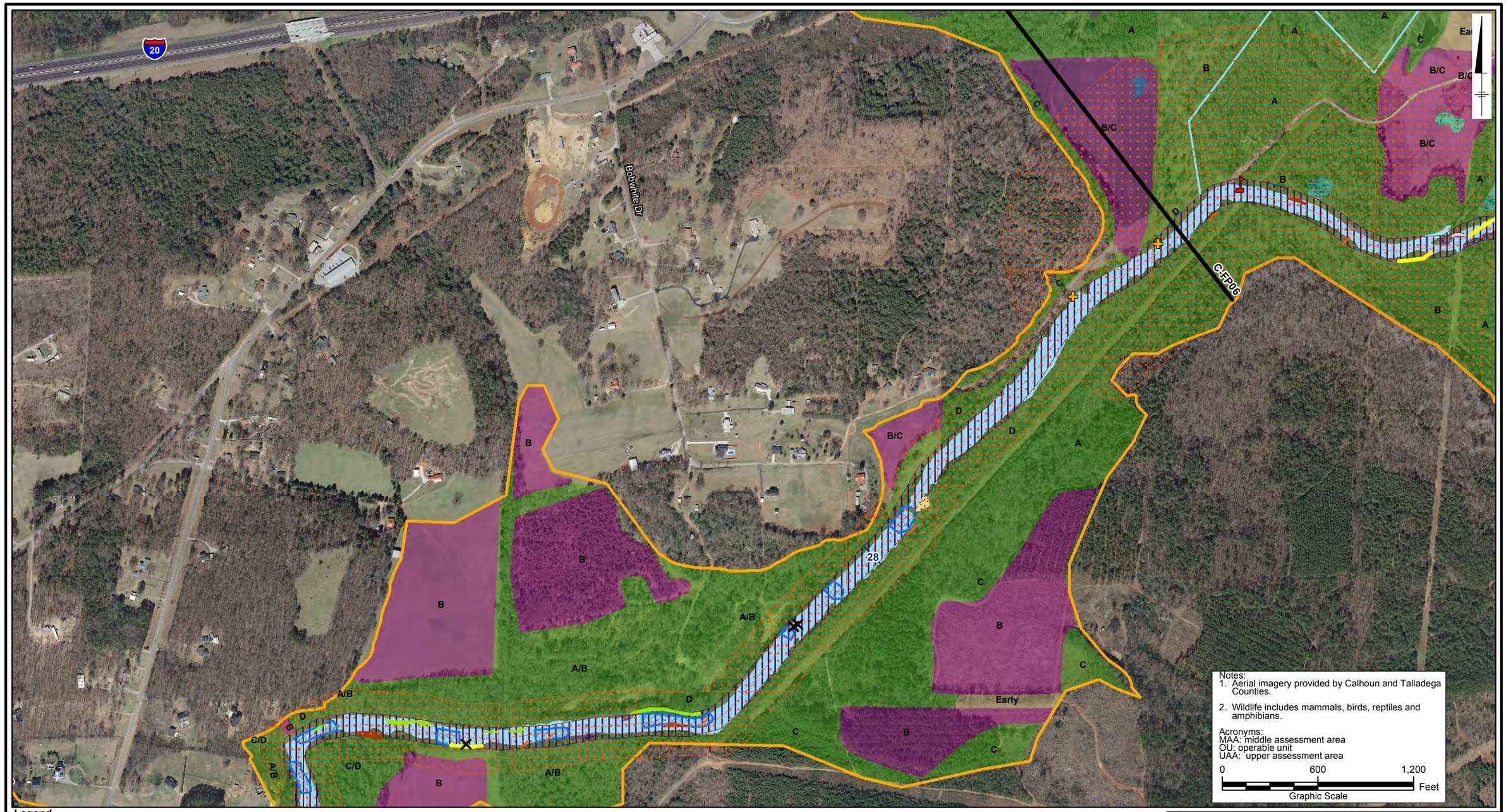
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1f

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALLMXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map5_CC.mxd 9/13/2016 11:16:18 AM



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland

Forested Floodplain

- A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
- B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
- C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
- D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field

- Early - Herbacous plants dominant with little or no scrub/shrub layer.
- Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

Maintained Field

- A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
- B. Dominant land use is for agriculture/silverculture/hay; no grazing.
- C. Dominant land use is for grazing by livestock or horses.

- –26– River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

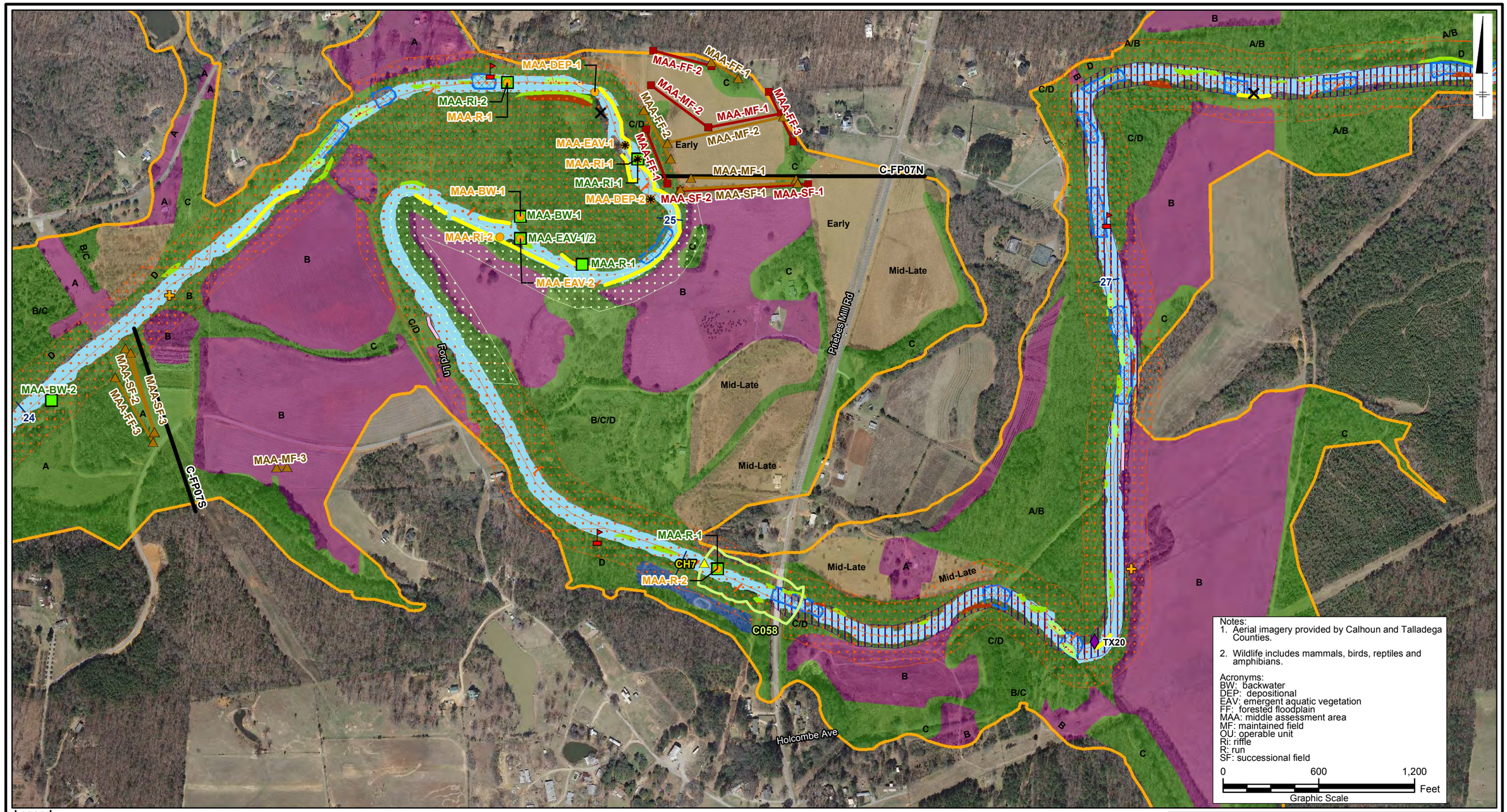
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1g

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map6_CC.mxd 9/13/2016 9:54:44 AM



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- 2010 Sediment Toxicity Collection Location
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland
- Forested Floodplain
  - A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
  - B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
  - C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
  - D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.
- Successional Field
  - Early - Herbacous plants dominant with little or no scrub/shrub layer.
  - Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.
- Maintained Field
  - A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
  - B. Dominant land use is for agriculture/silverculture/hay; no grazing.
  - C. Dominant land use is for grazing by livestock or horses.
- River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

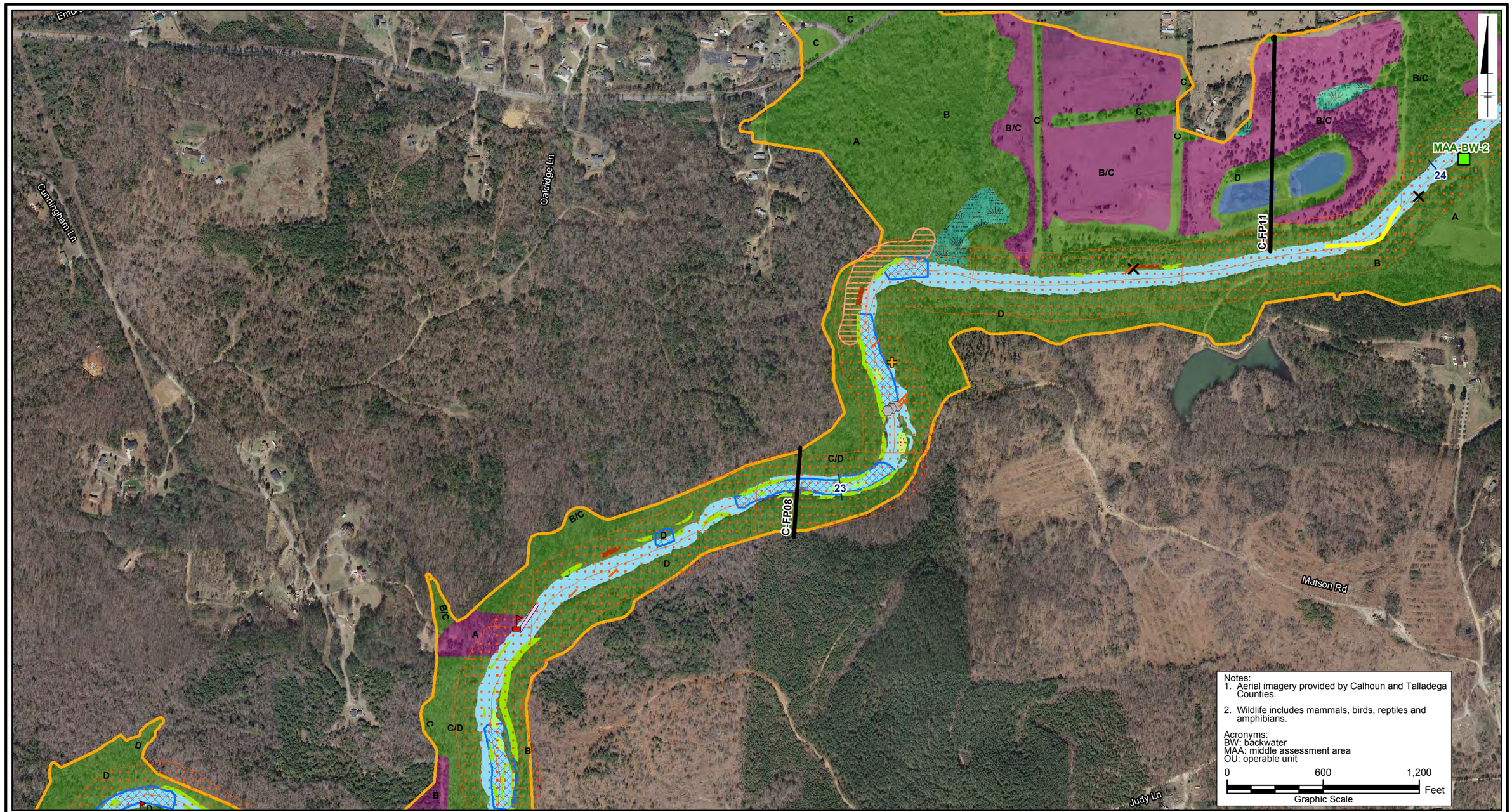
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1h

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\XDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map7_CC.mxd 9/9/2016 4:54:05 PM



Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.
2. Wildlife includes mammals, birds, reptiles and amphibians.

Acronyms:
BW: backwater
MAA: middle assessment area
OU: operable unit

0 600 1,200 Feet
Graphic Scale

Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland
- Forested Floodplain
  - A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
  - B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
  - C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
  - D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.
- Successional Field
  - Early - Herbacous plants dominant with little or no scrub/shrub layer.
  - Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.
- Maintained Field
  - A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
  - B. Dominant land use is for agriculture/silverculture/hay; no grazing.
  - C. Dominant land use is for grazing by livestock or horses.
- —26— River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

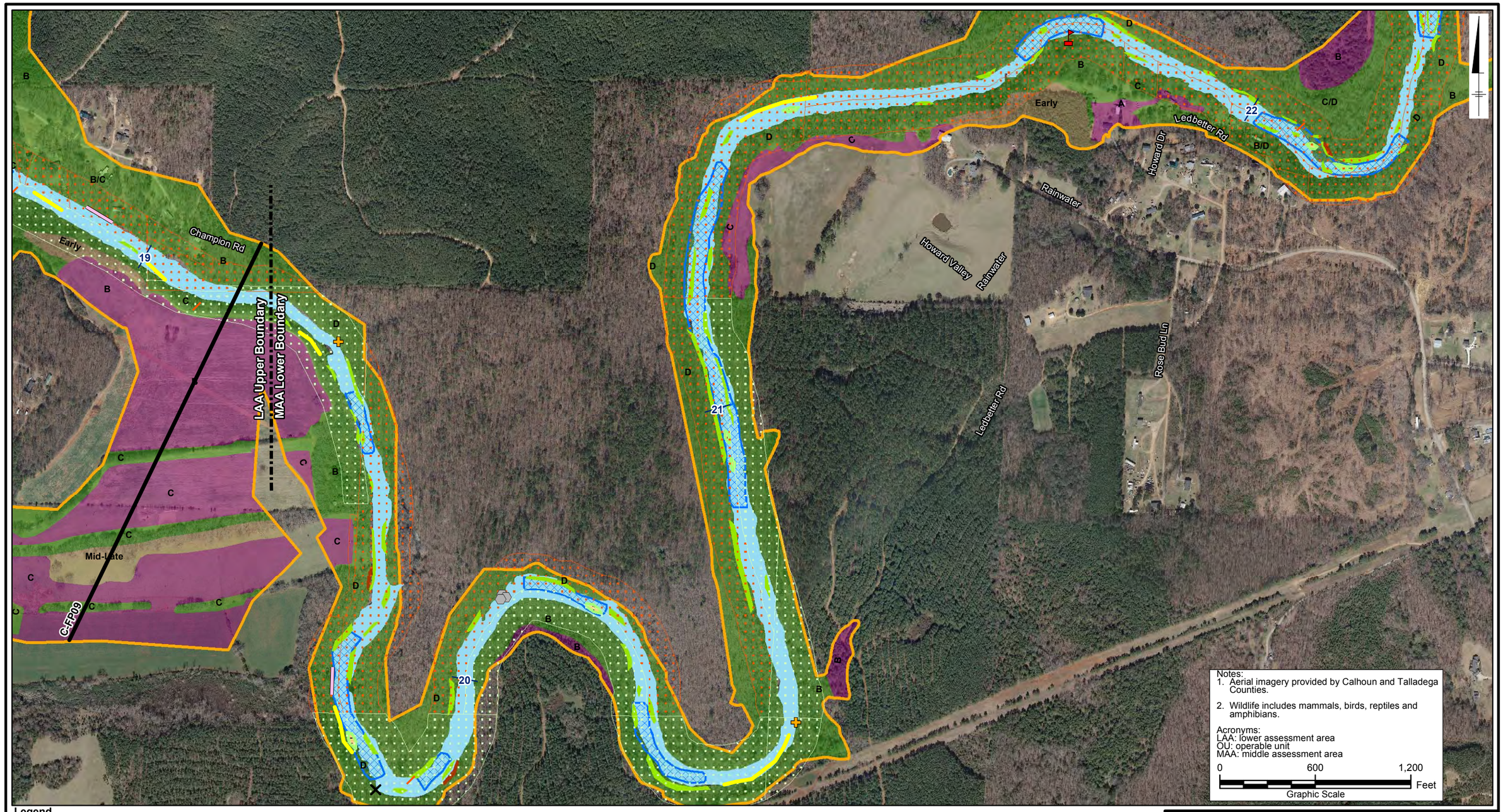
Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1i

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map8_CC.mxd 5/26/2015 12:43:50 PM



Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland
- Forested Floodplain
  - A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
  - B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
  - C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
  - D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.
- Successional Field
  - Early - Herbacous plants dominant with little or no scrub/shrub layer.
  - Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.
- Maintained Field
  - A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
  - B. Dominant land use is for agriculture/silverculture/hay; no grazing.
  - C. Dominant land use is for grazing by livestock or horses.
- —26— River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

OU-4 Floodplain and Riparian Habitat

Solutia

Figure
2-1j

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: k.ives
Anniston
Q:\Anniston_PCB_site\Anniston\ALM\XDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map9_CC.mxd 5/26/2015 12:44:05 PM

LAA-DEP-2
LAA-R-2
LAA-EAV-2
LAA-Ri-1
LAA-R-1
LAA-R-2
LAA-Ri-2
LAA-Ri-1
LAA-EAV-2
LAA-BW-1
LAA-R-1
LAA-BW-2
LAA-R-2
LAA-BW-2
LAA-DEP-1
LAA-EAV-1
C103
LAA-EAV-1
LAA-FF-3
LAA-FF-2
LAA-FF-1
C-FP10
LAA-MF-1
LAA-BW-1
LAA-MF-2
LAA-SF-1
LAA-MF-3
17
LAA-FF-3
LAA-SF-2
LAA-SF-3
LAA-FF-2
LAA-SF-1
LAA-FF-1
16
Early
Creek Rd
Mid-Late
Early
Mid-Late

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.
2. Wildlife includes mammals, birds, reptiles and amphibians.

Acronyms:
BW: backwater
DEP: depositional
EAV: emergent aquatic vegetation
FF: forested floodplain
LAA: lower assessment area
MF: maintained field
OU: operable unit
RI: riffle
R: run
SF: successional field

0 600 1,200 Feet
Graphic Scale

Legend

- Approximate 1996 Bayne Study Habitat Assessment Area
- Approximate 1999 Habitat Assessment Area
- 2001/2002 Floodplain Transect
- Bank Erosion
- Open Area
- Human Use Area
- Riprap
- Deadfall
- Tributary Confluence
- Snag
- Boulder
- Deposition - Bank Area
- Emergent Aquatic Vegetation
- Deposition - Island
- Riffle

2001/2002 Habitat Survey

- Open Water
- Wetland

Forested Floodplain

A. Inner Forest. Canopy dense, continuous, and closed. Understory and/or herbaceous sparse or absent.
B. Inner Forest. Canopy sparse, narrow, or open. Understory and/or herbaceous layer common; sometimes dense.
C. Forest Edge of Fields. Canopy sparse narrow or open. Understory well developed. Includes fencelines.
D. Forest Edge of Creek Bank. Canopy sparse narrow or open. Understory well developed.

Successional Field

Early - Herbacous plants dominant with little or no scrub/shrub layer.
Mid-Late - Scrub/shrub layer well represented; intermixed herb layer; some larger saplings present in islands or singular.

- Maintained Field
  - A. Dominant land use is as landscaped property, right-of-way, and/or mowed lawn.
  - B. Dominant land use is for agriculture/silverculture/hay; no grazing.
  - C. Dominant land use is for grazing by livestock or horses.
- —26— River Mile
- 2006/2007 Fish Survey Location
- 2006/2007 Mollusk Survey Location
- 2006/2007 Benthic Macroinvertebrate Survey Location
- 2006/2007 Wildlife[2] and Vegetation Survey Transect
- 2006/2007 Small Mammal and/or Soil Macroinvertebrate Survey Location
- 2008 Dusk Choral Survey Location
- 2008 Aquatic Reptile/Amphibian Survey Location
- 2008 Terrestrial Reptile/Amphibian Survey Location
- Choccolocco Creek
- OU-4 100-Year Floodplain
- Current Conservation Corridor Easement
- Proposed Conservation Corridor Easement

Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

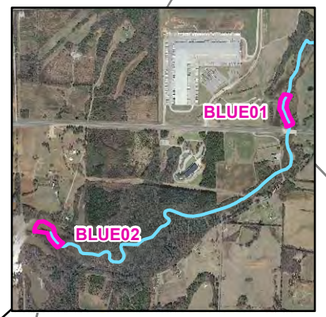
OU-4 Floodplain and Riparian Habitat

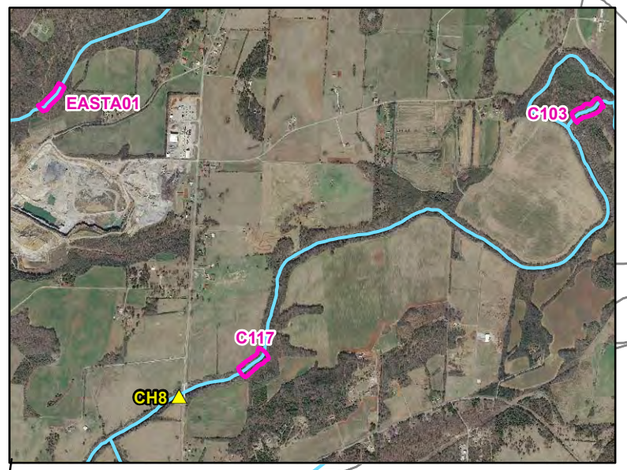
Solutia

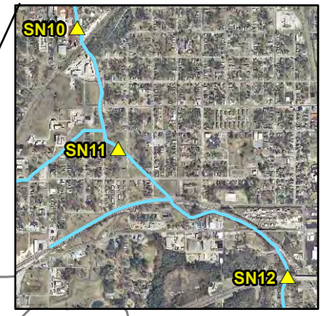
Figure
2-1k

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\RiparianFloodplain_Map10_CC.mxd 5/26/2015 12:43:46 PM

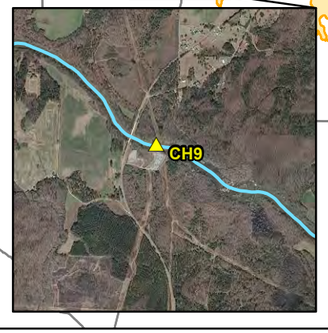


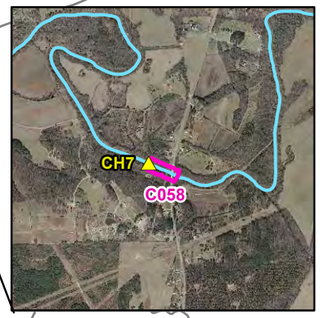


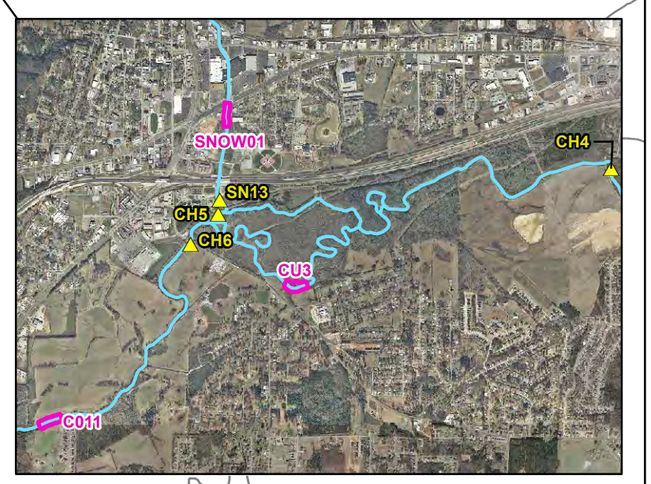












Blue Eye Creek
Eastaboga Creek
Cheaha Creek
Coldwater Creek
Snow Creek
21
Lake Logan Martin

Legend

- Approximate Bayne Study Habitat Assessment Area
- Major Road
- Approximate RFI Habitat Assessment Area
- Choccolocco Creek
- OU-4 100-Year Floodplain
- OU-3 Boundary
- OU-1/OU-2 Downgradient Floodplain

0 2 4 Miles
Graphic Scale

Notes:
1. The OU-3 boundary shown has been modified since issuance of the OU-3 IROD. P/S are currently working with USEPA to formally revise the boundary.

2. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
IROD = Interim Record of Decision
OU = operable unit
P/S = Pharmacia LLC and Solutia Inc.
USEPA = United States Environmental Protection Agency

Anniston PCB Site
Anniston, Alabama

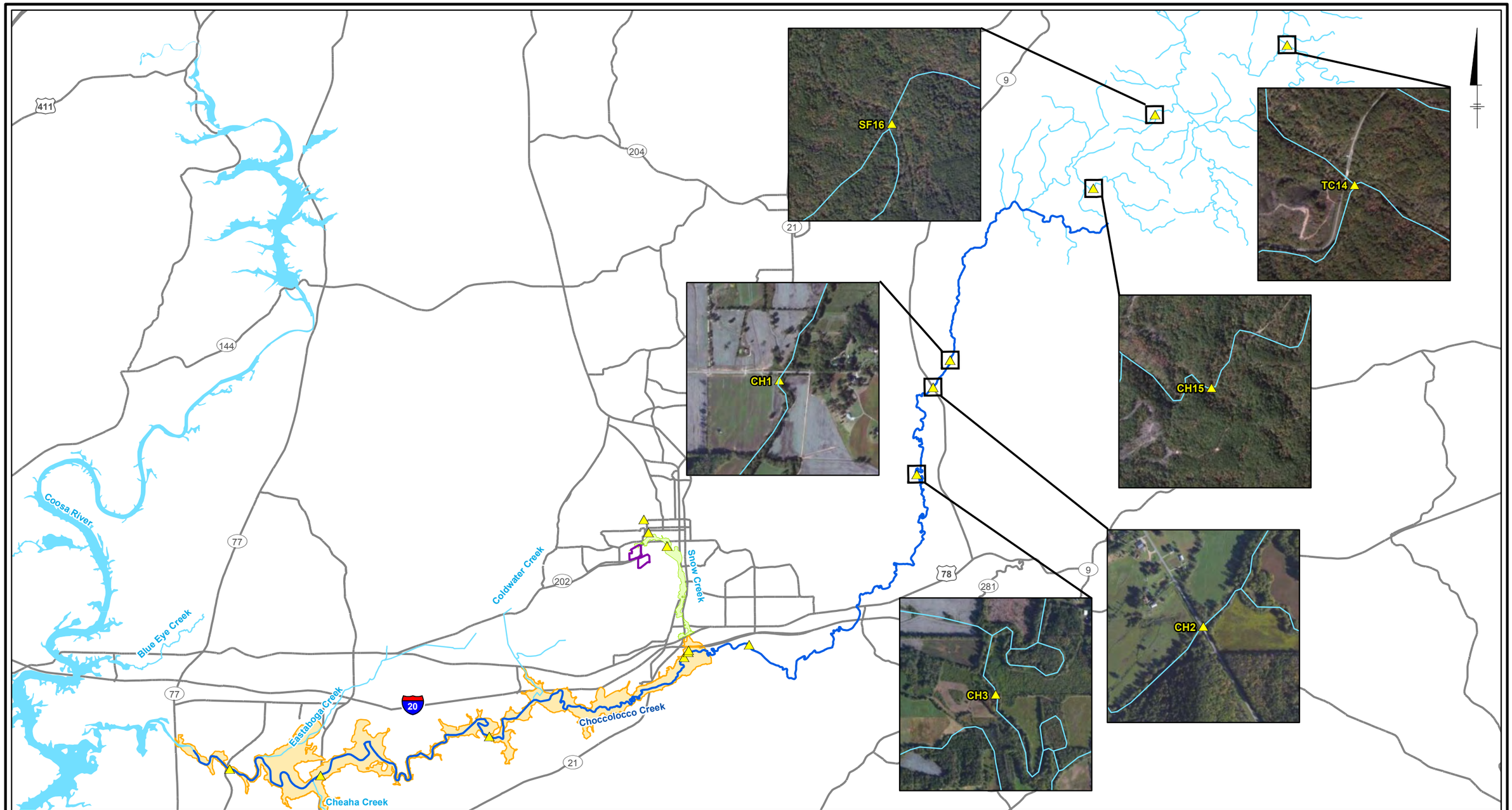
Baseline Ecological Risk Assessment for OU-4

Bayne (1997) and 2000 RFI Sampling Locations

Solutia

Figure
2-2a

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\Bayne_RFI.mxd 3/12/2015 1:48:11 PM



Legend

- Approximate Bayne Study Habitat Assessment Area
- Choccolocco Creek
- Other Tributaries
- Major Road
- OU-3 Boundary
- OU-1/OU-2 Downgradient Floodplain
- OU-4 100-Year Floodplain

Notes:
1. The OU-3 boundary shown has been modified since issuance of the OU-3 IROD. P/S are currently working with USEPA to formally revise the boundary.
2. Stations SF16, TC14 and CH15 are reference stations (Bayne 1997a).
3. Imagery provided by NAIP imagery service licensed through ESRI product software.

Acronyms:
CH = Choccolocco Creek
IROD = Interim Record of Decision
OU = operable unit
P/S = Pharmacia LLC and Solutia Inc.
SF = South Fork of Terrapin Creek
TC = Terrapin Creek
USEPA = United States Environmental Protection Agency

0 3.25 6.5 Miles
Graphic Scale

Anniston PCB Site
Anniston, Alabama

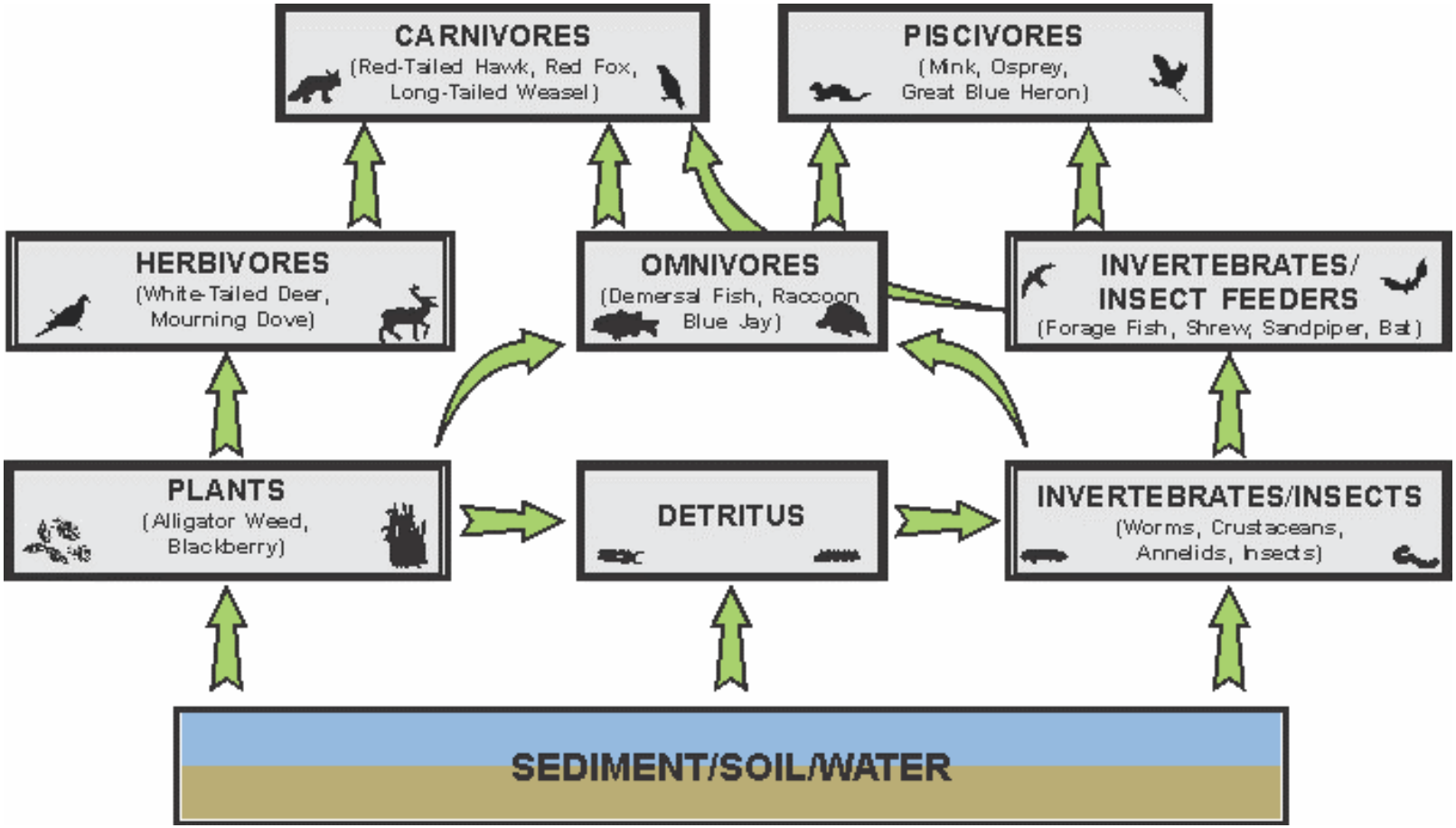
Baseline Ecological Risk Assessment for OU-4

Bayne (1997) and 2000 RFI Sampling Locations

Solutia

Figure **2-2b**

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\Bayne_RFI_Map2.mxd 3/6/2015 4:35:48 PM



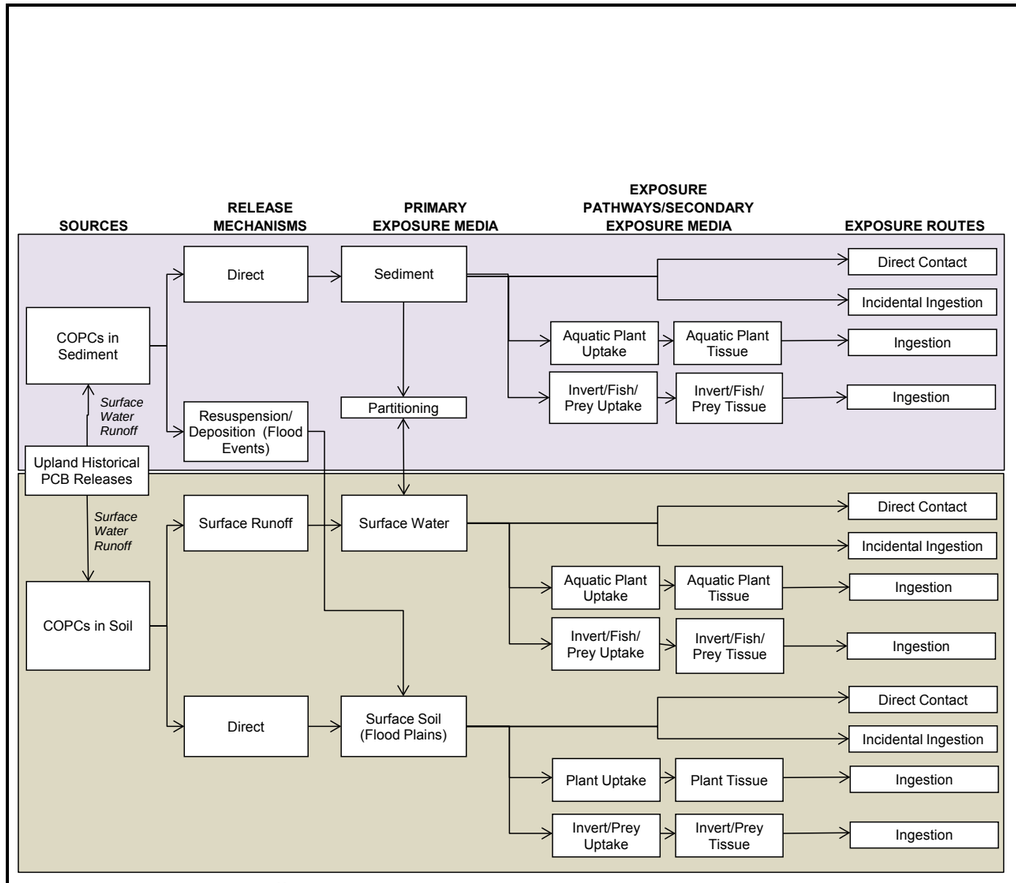
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

Ecological Receptor Food Web

Solutia

Figure 2-3

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\



Notes:

COPCs: Constituents of Potential Concern

○ Exposure pathway considered *de minimus* . Not quantitatively evaluated.

▨ Pathway complete but expected to be minimal relative to the identified primary complete pathways. Not quantitatively evaluated.

● High potential for complete exposure pathway. Primary pathway quantitatively evaluated.

1. Representative species listed in parentheses.
2. Multiple scenarios evaluated (See Tables 4-1b and 4-2b for different exposure scenarios).
3. Complete pathways identified but due to lack of toxicity values, potential risks could not be quantified.
4. These receptors may be exposed to both aquatic and terrestrial media and/or prey.
5. Receptor is primarily aquatic but has a small percentage of terrestrial prey (mammals/birds) as part of its diet composition.
6. Receptor is primarily terrestrial but has a small percentage of aquatic prey (amphibians/reptiles) as part of its diet composition.

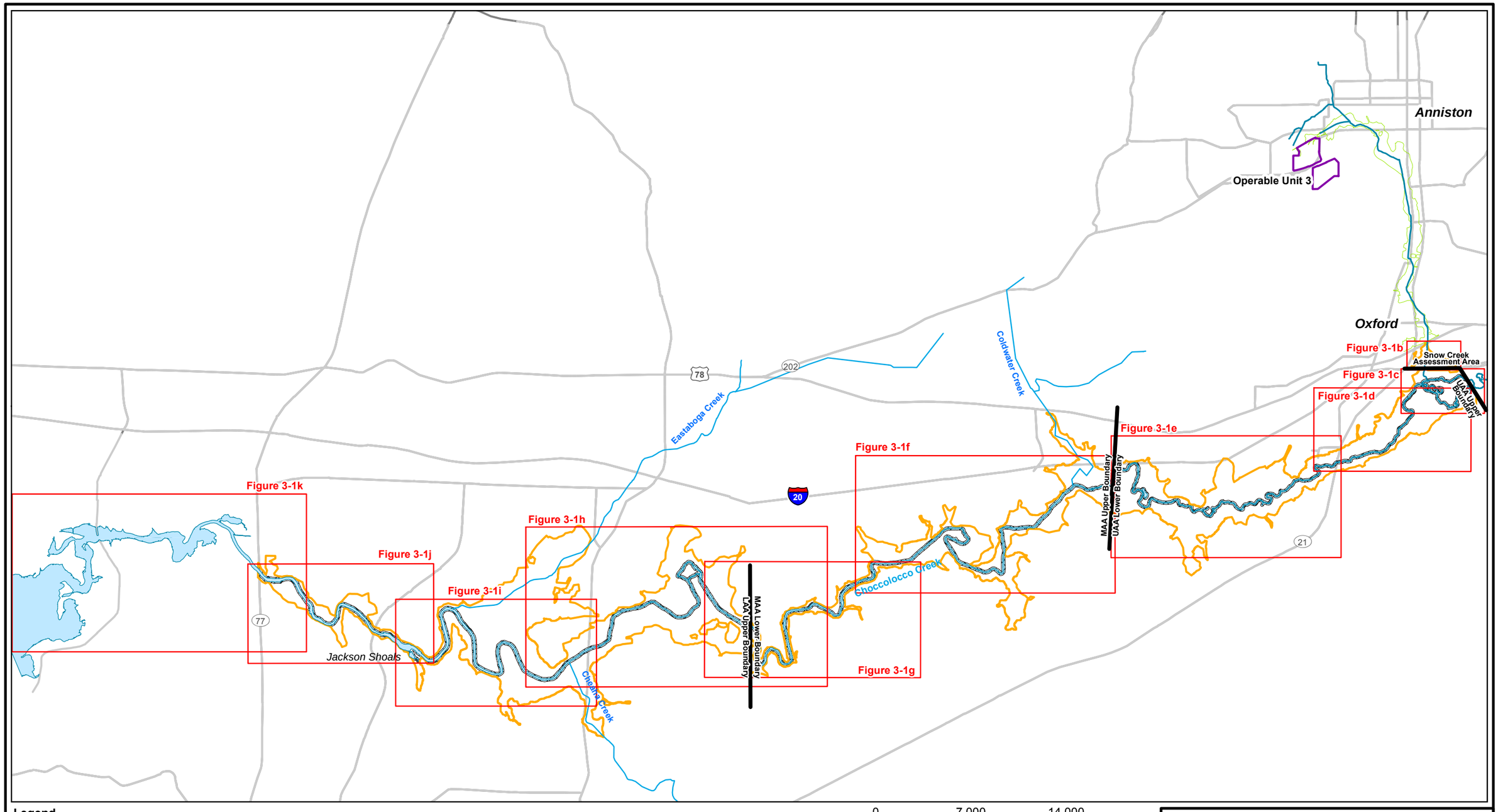
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Conceptual Site Model

Solutia

FIGURE
2-4



Legend

- Major Roadway
- OU-3 Boundary
- OU-1/OU-2 Downgradient Floodplain
- OU-4 100-Year Floodplain
- Choccolocco Creek
- Riparian Corridor

0 7,000 14,000 Feet

Graphic Scale

Acronym:
OU: operable unit

Anniston PCB Site
Anniston, Alabama

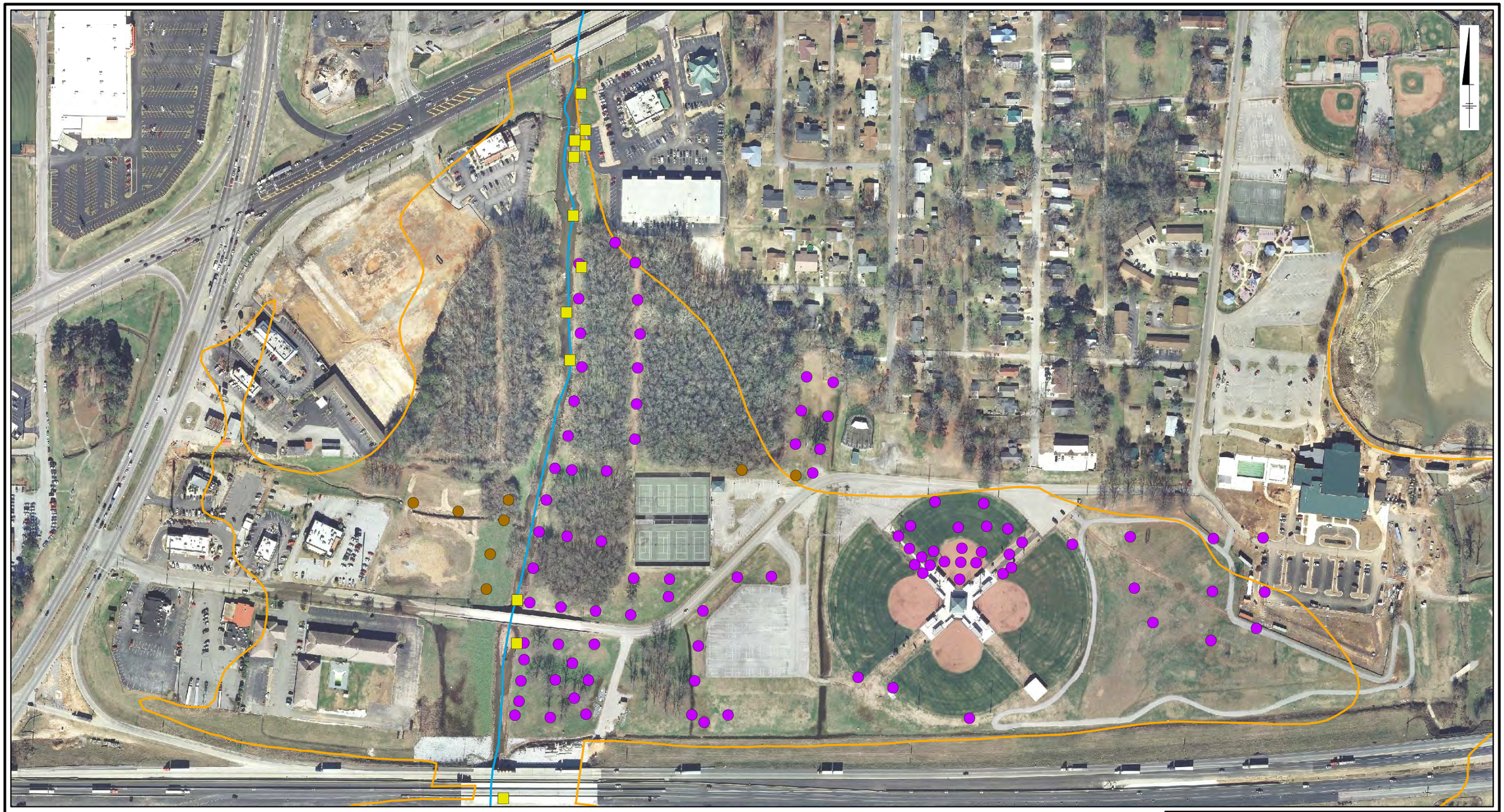
Baseline Ecological Risk Assessment for OU-4

Key for Soil and Sediment Locations by Program

Solutia

Figure 3-1a

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: Kives
AnnistonAL
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPrograms_KEYMAP.mxd 9/13/2016 1:10:16 PM



Legend

Sediment Program
- RFI Sediment

Soil Program
- Oxford Lake Park
- Other Soil Characterization Program

- Snow Creek Centerline
- OU-4 100-Year Floodplain

0 275 550 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation

Anniston PCB Site
Anniston, Alabama

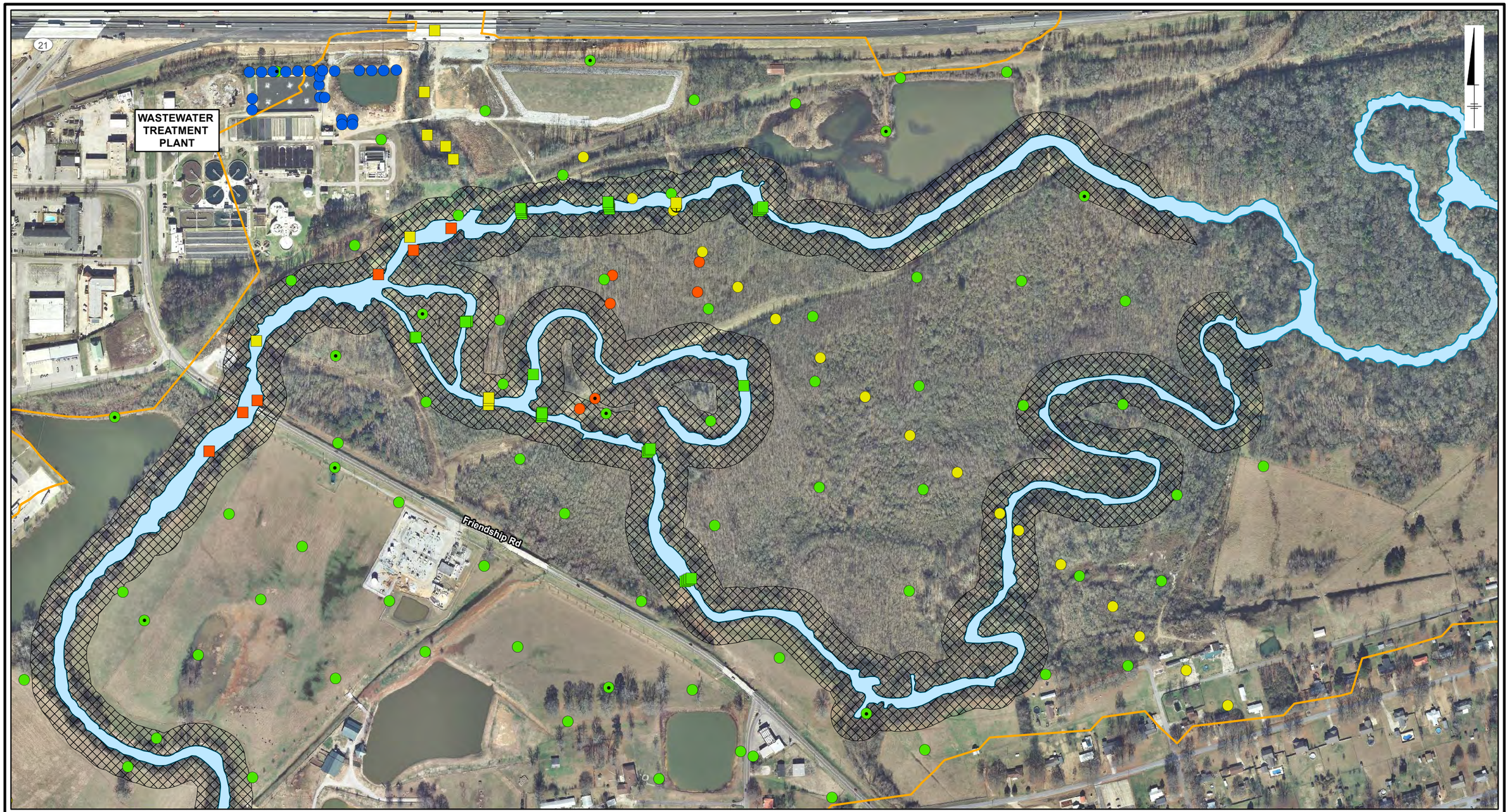
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1b

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C1_v2.mxd 9/30/2014 1:08:29 PM



Legend

Sediment Program
- RI/FS Sediment
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank
- WWTP

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 425 850 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study
WWTP: wastewater treatment plant

Anniston PCB Site
Anniston, Alabama

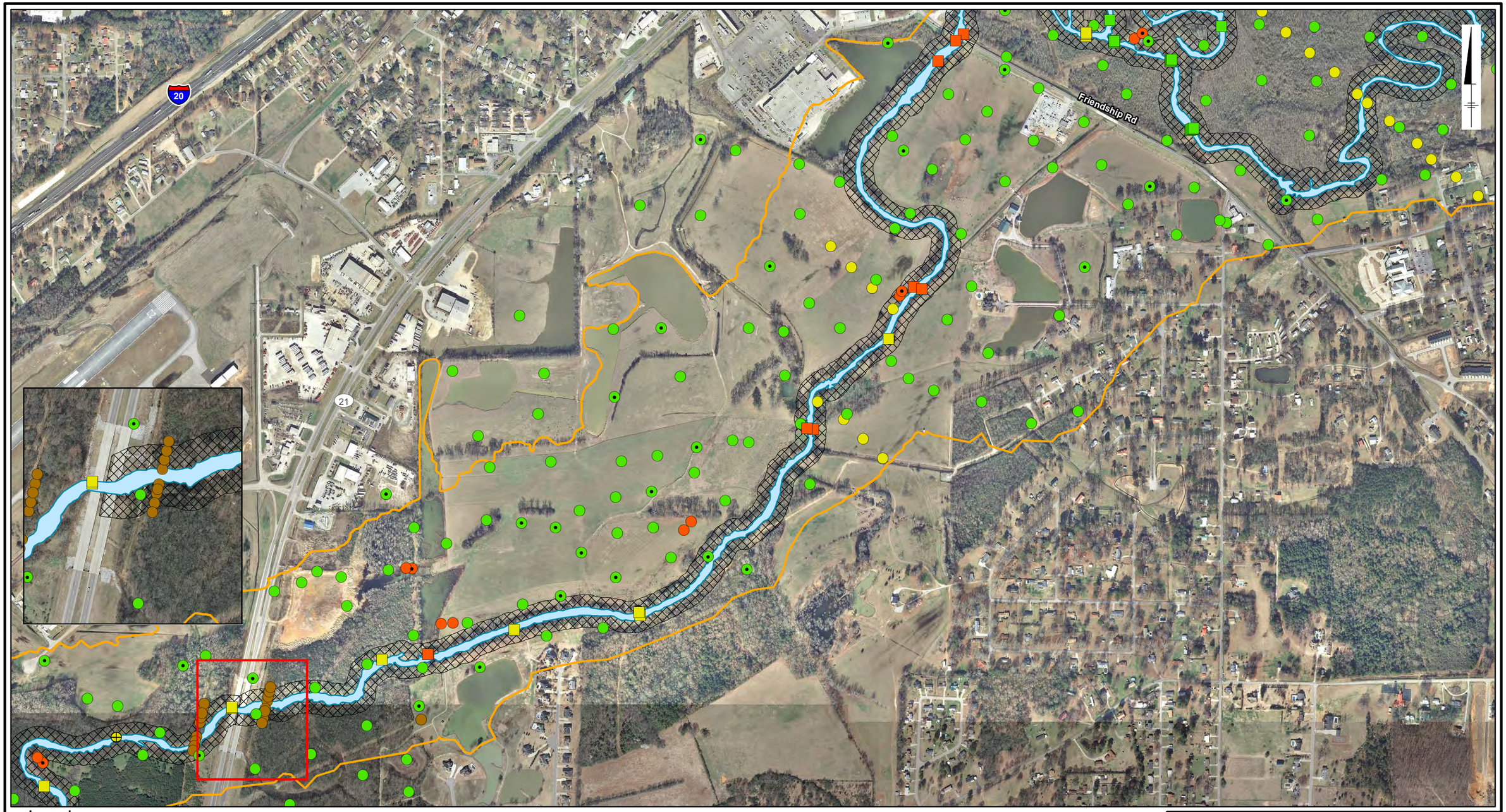
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1c

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: k.ives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C2_v2.mxd 9/30/2014 1:08:31 PM



Legend

Sediment Program
- RI/FS Sediment
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank
- Other Soil Characterization Program

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 800 1,600 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

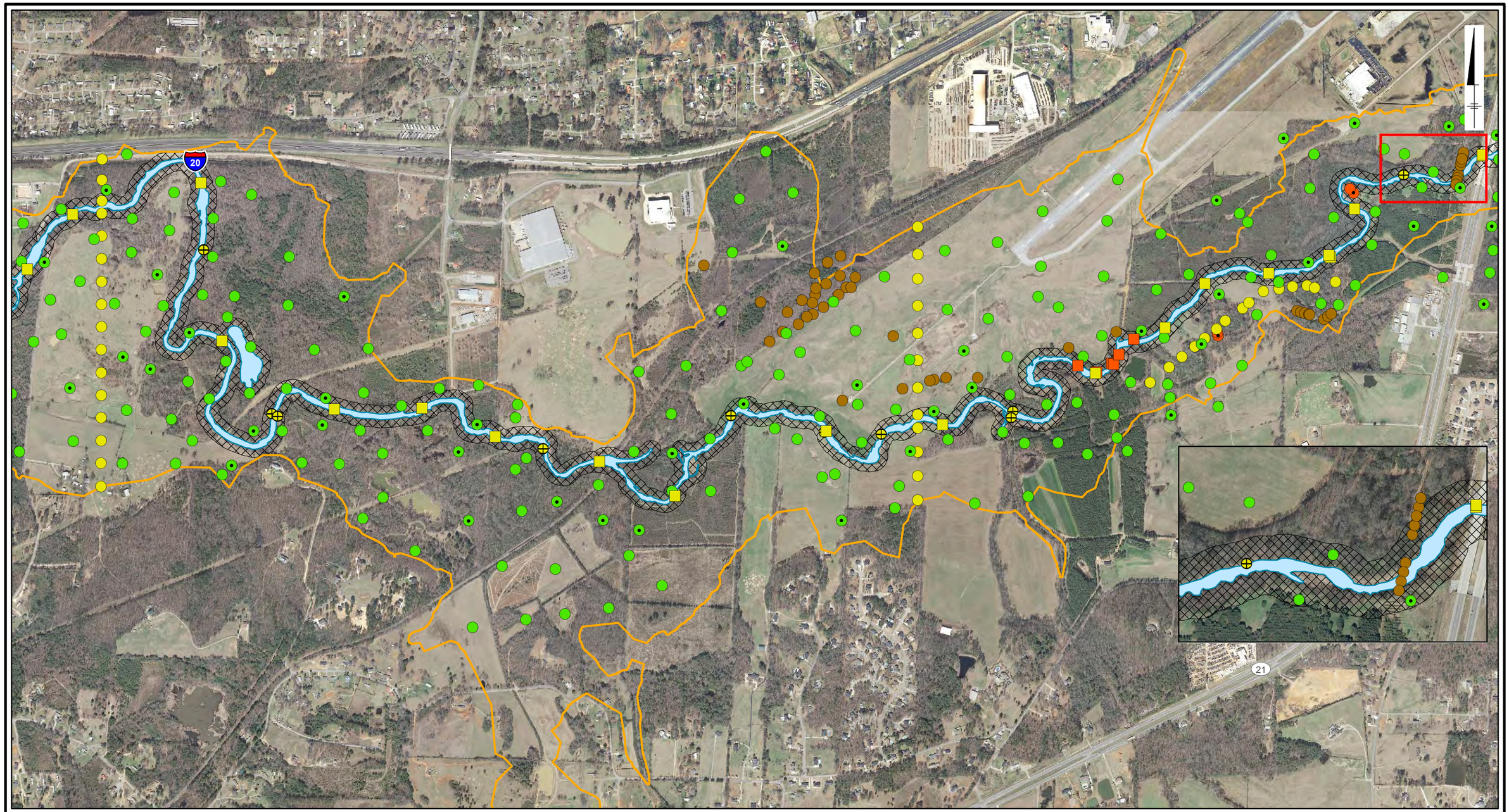
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1d

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALM\XDs_PrintFiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C3_v2.mxd 9/30/2014 1:08:27 PM



Legend

Sediment Program
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank
- Other Soil Characterization Program

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,175 2,350 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

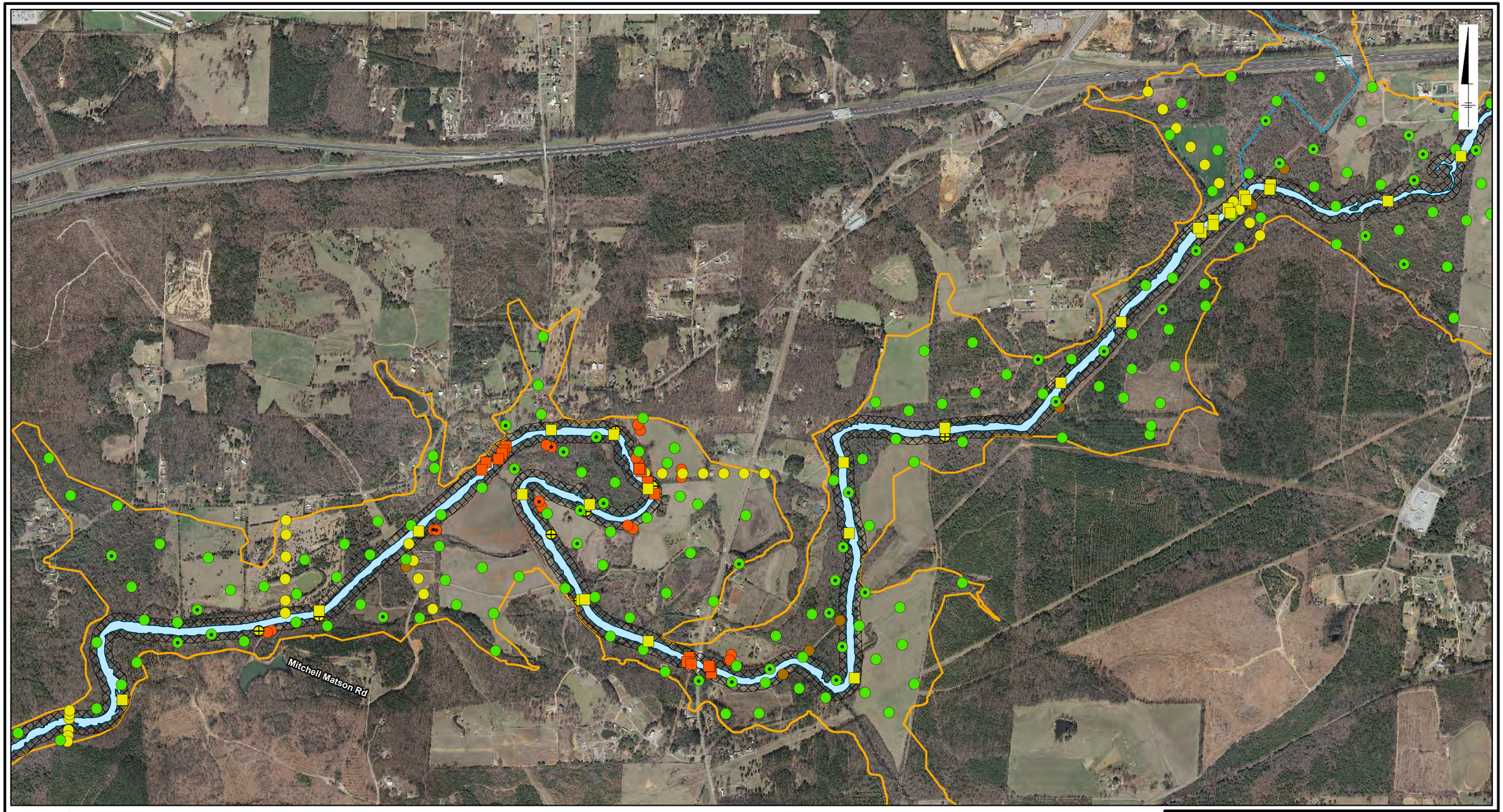
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1e

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C4_v2.mxd 9/30/2014 1:21:20 PM



Legend

Sediment Program
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank
- Other Soil Characterization Program

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,325 2,650 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

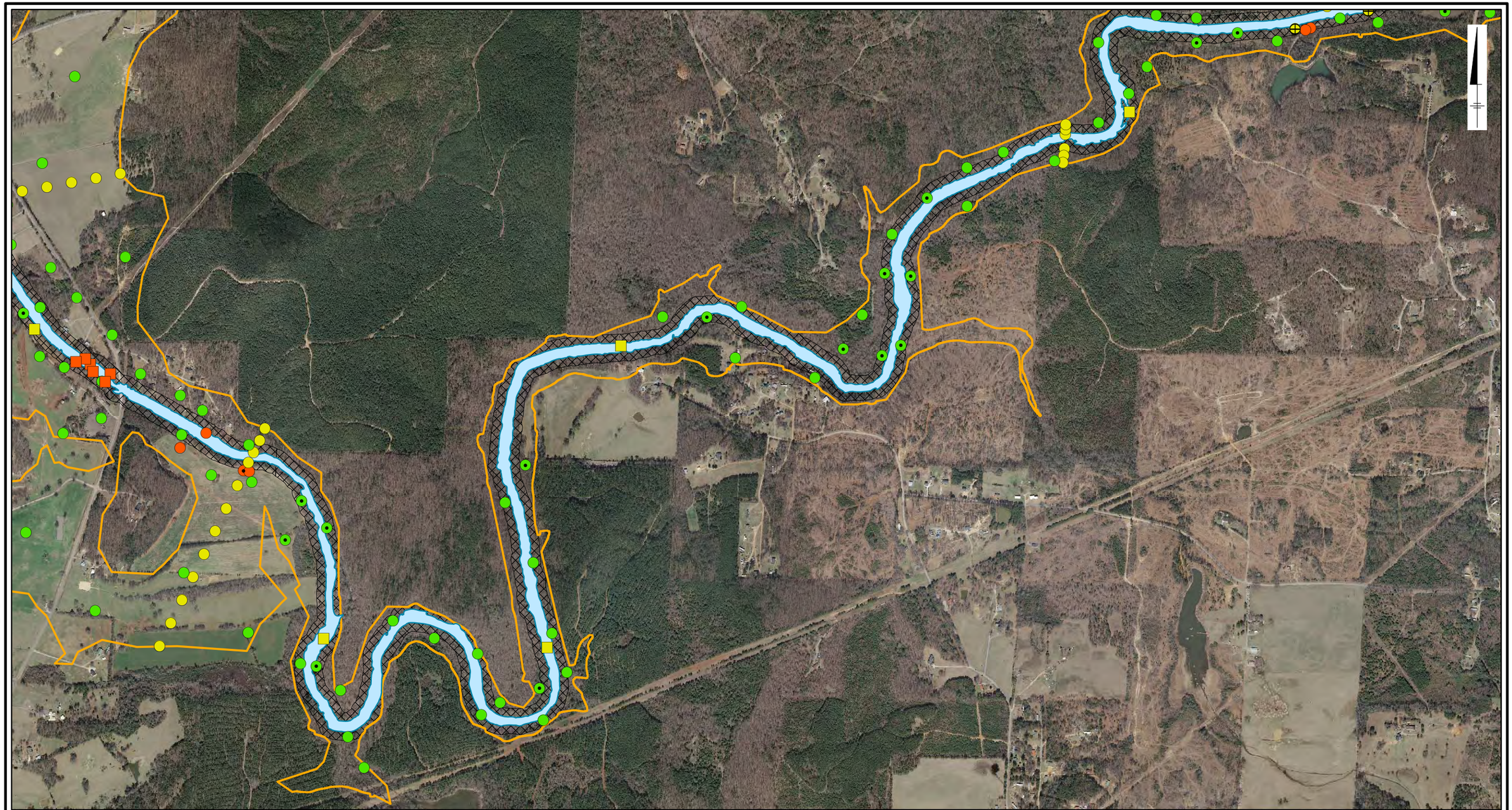
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1f

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C5_v2.mxd 9/30/2014 1:08:35 PM



Legend

Sediment Program
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,100 2,200 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

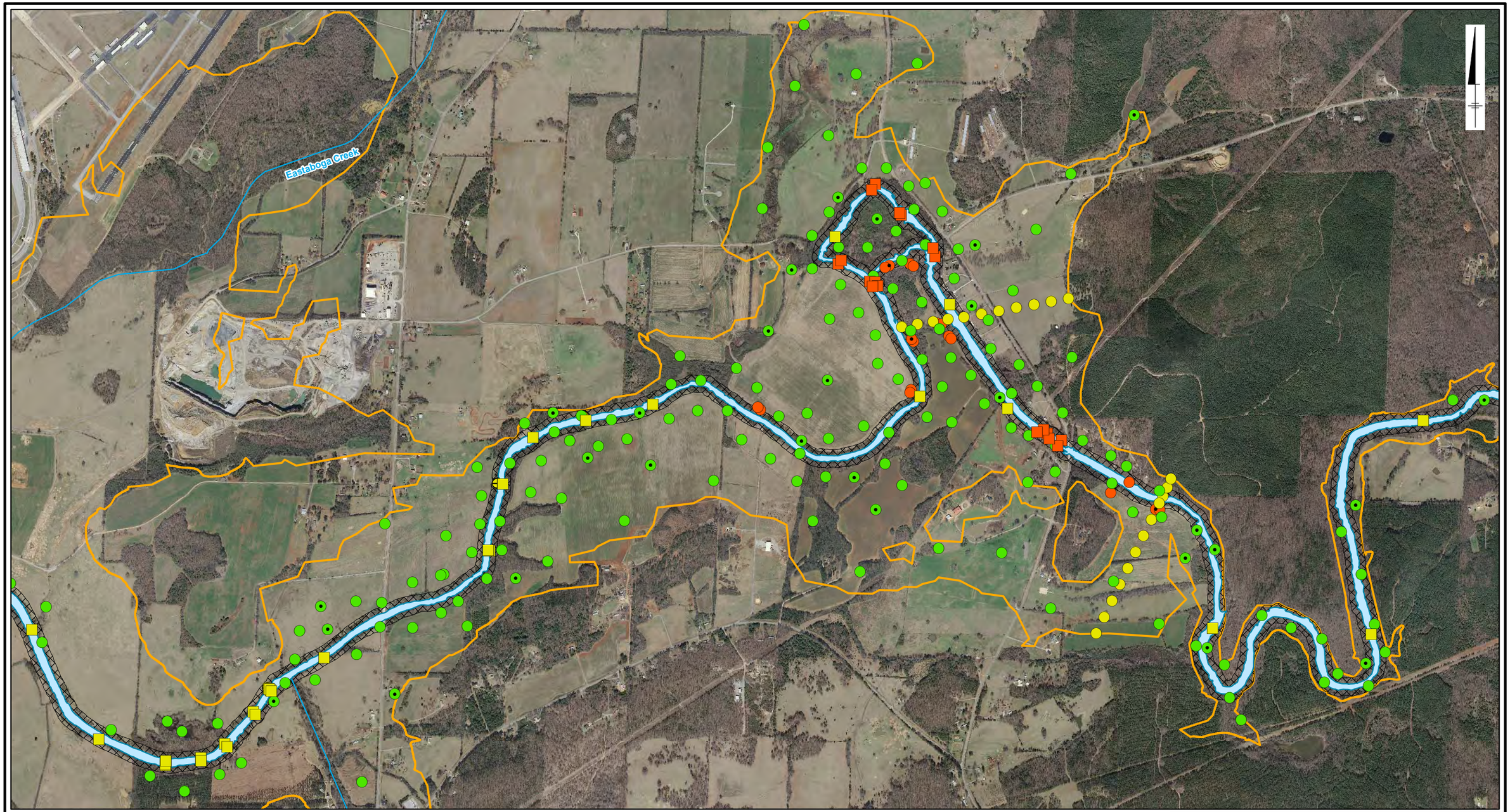
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1g

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C6_v2.mxd 9/30/2014 1:08:33 PM



Legend

Sediment Program
- RI/FS Phase 2 Ecological Sediment
- RFI Sediment

Soil Program
- RI/FS Soil
- RI/FS Phase 2 Ecological Soil
- RFI Soil
- RFI Soil -Top of Bank

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,550 3,100 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS = Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

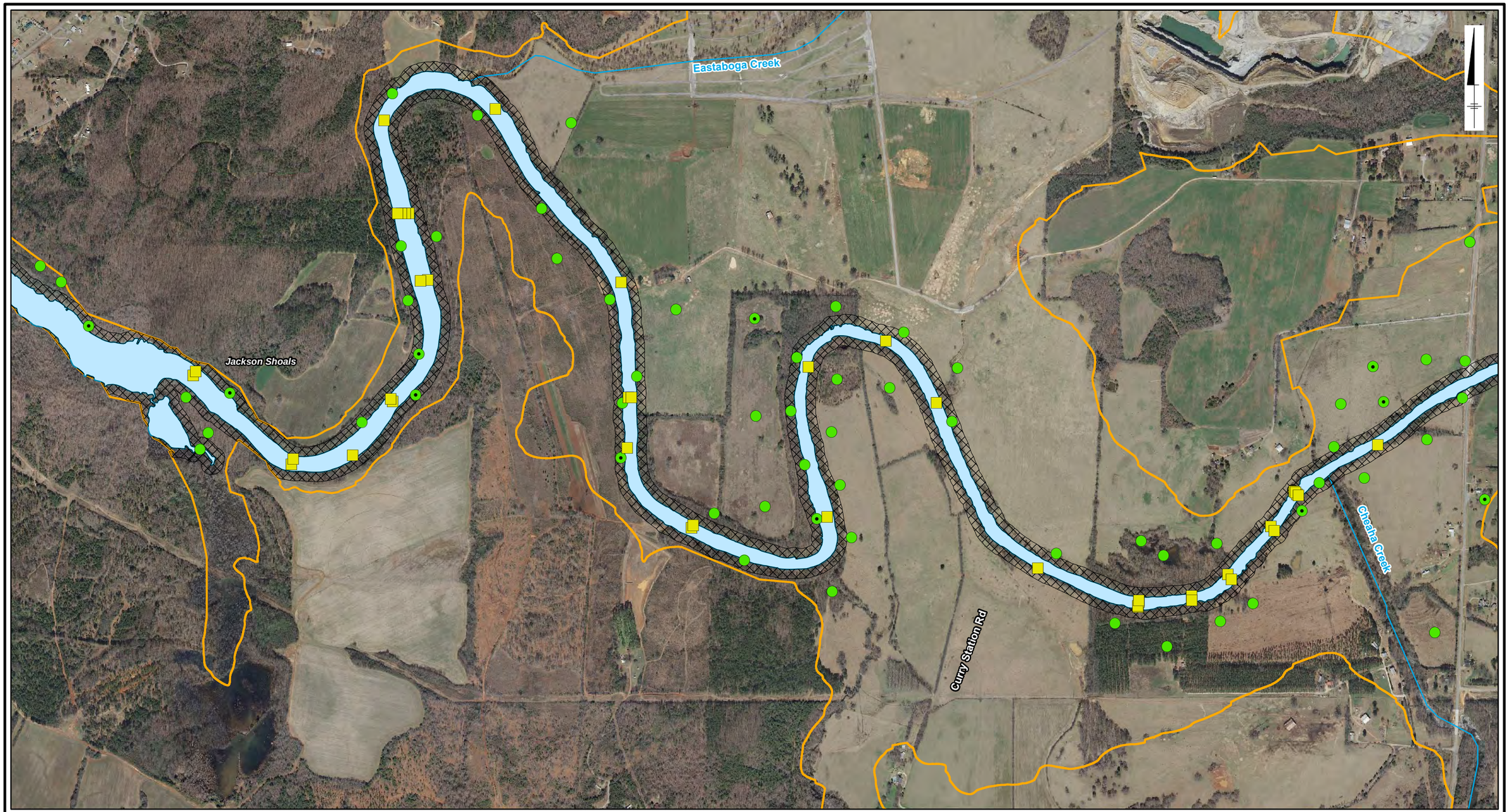
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1h

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C7_v2.mxd 9/30/2014 1:09:06 PM



Legend

Sediment Program
- RFI Sediment

Soil Program
- RI/FS Soil
- RFI Soil -Top of Bank
- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,025 2,050 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

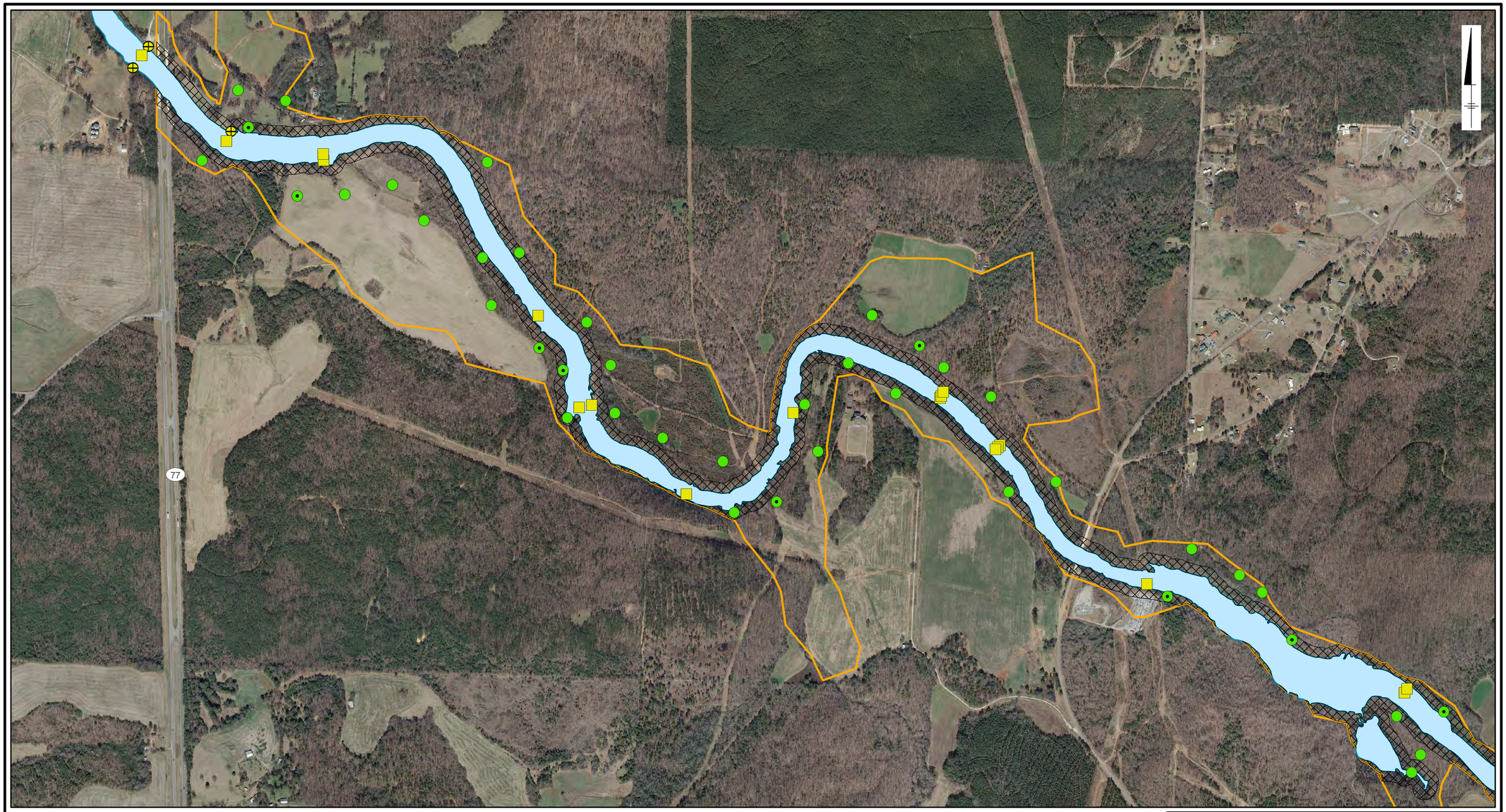
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1i

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C8_v2.mxd 9/30/2014 1:08:39 PM



Legend

Sediment Program
- RFI Sediment

Soil Program
- RI/FS Soil
- RFI Soil -Top of Bank

- Samples Analyzed for Constituents Other than PCBs
- Riparian Corridor
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 950 1,900 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

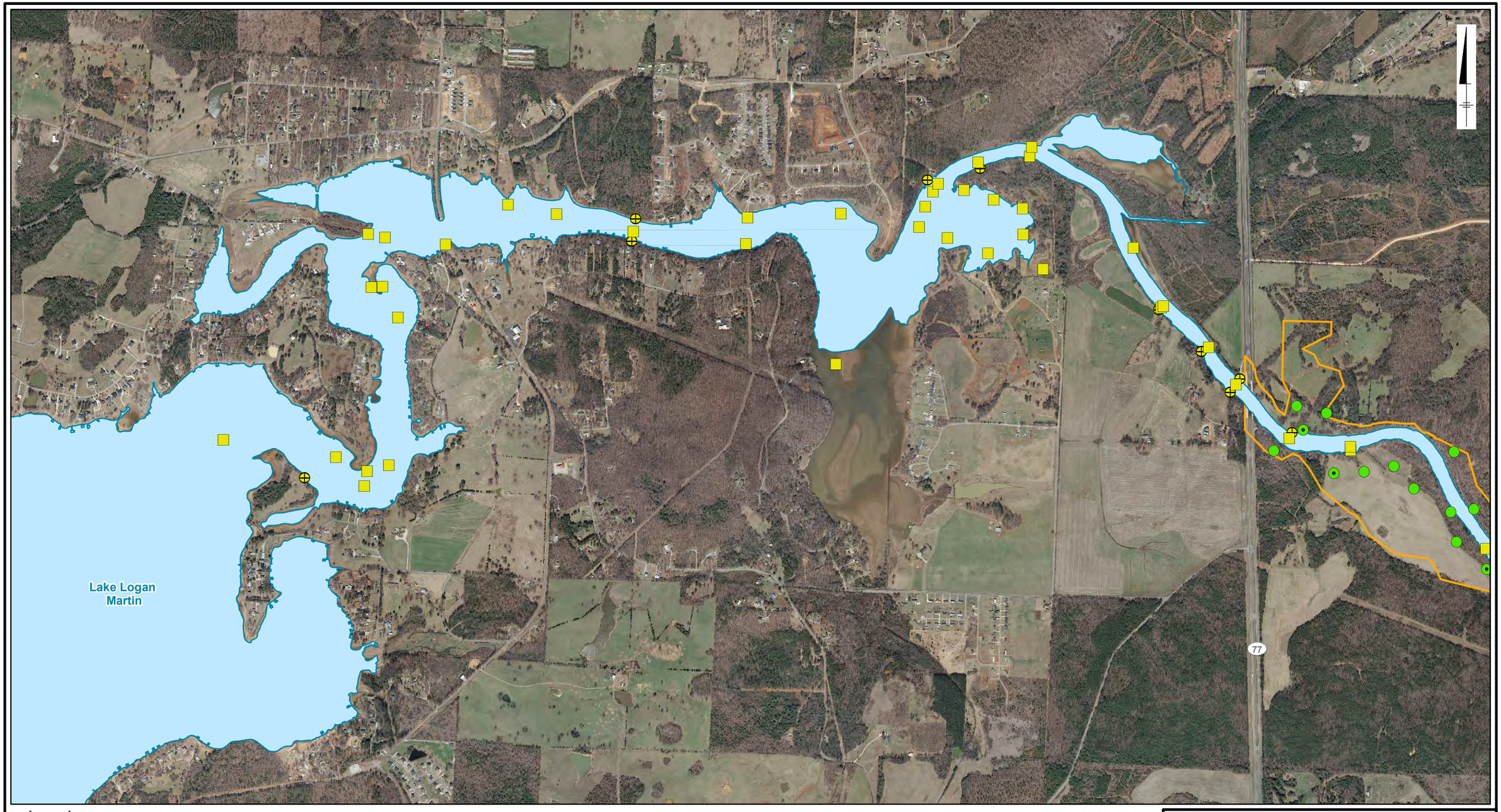
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1j

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C9_v2.mxd 9/30/2014 1:08:41 PM



Legend

Sediment Program
- RFI Sediment

Soil Program
- RI/FS Soil
- RFI Soil -Top of Bank
- Samples Analyzed for Constituents Other than PCBs
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,500 3,000 Feet

Graphic Scale

Notes:
1. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl
RCRA: Resource Conservation and Recovery Act
RFI: RCRA Facility Investigation
RI/FS: Remedial Investigation / Feasibility Study

Anniston PCB Site
Anniston, Alabama

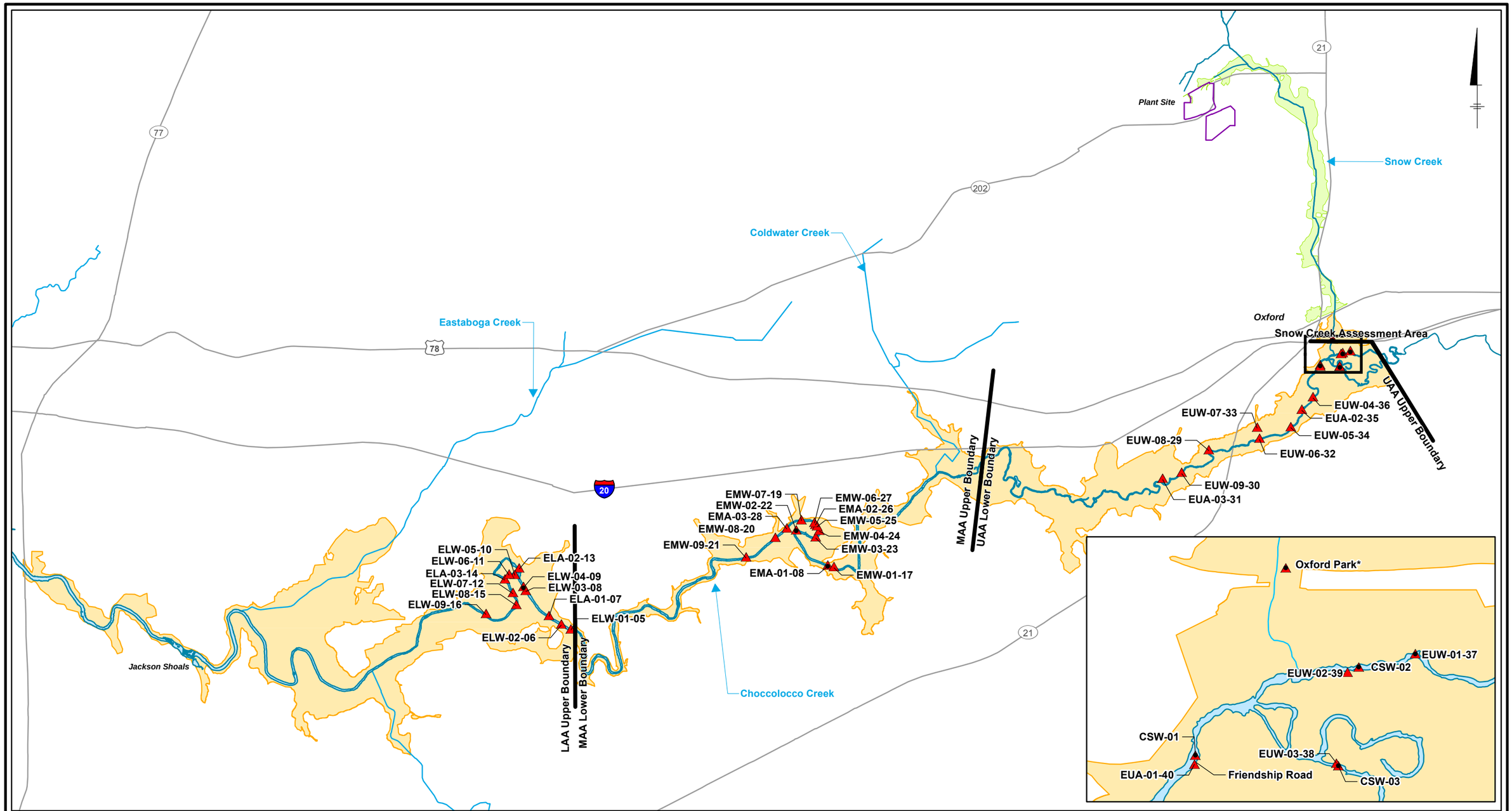
Baseline Ecological Risk Assessment for OU-4

Soil and Sediment Locations by Program

Solutia

Figure
3-1k

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilProgram_C10_v2.mxd 9/30/2014 1:08:37 PM



Legend

- Assessment Area Boundary
- Samples Analyzed for Constituents Other than PCBs and Mercury
- Whole Water PCB and Mercury Sampling Location
- Choccolocco Creek
- OU-3 Boundary
- OU-4 100-Year Floodplain
- OU-1/OU-2 Downgradient Floodplain

0 6,750 13,500 Feet

Graphic Scale

Acronyms:
OU: operable unit
PCB: polychlorinated biphenyl

Note:
1. *: Oxford Park locations include samples S50048, S50049, S50050, S50051, and S50052.

Anniston PCB Site
Anniston, Alabama

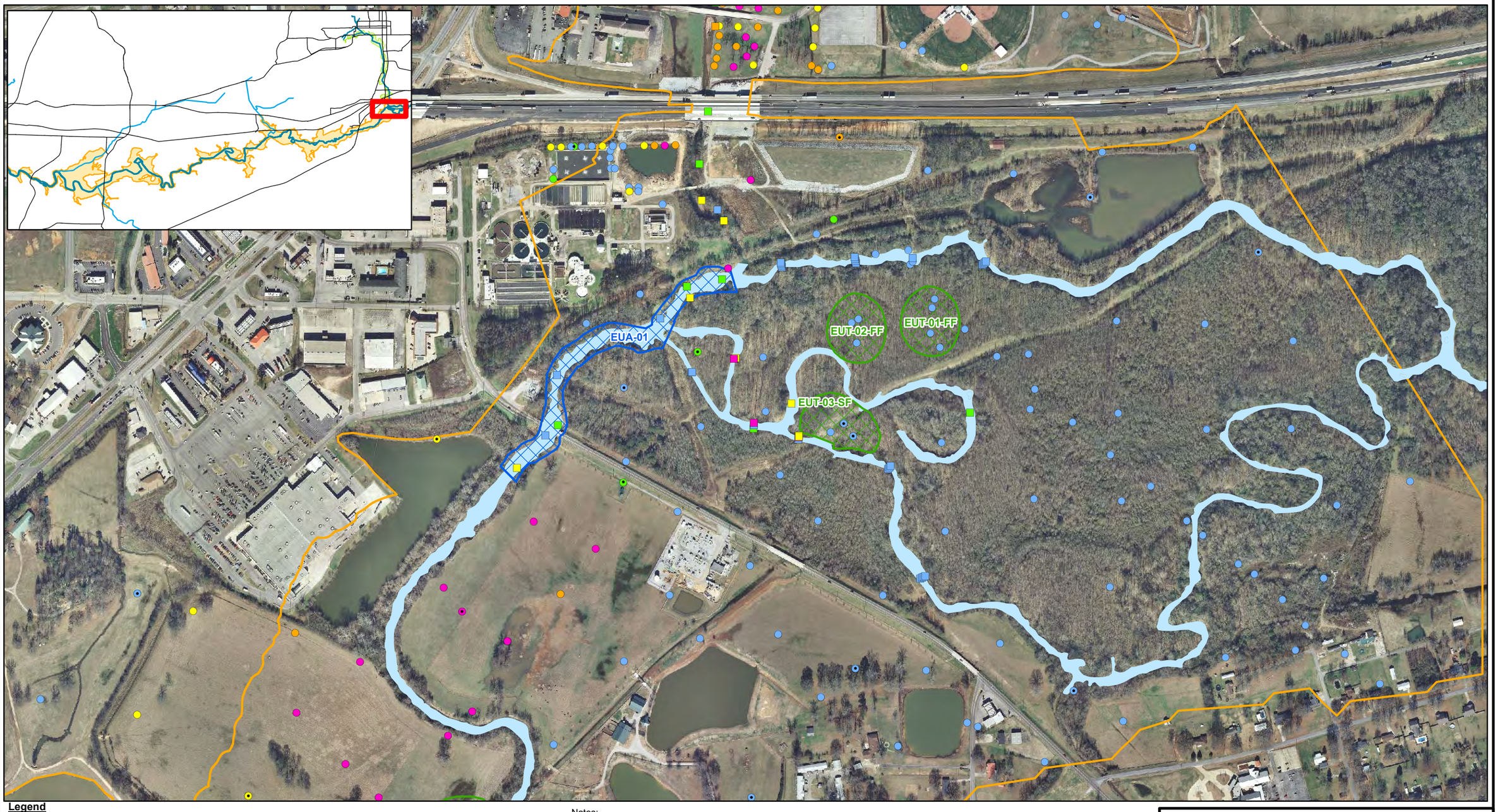
Baseline Ecological Risk Assessment for OU-4

OU-4 Whole Water Surface Water Sampling Locations

Solutia

Figure 3-2

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\SurfaceWaterSamplingProgram_v2.mxd 9/13/2016 1:19:07 PM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

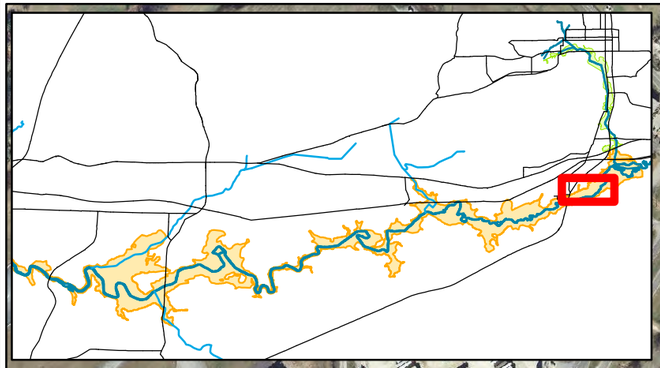
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Upper Assessment Area
EUA-01, EUT-01, EUT-02, and EUT-03

Solutia

Figure
3-3a

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map1.mxd 9/30/2014 1:48:53 PM



EUT-04-MF

EUT-05-MF

EUT-07-SF

EUT-06-MF

EUA-02

Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
MF: maintained field
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

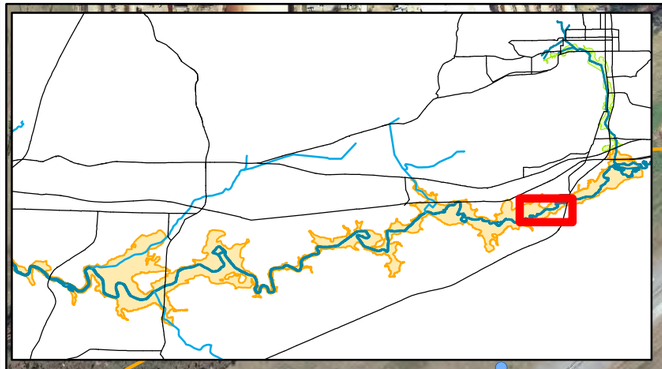
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Upper Assessment Area
EUA-02, EUT-04, EUT-05, EUT-06, and EUT-07

Solutia

Figure
3-3b

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map2.mxd 9/30/2014 1:49:03 PM



EUT-08-SF

EUT-09-FF

EUA-03

Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

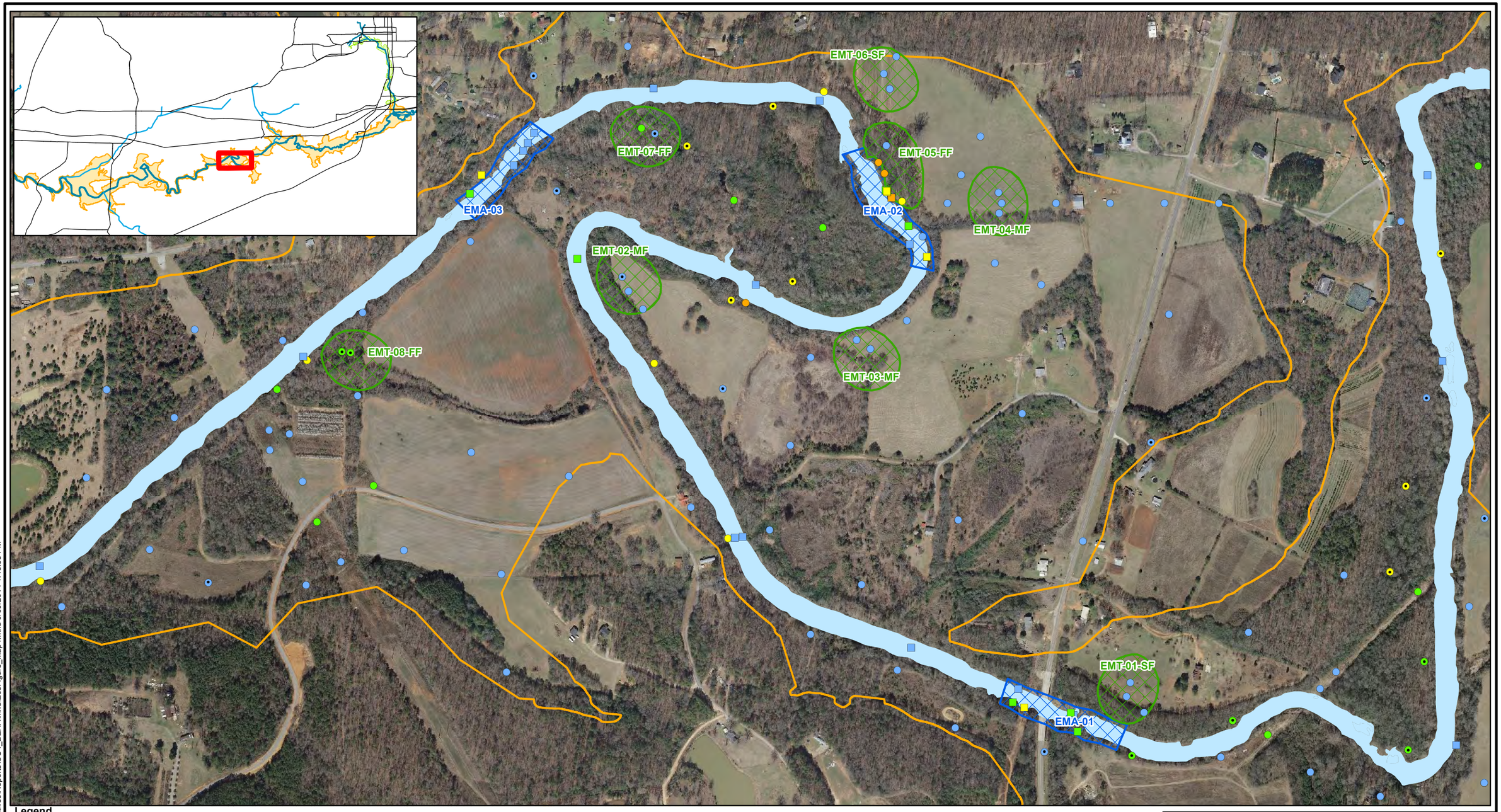
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Upper Assessment Area
EUA-03, EUT-08, and EUT-09

Solutia

Figure
3-3c

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALM\XDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map3.mxd 9/30/2014 1:48:55 PM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
MF: maintained field
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

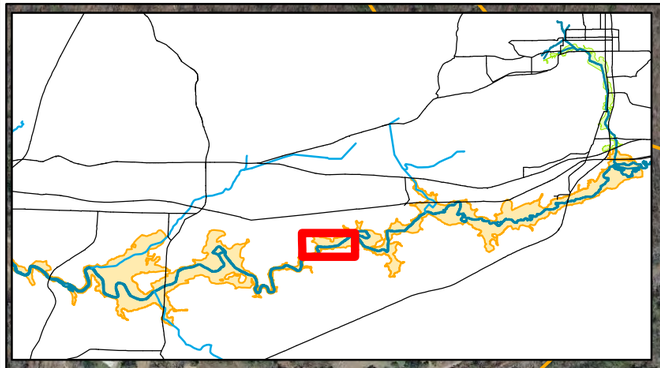
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Middle Assessment Area
EMA-01, EMA-02, EMA-03, EMT-01, EMT-02, EMT-03, EMT-04, EMT-05, EMT-06, EMT-07, and EMT-08

Solutia

Figure
3-3d

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map4.mxd 9/30/2014 1:48:58 PM



EMA-03

EMT-08-FF

EMT-09-SF

Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional forest

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

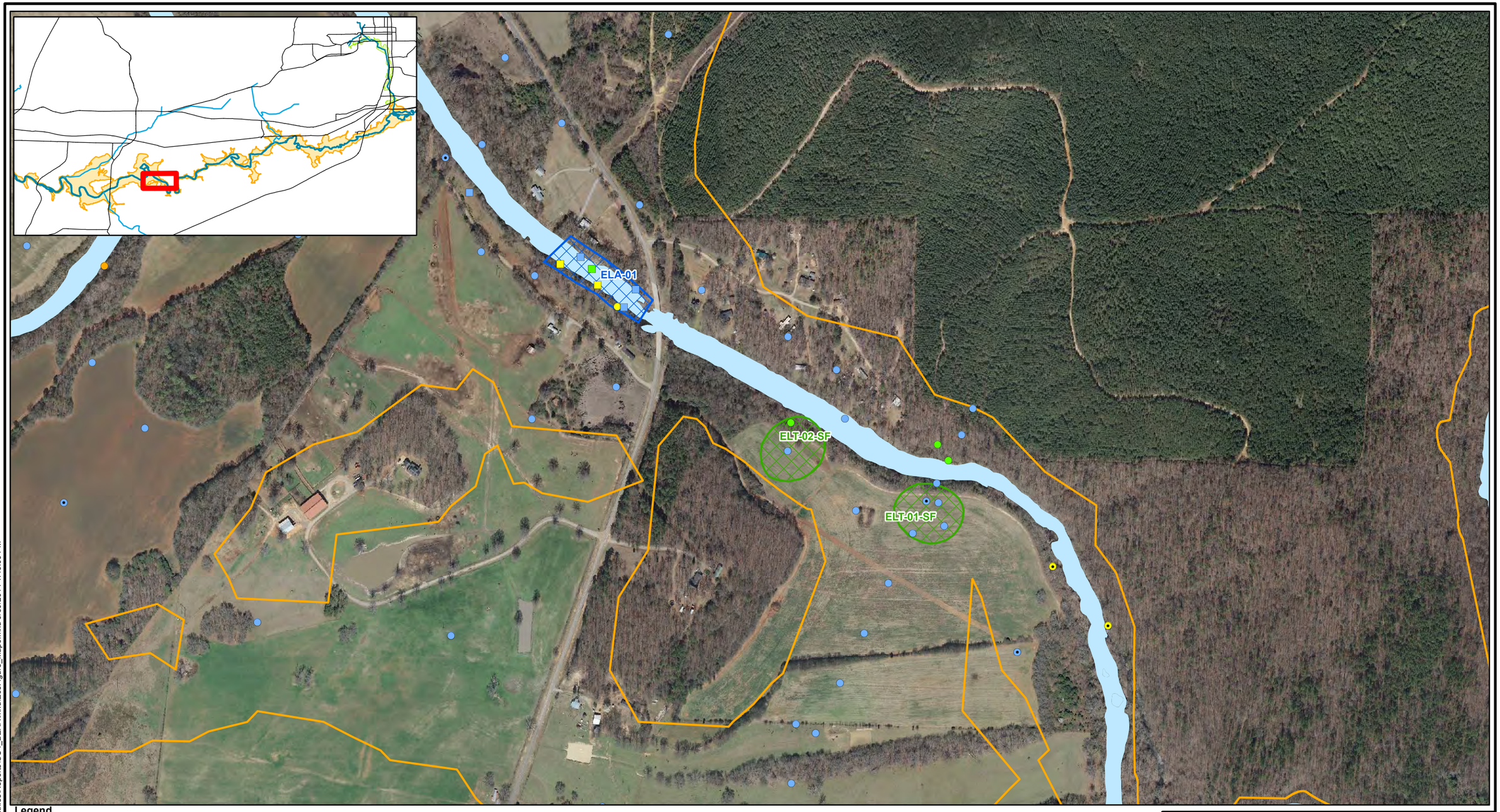
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Middle Assessment Area
EMT-09, EMA-03, and EMT-08

Solutia

Figure
3-3e

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map5.mxd 9/30/2014 1:49:06 PM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

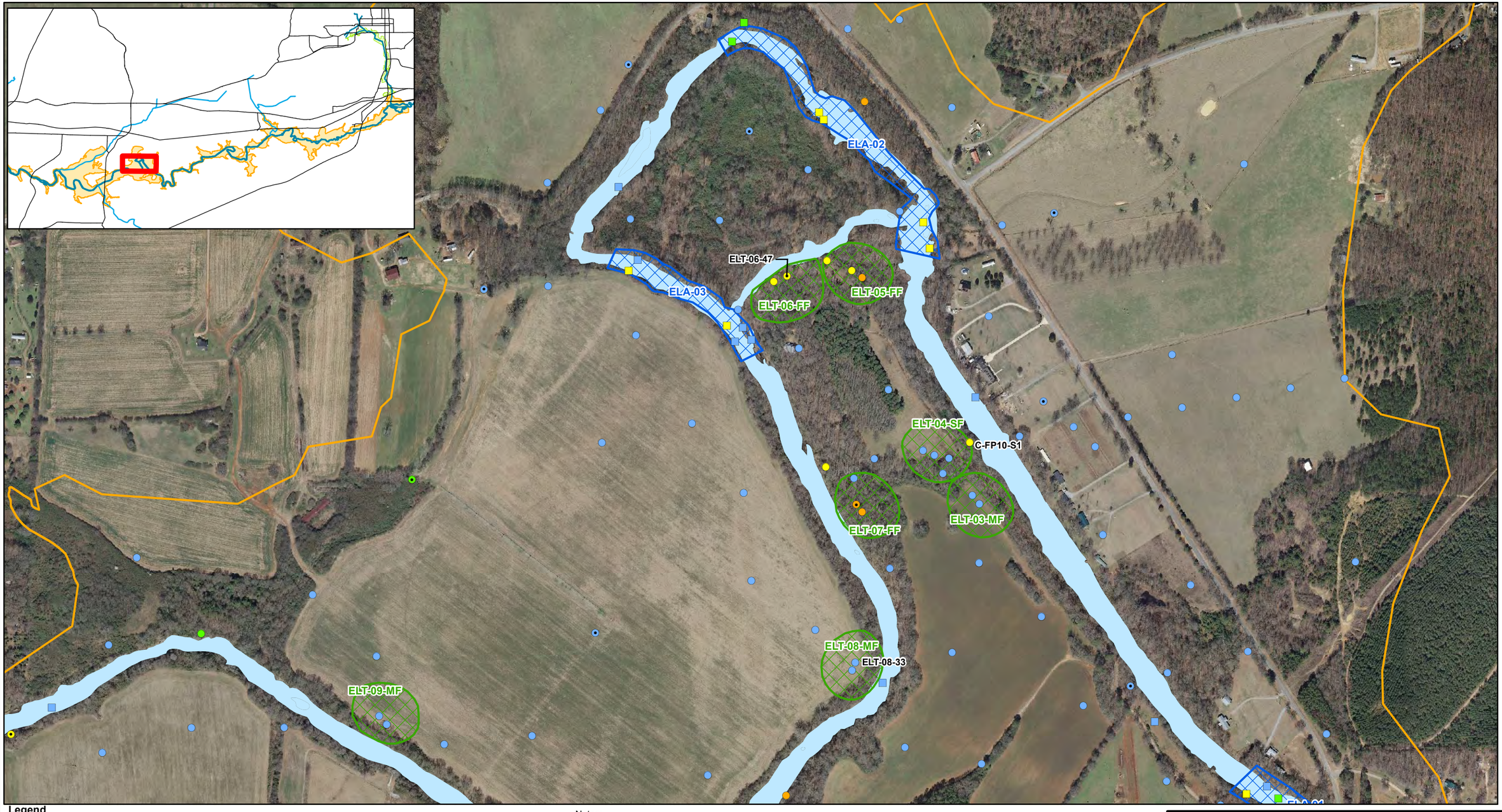
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Lower Assessment Area
ELA-01, ELT-01, and ELT-02

Solutia

Figure 3-3f

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALWXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map6.mxd 9/30/2014 1:49:09 PM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Creek
- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
4. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
MF: maintained field
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

0 500 1,000 Feet
Graphic Scale

Anniston PCB Site
Anniston, Alabama

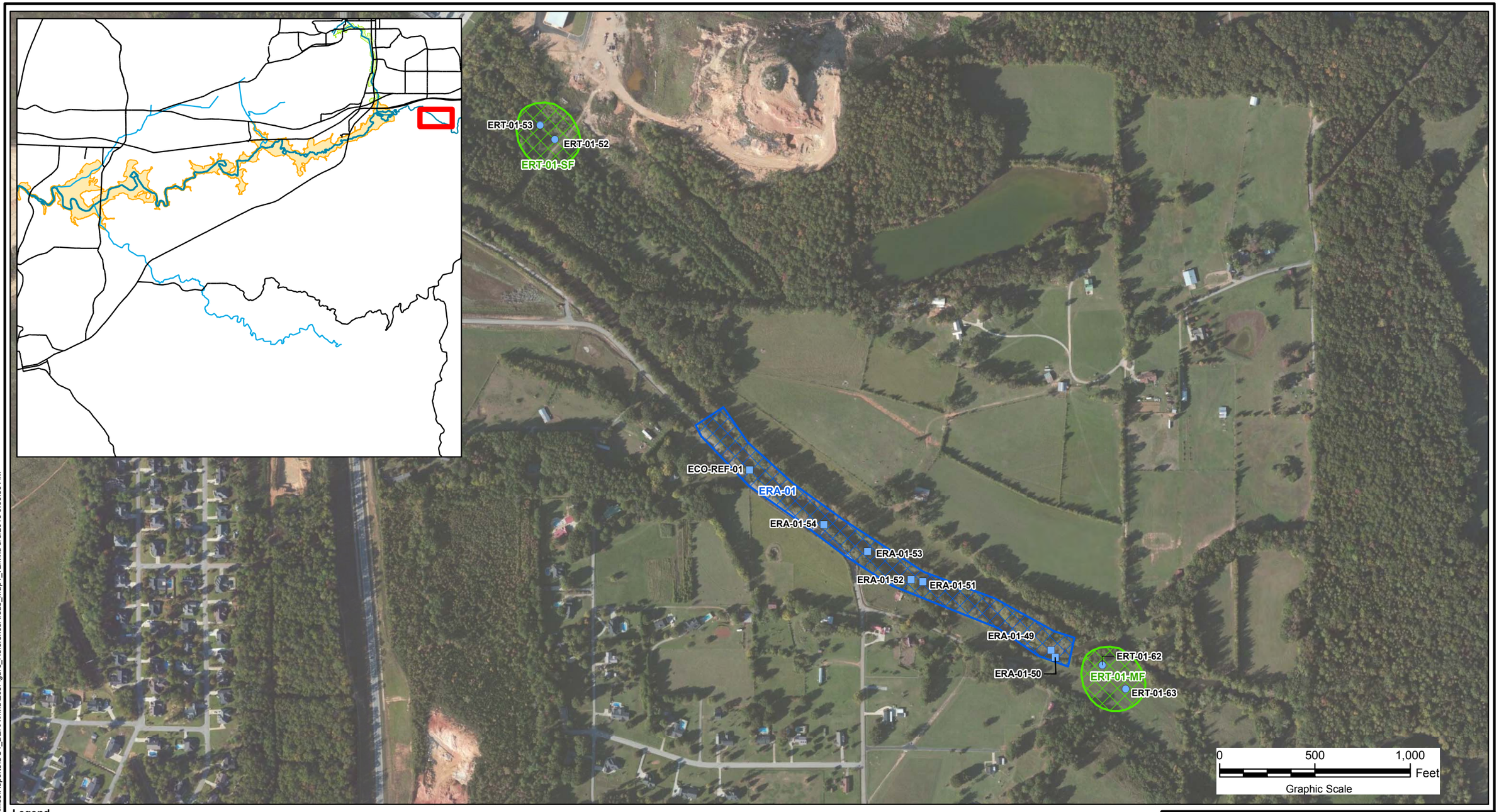
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Lower Assessment Area
ELA-02, ELA-03, ELT-03, ELT-04, ELT-05, ELT-06, ELT-07, ELT-08, and ELT-09

Solutia

Figure
3-3g

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_Map7.mxd 9/30/2014 1:49:01 PM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]

Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
3. Imagery provided by NAIP imagery service licensed through ESRI product software.

Acronyms:
BSA: biological sampling area
in: inches
MF: maintained field
mg/kg: milligrams per kilogram
SF: successional field

Anniston PCB Site
Anniston, Alabama

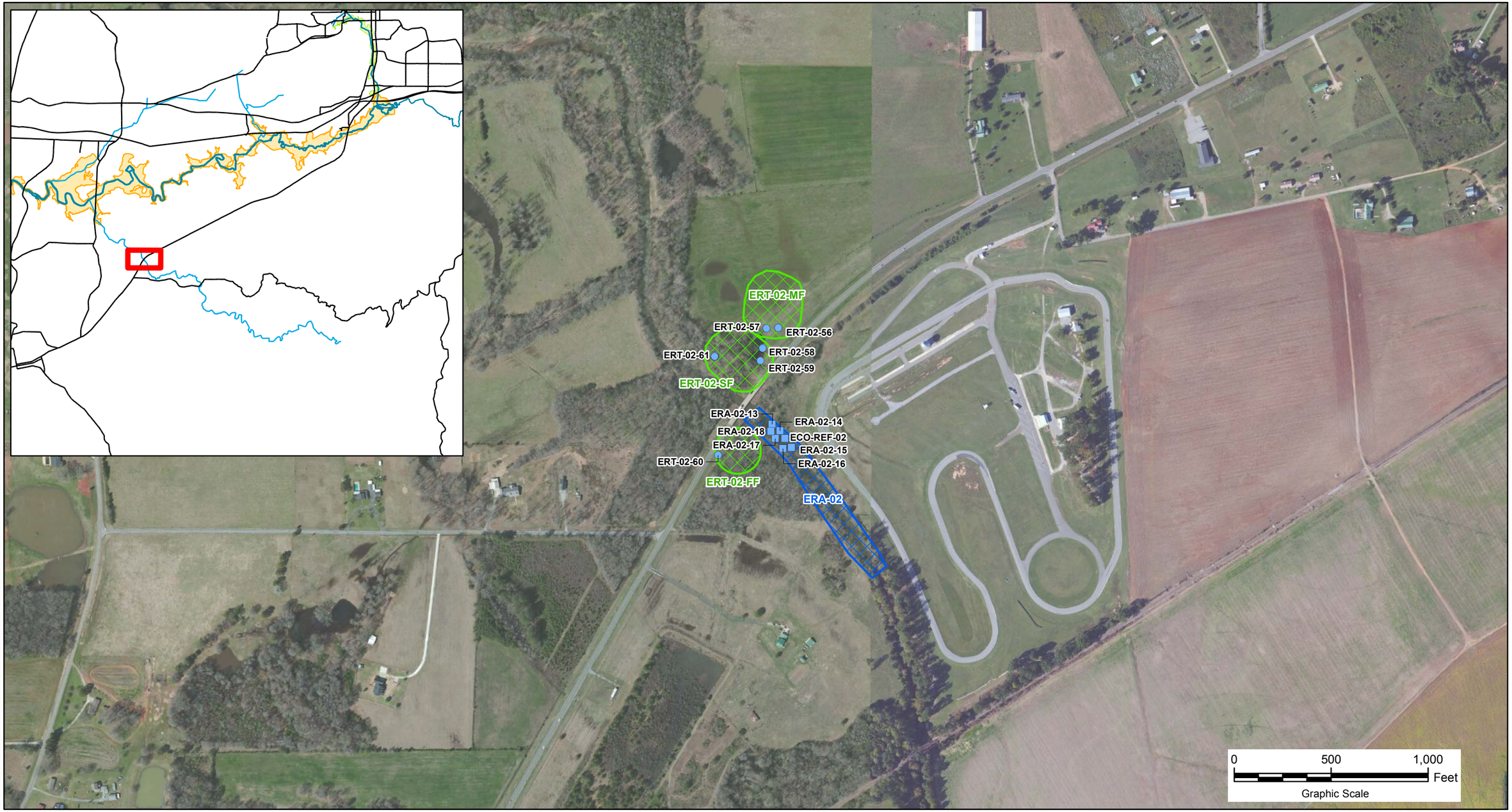
Baseline Ecological Risk Assessment for OU-4

**Biological Sample Areas and Locations
Reference Area 1
ERA-01 and ERT-01**

Solutia

Figure
3-3h

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALL\MXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_ReferenceAreas_Map1_v2.mxd 3/6/2015 9:39:55 AM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.

3. Imagery provided by NAIP imagery service licensed through ESRI product software.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
in: inches
MF: maintained field
mg/kg: milligrams per kilogram
OU: operable unit
SF: successional field

Anniston PCB Site
Anniston, Alabama

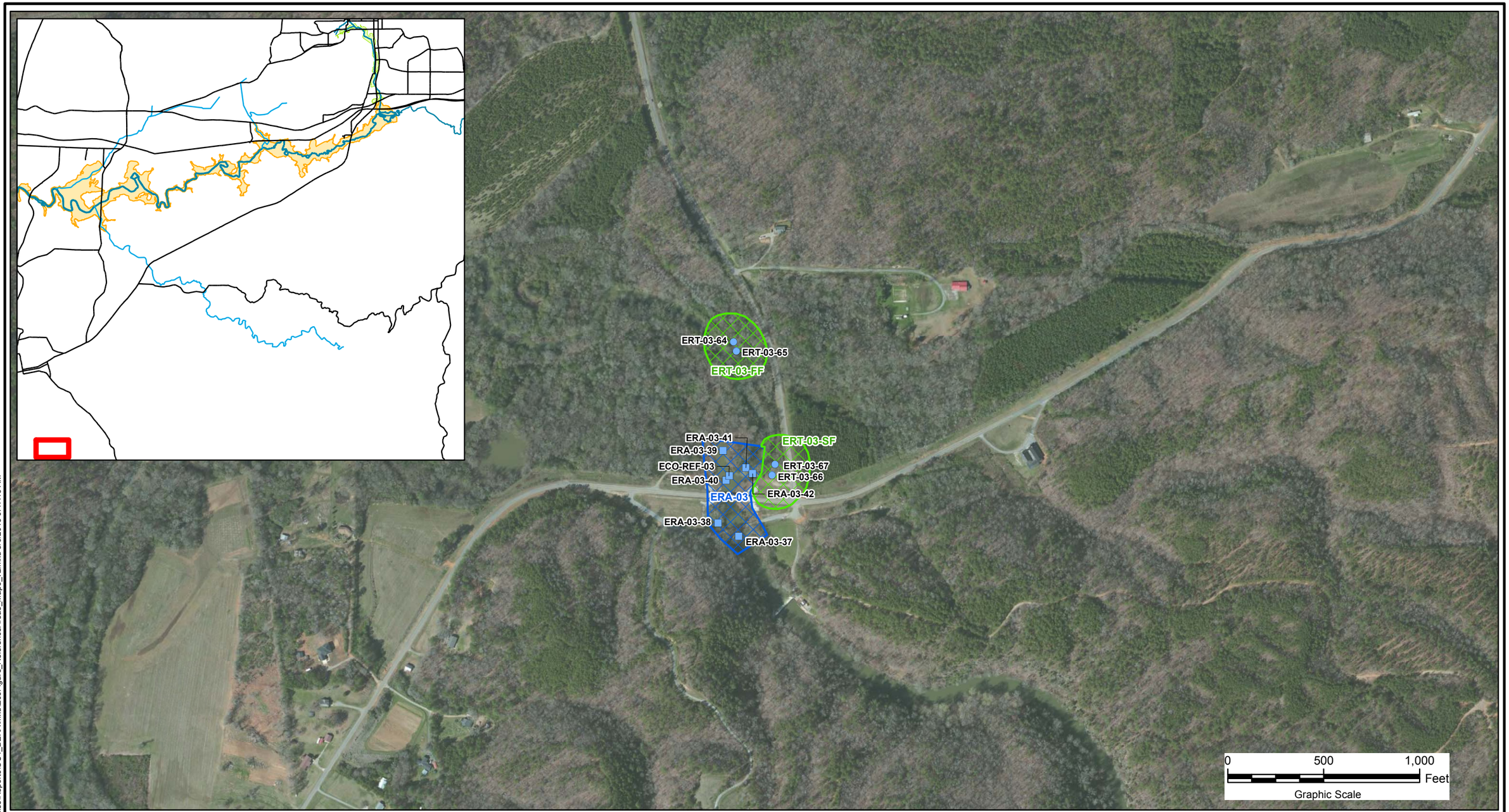
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Reference Area 2
ERA-02 and ERT-02

Solutia

Figure
3-3i

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Arniston
Q:\Anniston_PCB_site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_ReferenceAreas_Map2_v2.mxd 3/6/2015 9:38:42 AM



Legend

Surface[1] Sediment Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

Surface[2] Soil Sample Location
PCB Result (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Approximate Area of Aquatic BSA - OU-4 Phase 2 Ecological Sampling[3]
- Approximate Area of Terrestrial BSA - OU-4 Phase 2 Ecological Sampling[3]

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Paired biota and soil or sediment data collected in the BSA areas.
3. Imagery provided by NAIP imagery service licensed through ESRI product software.

Acronyms:
BSA: biological sampling area
FF: forested floodplain
in: inches
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl
SF: successional field

Anniston PCB Site
Anniston, Alabama

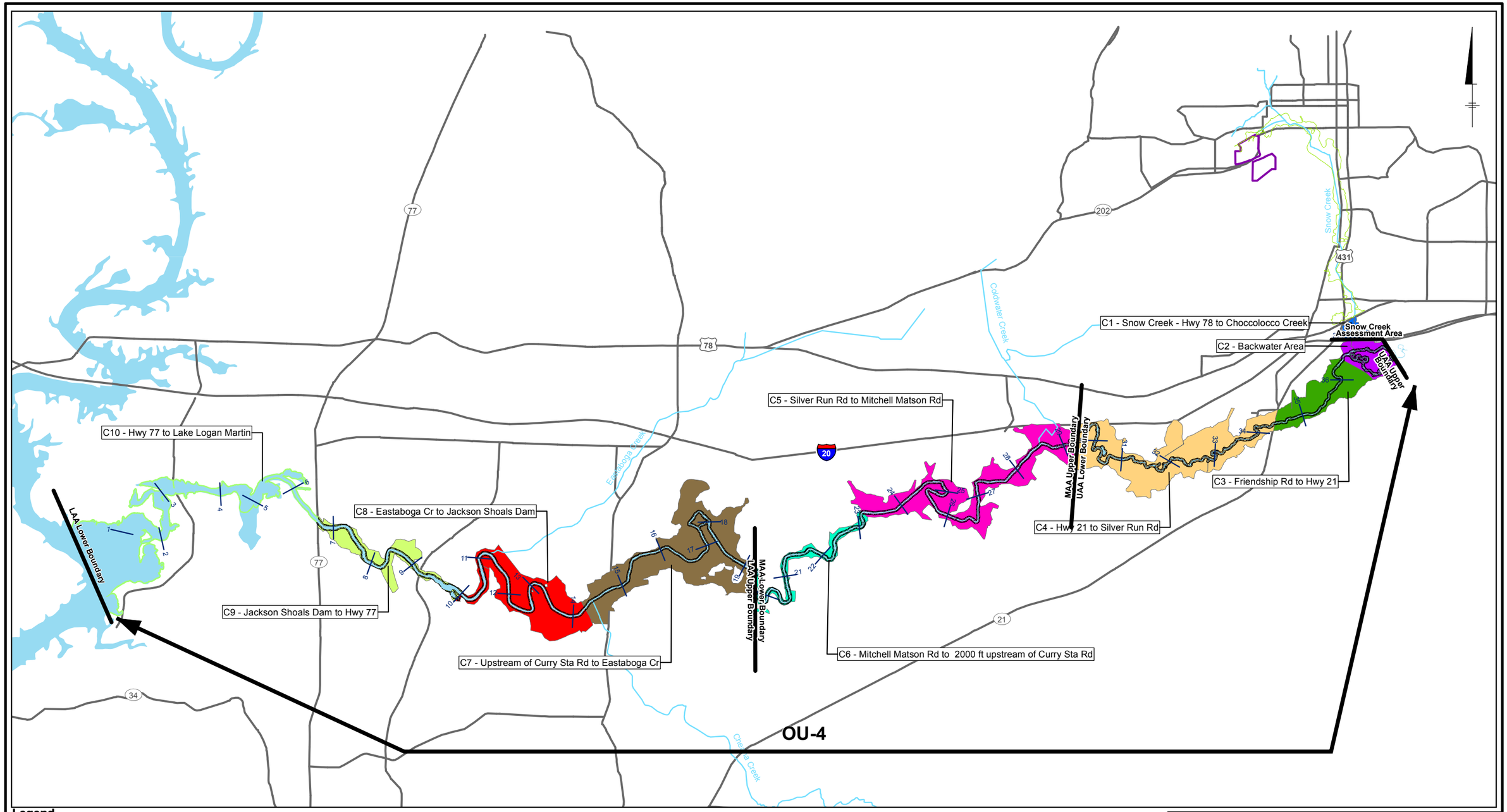
Baseline Ecological Risk Assessment for OU-4

Biological Sample Areas and Locations
Reference Area 3
ERA-03 and ERT-03

Solutia

Figure
3-3j

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALLMXDs_Printfiles\Reports\OU4_BERA\mxd\EcoFigure_ReferenceAreas_Map3_v2.mxd 3/6/2015 9:47:15 AM



Legend

- Assessment Area Boundary
- River Mile
- Other Tributaries
- Major Roadway
- Riparian Corridor
- OU-1/OU-2 Downgradient Floodplain
- OU-3 Boundary
- Choccolocco Creek

Ecological Reaches

- C1- Snow Creek - Hwy 78 to Choccolocco Creek
- C2 - Backwater Area
- C3 - Friendship Rd to Hwy 21
- C4 - Hwy 21 to Silver Run Rd
- C5 - Silver Run Rd to Mitchell Matson Rd
- C6 - Mitchell Matson Rd to 2000 ft upstream of Curry Sta Rd
- C7 - Upstream of Curry St Rd to Eastaboga Cr
- C8 - Eastaboga Cr to Jackson Shoals Dam
- C9 - Jackson Shoals to Hwy 77
- C10 - Hwy 77 to Lake Logan Martin

0 7,500 15,000 Feet

Graphic Scale

Acronyms:
Cr: creek
ft: feet
Hwy: highway
OU: operable unit
Rd: road
Sta: station

Anniston PCB Site
Anniston, Alabama

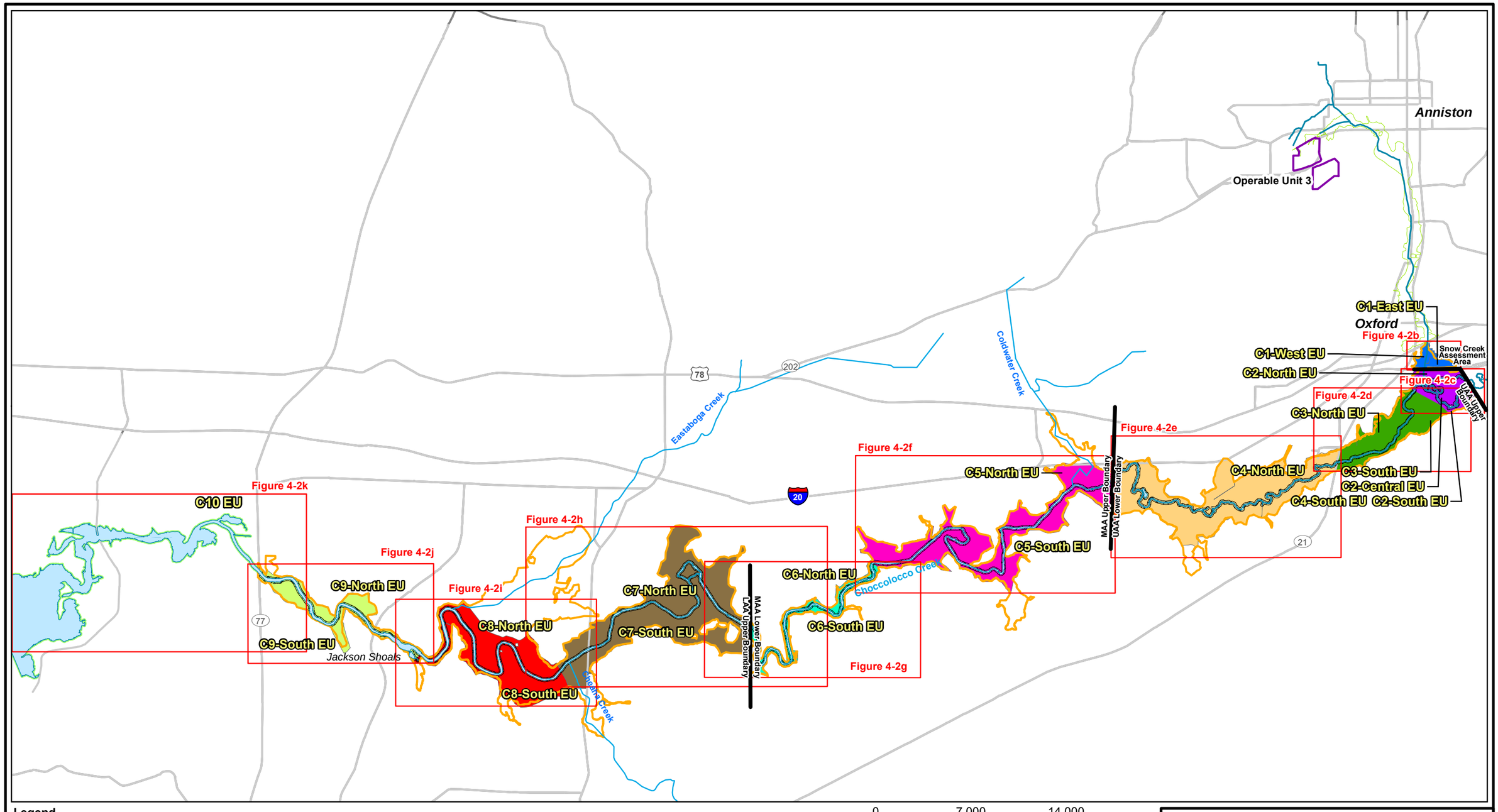
Baseline Ecological Risk Assessment for OU-4

OU-4 Ecological Reaches

Solutia

Figure
4-1

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\EcoReaches_ES-1_v2.mxd 10/18/2016 5:19:54 PM



Legend

- Assessment Area Boundary
- Major Roadway
- OU-3 Boundary
- OU-1/OU-2 Downgradient Floodplain
- OU-4 100-Year Floodplain
- Choccolocco Creek
- Riparian Corridor

Reaches

- C1- Snow Creek - Hwy 78 to Choccolocco Creek
- C2 - Backwater Area
- C3 - Friendship Rd to Hwy 21
- C4 - Hwy 21 to Silver Run Rd
- C5 - Silver Run Rd to Mitchell Matson Rd
- C6 - Mitchell Matson Rd to 2000 ft upstream of Curry Sta Rd
- C7 - Upstream of Curry St Rd to Eastaboga Cr
- C8 - Eastaboga Cr to Jackson Shoals Dam
- C9 - Jackson Shoals to Hwy 77
- C10 - Hwy 77 to Lake Logan Martin (In-Stream Sediment Only)

0 7,000 14,000 Feet

Graphic Scale

Notes:
1. EUs were identified for in-stream sediment (C1 through C10) and riparian/floodplain soil (C2 through C9).

Acronyms:
Cr: creek
EU: exposure unit
ft = feet
Hwy: highway
OU: operable unit
Rd: road
Sta: station

Anniston PCB Site
Anniston, Alabama

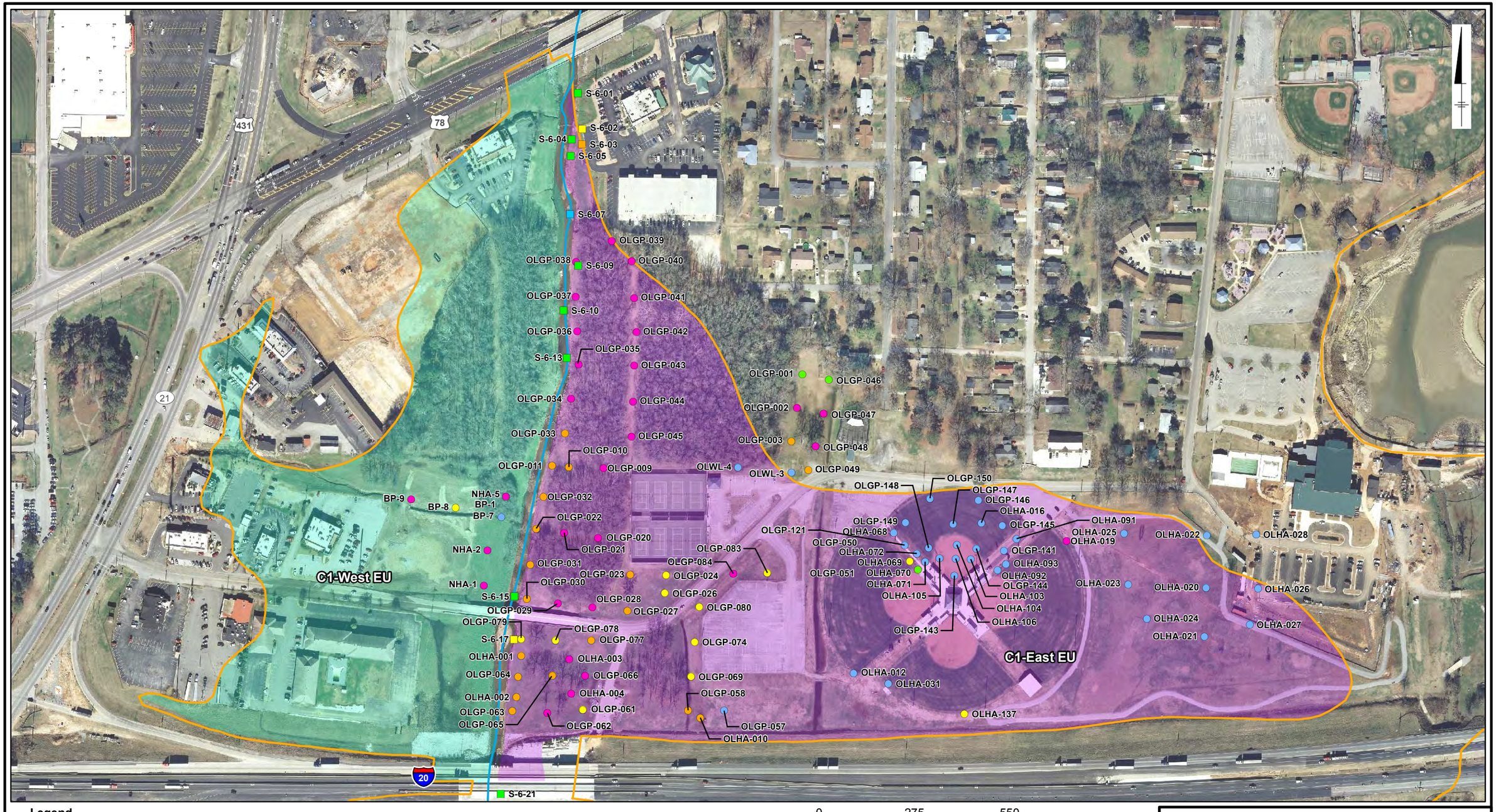
Baseline Ecological Risk Assessment for OU-4

Key for PCB Soil and Sediment Results by Exposure Unit

Solutia

Figure 4-2a

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: Kives
AnnistonAL
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_KEYMAP.mxd 10/20/2016 4:30:28 PM



Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Snow Creek Centerline
- C1-East EU
- C1-West EU
- OU-4 100-Year Floodplain

0 275 550 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

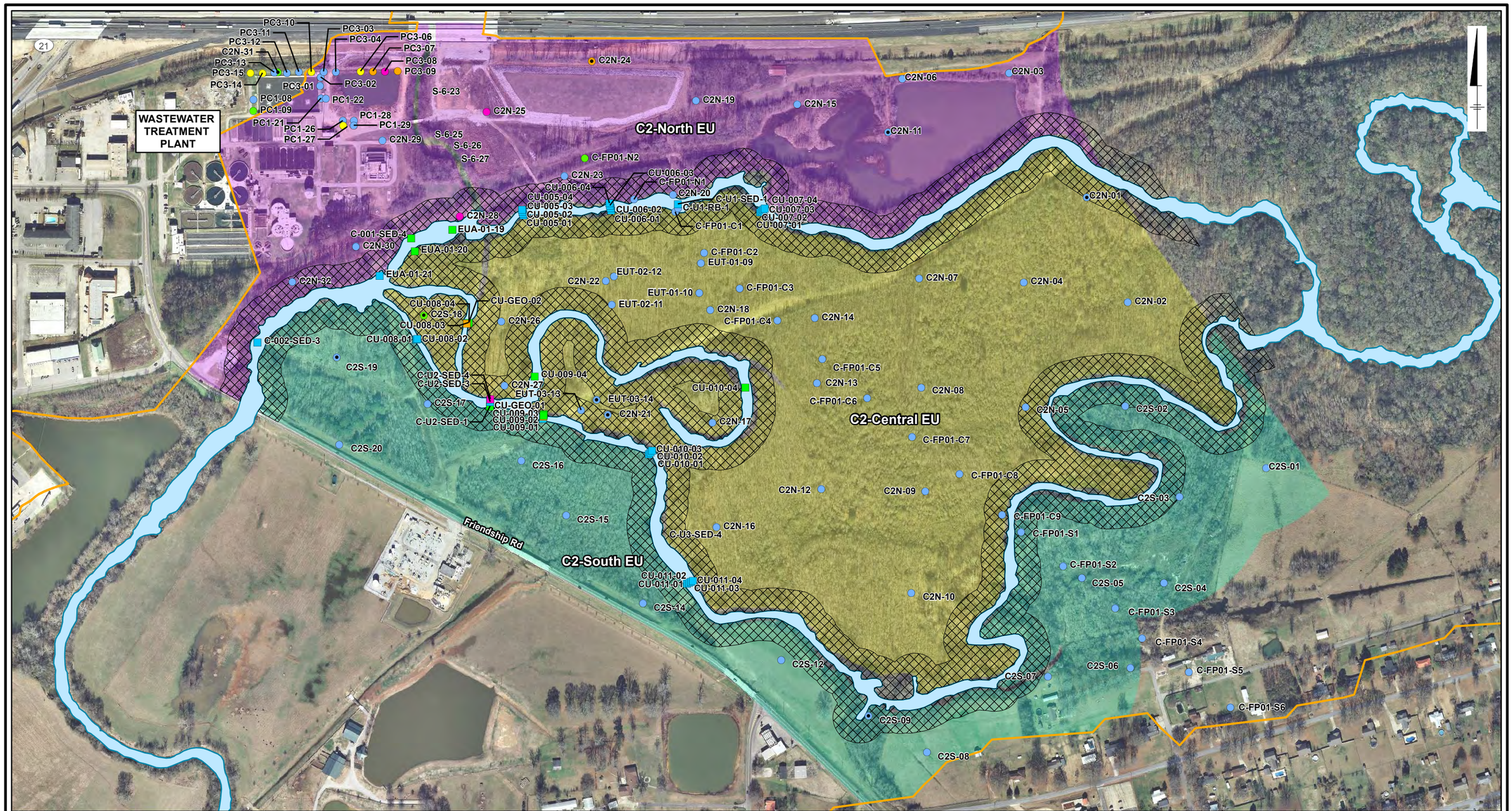
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C1-East EU and C1-West EU

Solutia

Figure
4-2b

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C1.mxd 9/30/2014 2:19:39 PM



Legend

Surface[1] Sediment Sample Location
Total PCB Concentration (mg/kg)
- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location
Total PCB Concentration (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C2-North EU
- C2-Central EU
- C2-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 425 850 Feet
Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

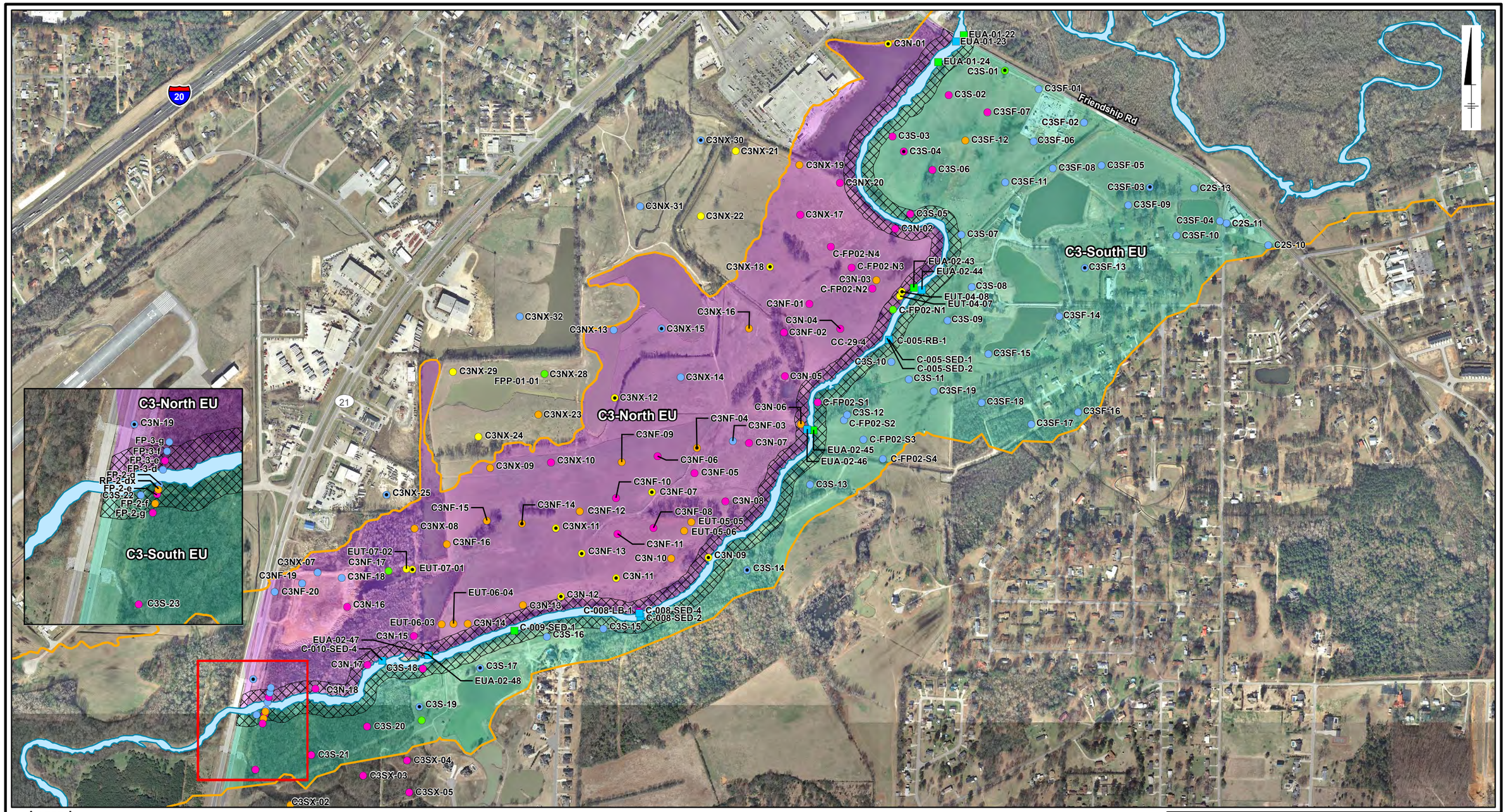
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C2-North EU, C2-Central EU, and C2-South EU

Solutia

Figure **4-2c**

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C2.mxd 9/30/2014 2:19:36 PM



City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C3.mxd 9/30/2014 2:19:20 PM

Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C3-North EU
- C3-South EU

- Choccolocco Creek
- OU-4 100-Year Floodplain

0 800 1,600 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

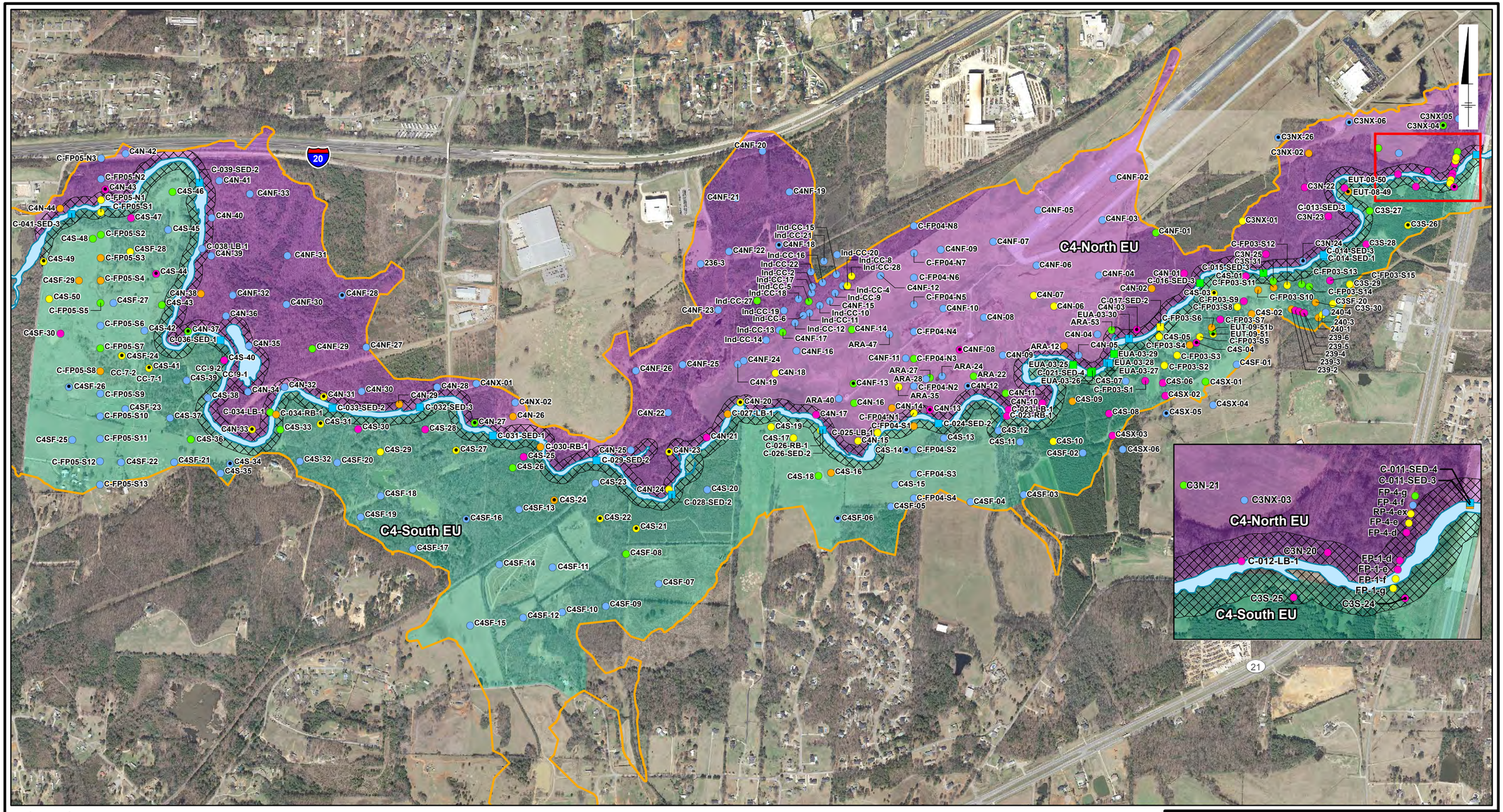
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C3-North EU and C3-South EU

Solutia

Figure
4-2d



City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALI\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C4.mxd 9/12/2016 3:44:13 PM

Legend

Surface[1] Sediment Sample Location
Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location
Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C4-North EU
- C4-South EU

- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,175 2,350 Feet
Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

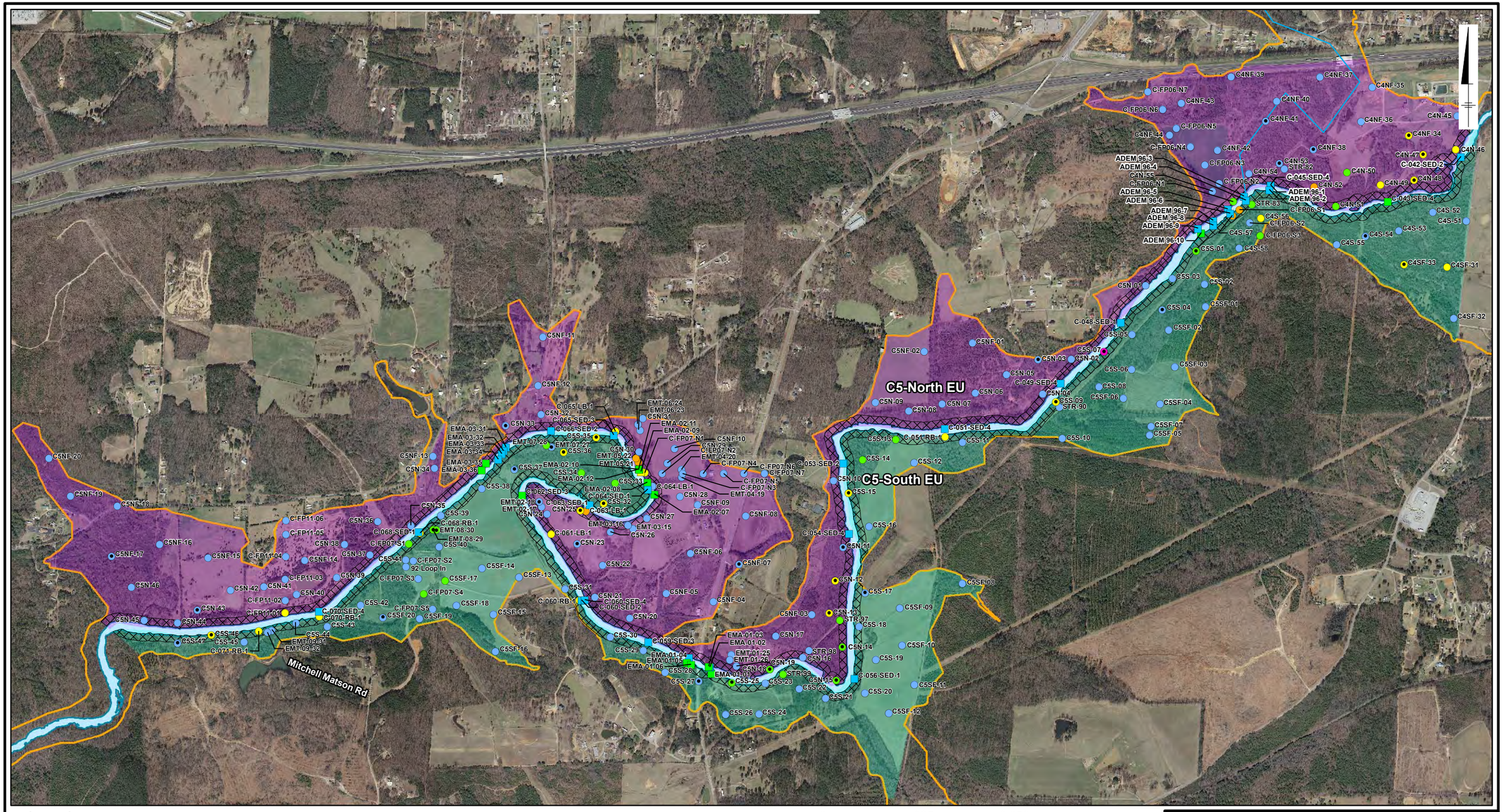
Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C4-North EU and C4-South EU

Solutia

Figure
4-2e



Legend

Surface[1] Sediment Sample Location
Total PCB Concentration (mg/kg)
- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location
Total PCB Concentration (mg/kg)
- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C5-North EU
- C5-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,325 2,650 Feet
Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

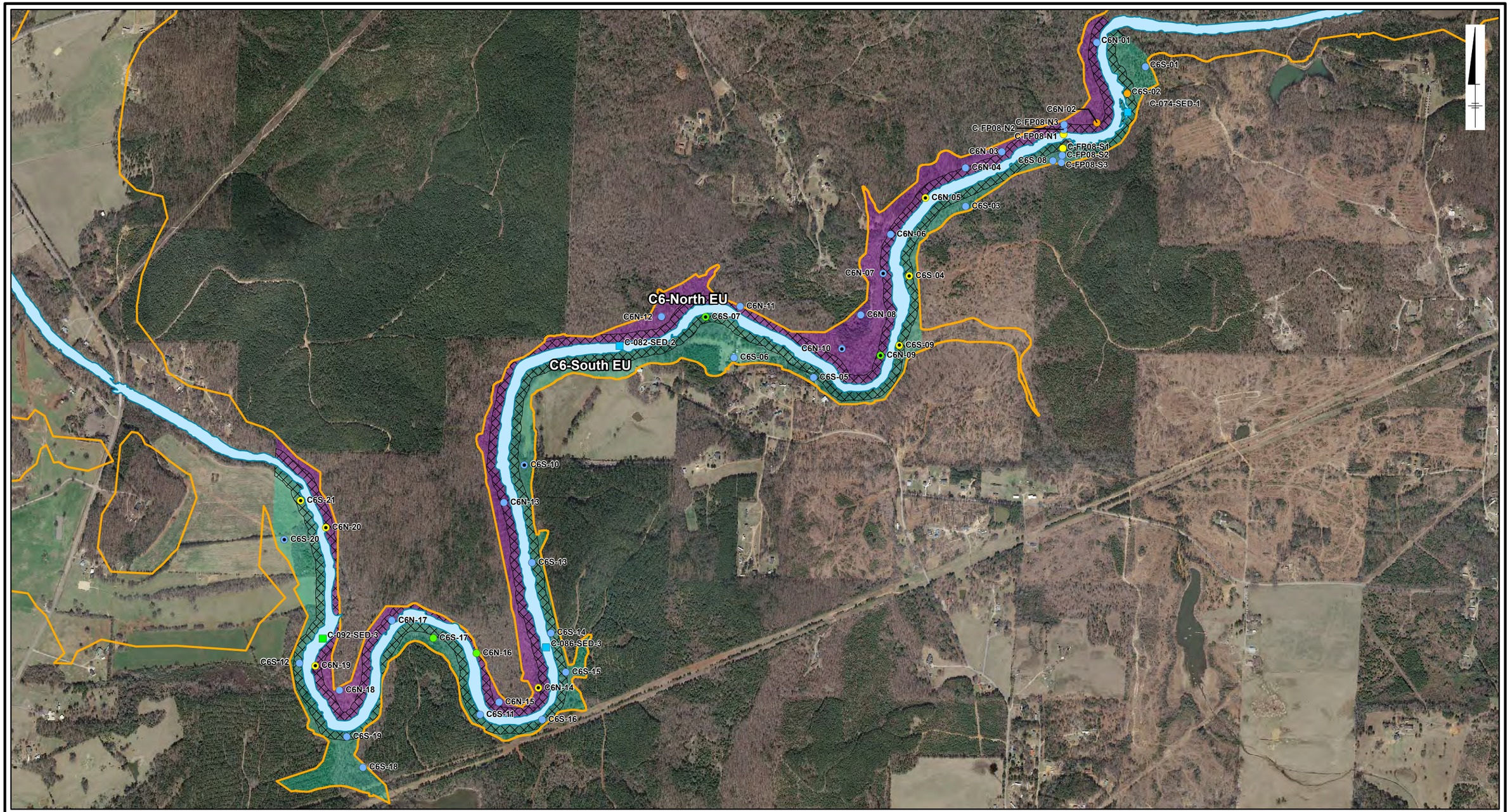
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C5-North EU and C5-South EU

Solutia

Figure
4-2f

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C5.mxd 9/12/2016 3:31:49 PM



City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C6.mxd 9/30/2014 2:19:26 PM

Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C6-North EU
- C6-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,100 2,200 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

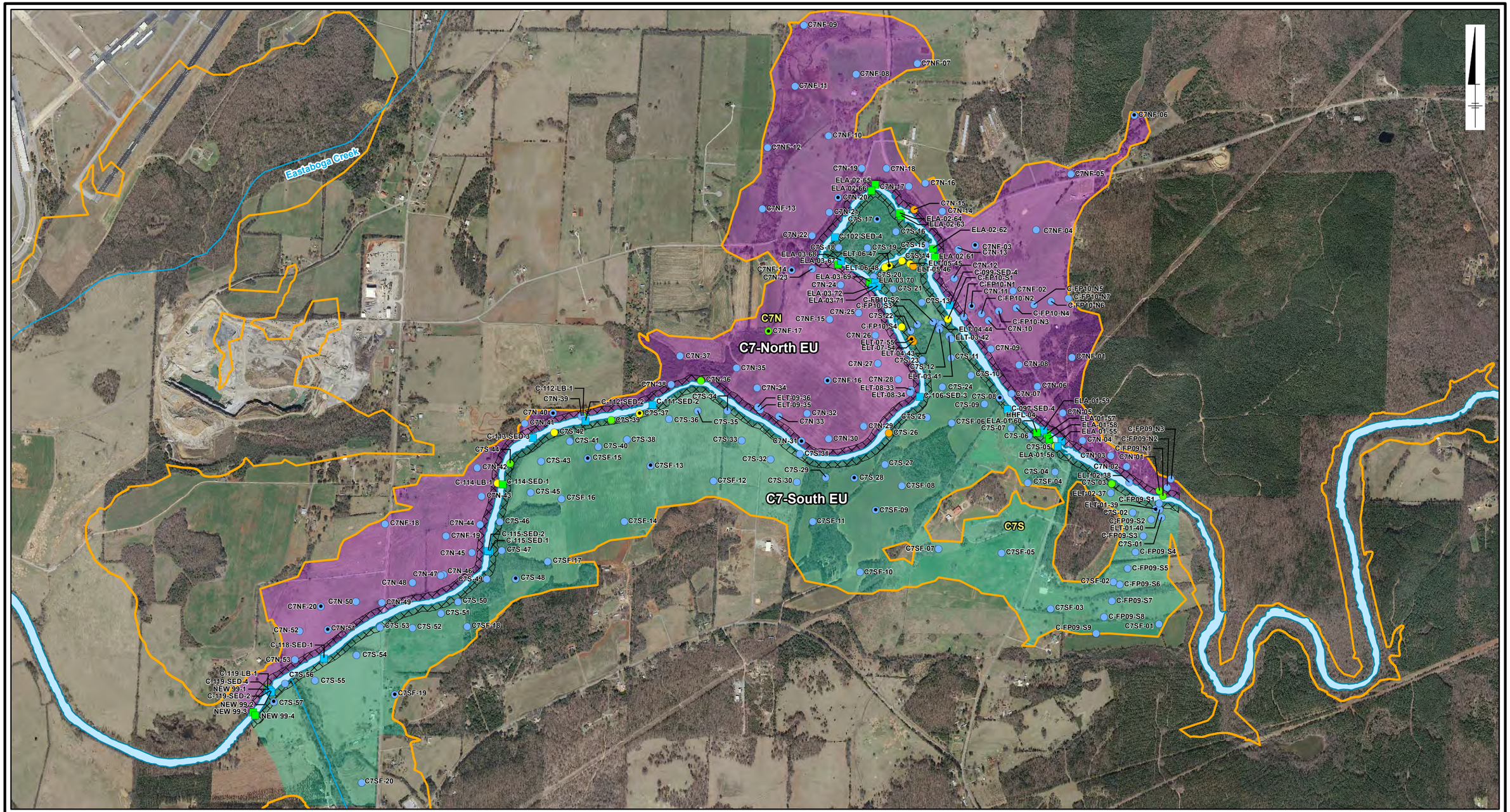
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C6-North EU and C6-South EU

Solutia

Figure
4-2g



Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C7-North EU
- C7-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,550 3,100 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

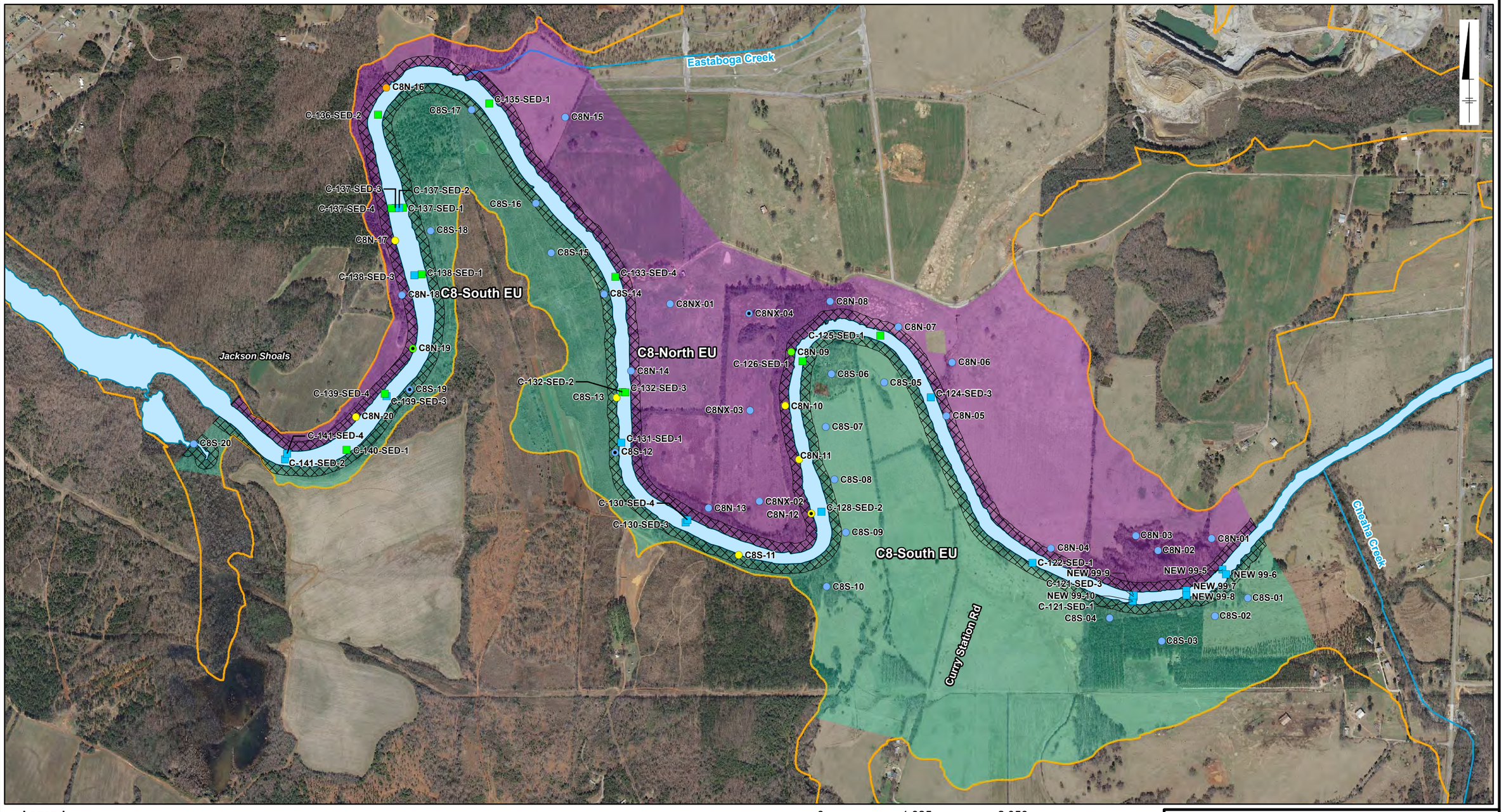
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C7-North EU and C7-South EU

Solutia

Figure 4-2h

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: k.ives
Anniston
Q:\Anniston_PCB_Site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C7.mxd 9/30/2014 2:19:41 PM



Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C8-North EU
- C8-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,025 2,050 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

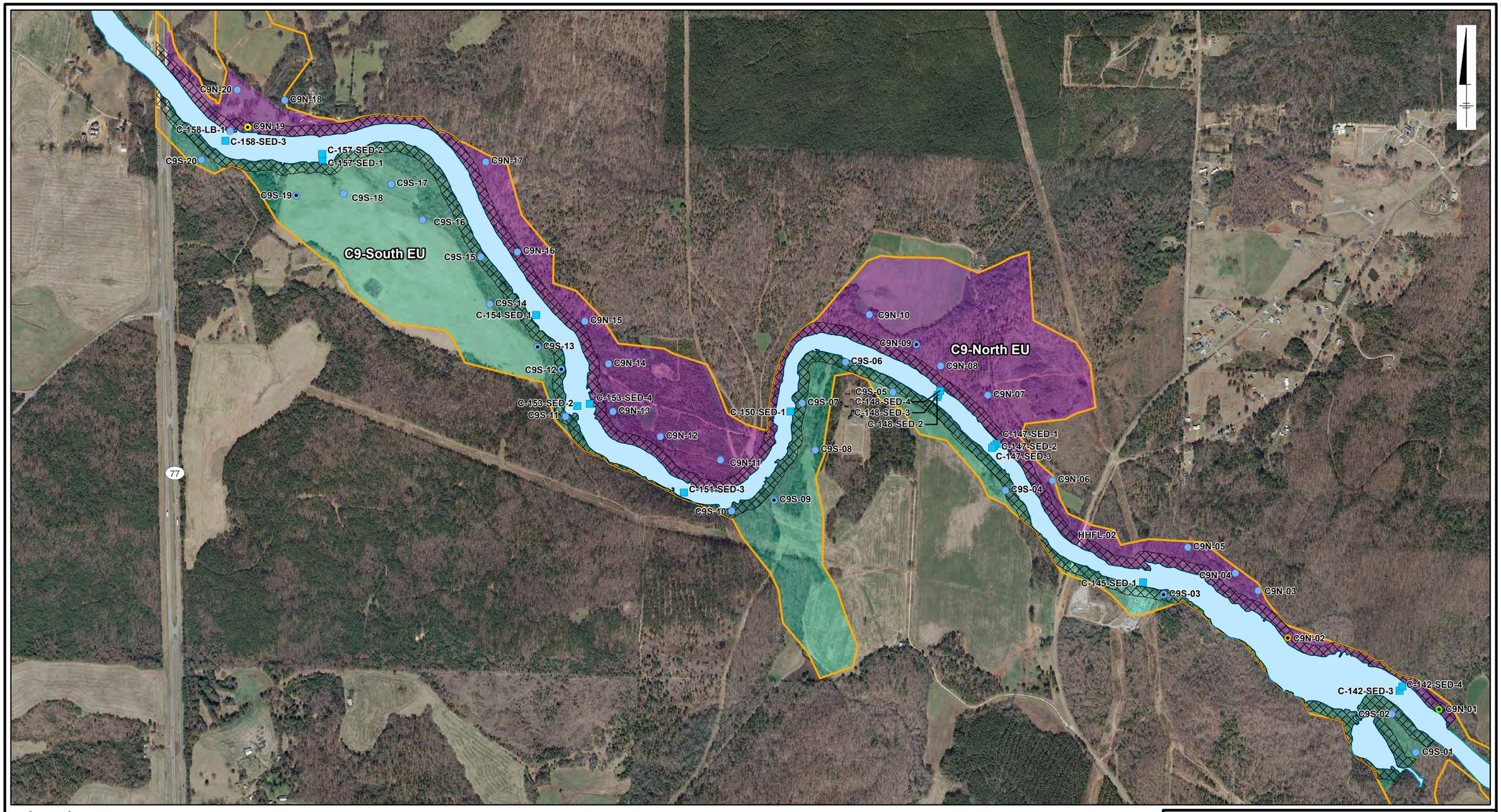
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C8-North EU and C8-South EU

Solutia

Figure **4-2i**

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: k.ives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C8.mxd 9/30/2014 2:19:47 PM



Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Samples Analyzed for Constituents Other than PCBs
- Riparian EU
- C9-North EU
- C9-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 950 1,900 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

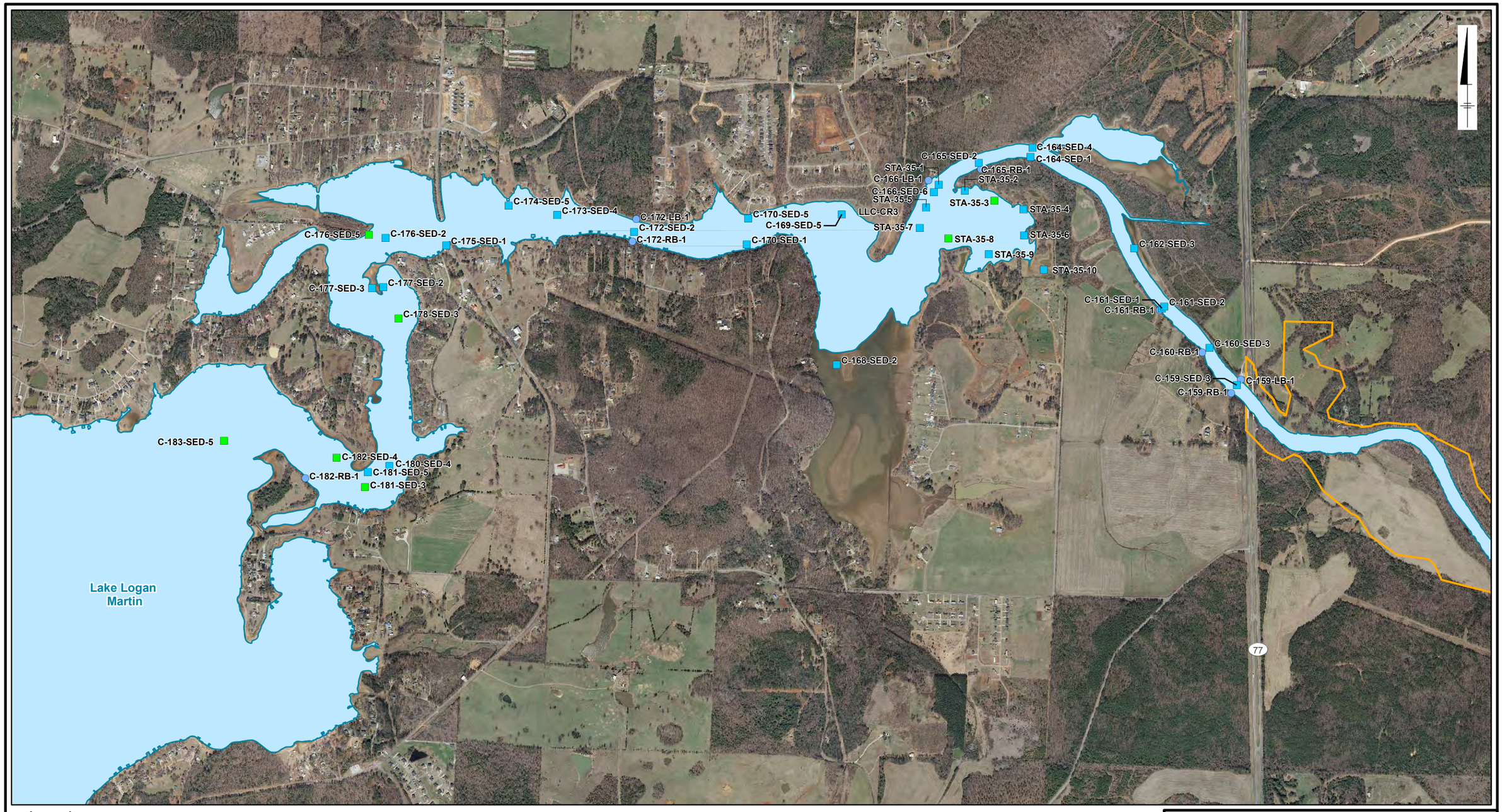
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C9-North EU and C9-South EU

Solutia

Figure
4-2j

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C9.mxd 9/30/2014 2:19:44 PM



Legend

Surface[1] Sediment Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00 - 4.99
- 5.00 - 9.99
- 10.00 - 49.99
- ≥ 50

Surface[2] Soil Sample Location

Total PCB Concentration (mg/kg)

- < 1
- 1.00- 1.99
- 2.00 - 4.99
- 5.00 - 9.99
- ≥ 10

- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,500 3,000 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

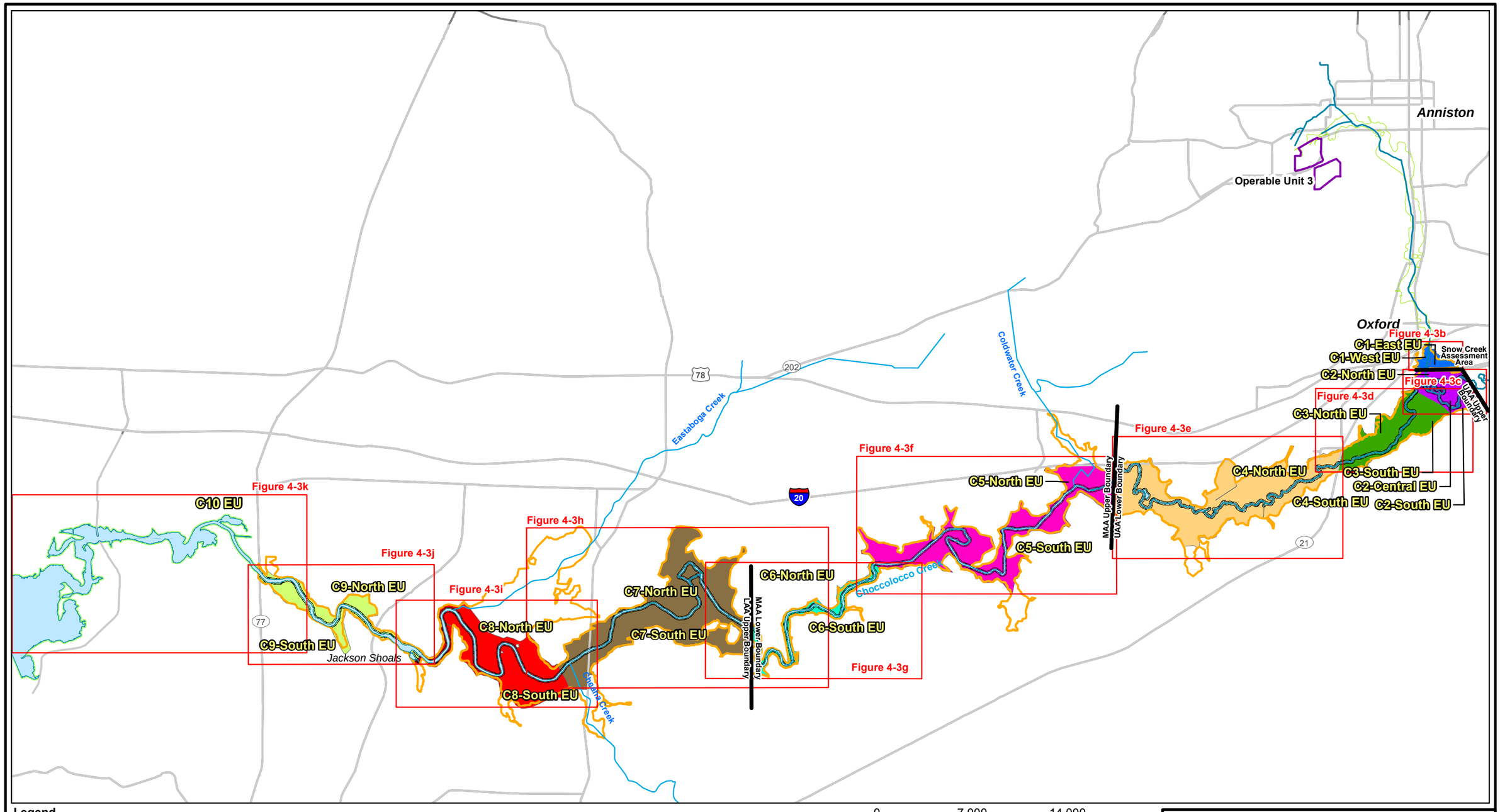
Baseline Ecological Risk Assessment for OU-4

PCB Soil and Sediment Results for C10

Solutia

Figure
4-2k

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: kives
Anniston
Q:\Anniston_PCB_Site\Anniston\ALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilPCB_C10.mxd 9/30/2014 2:19:51 PM



Legend

- Assessment Area Boundary
- Major Roadway
- OU-3 Boundary
- OU-1/OU-2 Downgradient Floodplain
- OU-4 100-Year Floodplain
- Choccolocco Creek
- Riparian Corridor

Reaches

- C1- Snow Creek - Hwy 78 to Choccolocco Creek
- C2 - Backwater Area
- C3 - Friendship Rd to Hwy 21
- C4 - Hwy 21 to Silver Run Rd
- C5 - Silver Run Rd to Mitchell Matson Rd
- C6 - Mitchell Matson Rd to 2000 ft upstream of Curry Sta Rd
- C7 - Upstream of Curry St Rd to Eastaboga Cr
- C8 - Eastaboga Cr to Jackson Shoals Dam
- C9 - Jackson Shoals to Hwy 77
- C10 - Hwy 77 to Lake Logan Martin (In-Stream Sediment Only)

0 7,000 14,000 Feet

Graphic Scale

Notes:
1. EUs were identified for in-stream sediment (C1 through C10) and riparian/floodplain soil (C2 through C9).

Acronyms:
Cr: creek
EU: exposure unit
ft = feet
Hwy: highway
OU: operable unit
Rd: road
Sta: station

Anniston PCB Site
Anniston, Alabama

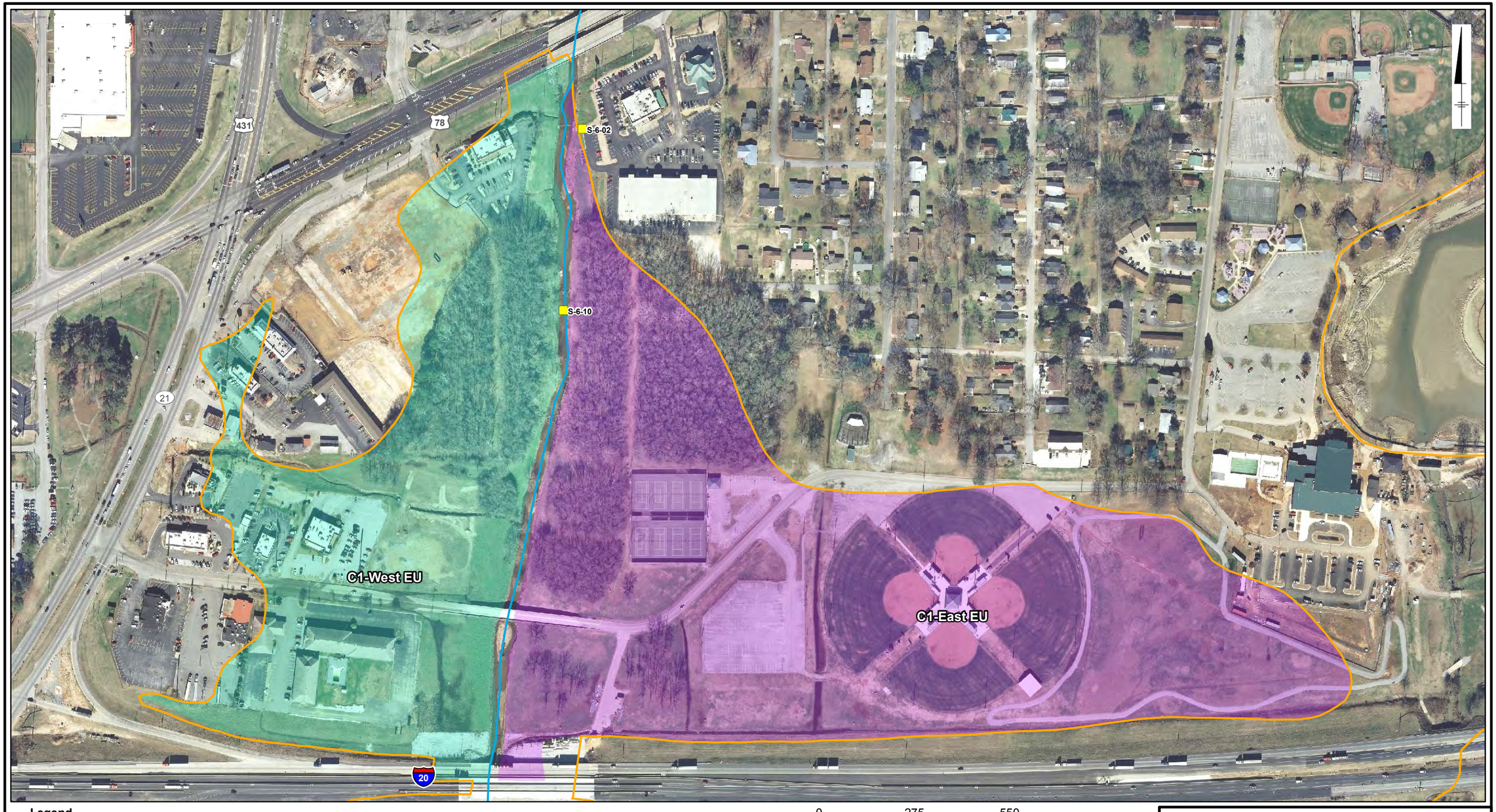
Baseline Ecological Risk Assessment for OU-4

Key for Mercury Soil and Sediment Results by Exposure Unit

Solutia

Figure 4-3a

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: Kives
AnnistonAL
Q:\Anniston_PCB_site\AnnistonAL\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_KEYMAP.mxd 10/20/2016 4:30:33 PM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Snow Creek Centerline
- C1-East EU
- C1-West EU
- OU-4 100-Year Floodplain

0 275 550 Feet
Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

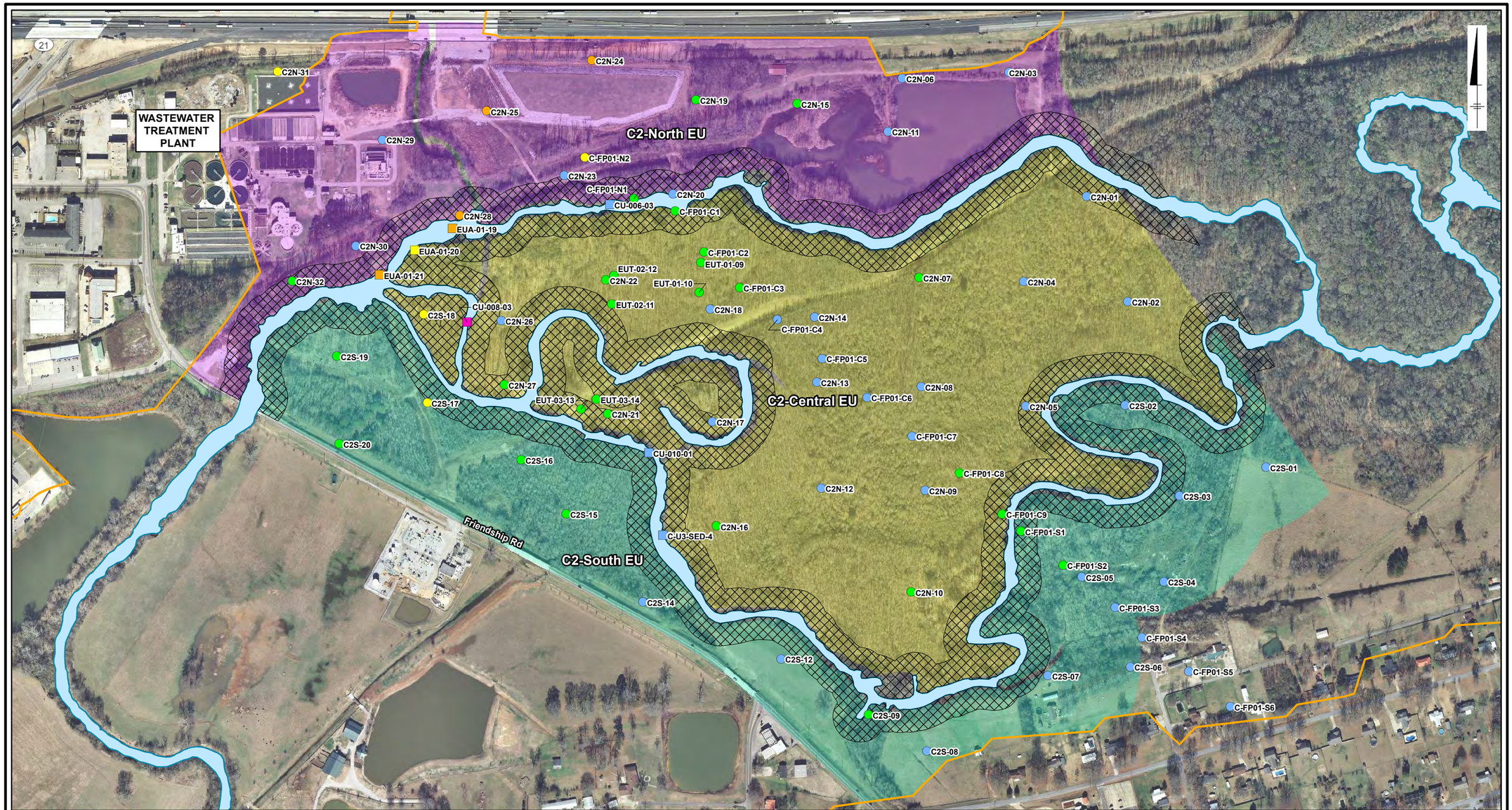
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C1-East EU and C1-West EU

Solutia

Figure
4-3b

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C1.mxd 9/9/2016 12:47:44 PM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
AvgOfResul
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- C2-North EU
- C2-Central EU
- C2-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 425 850 Feet
Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

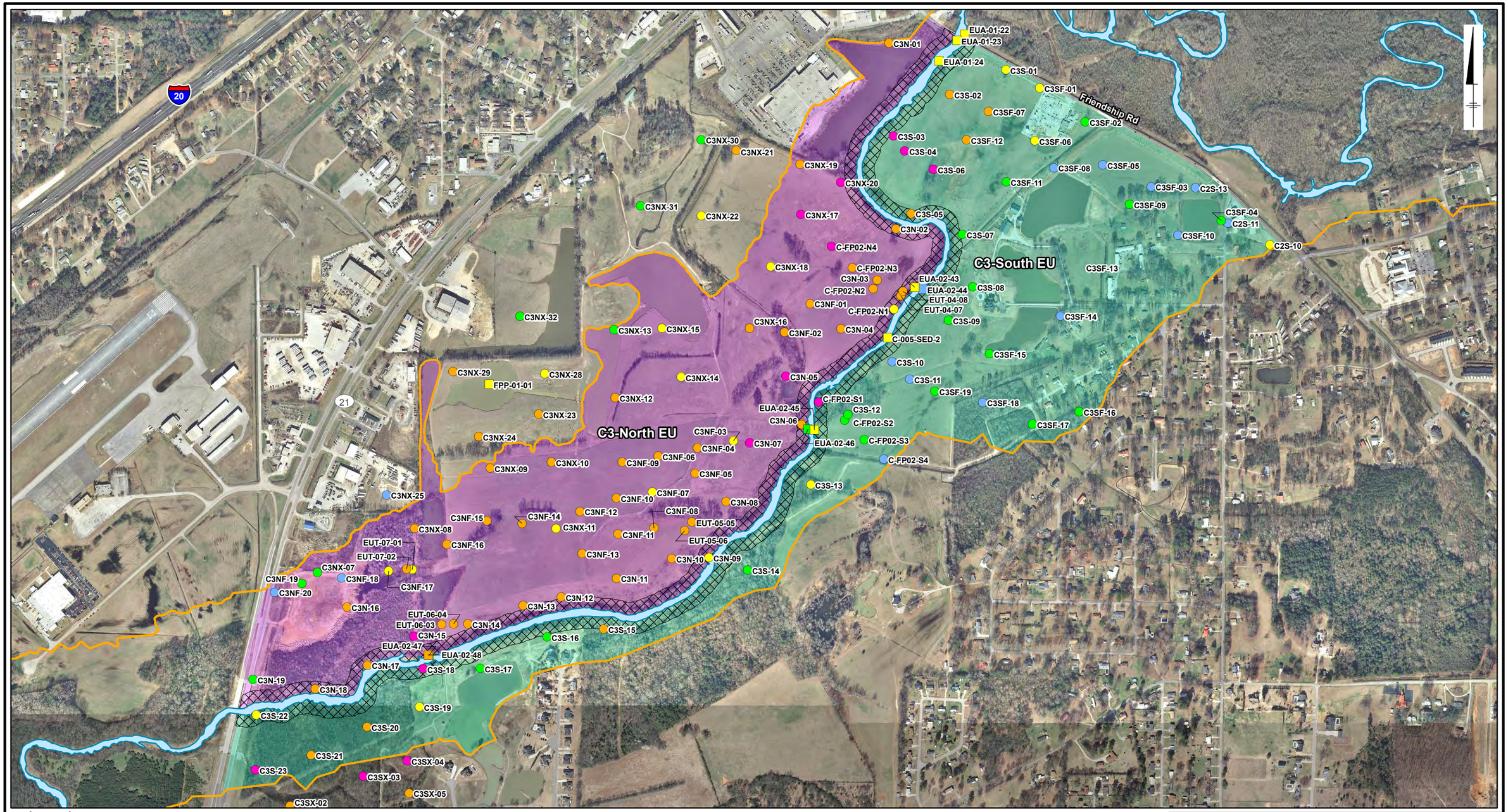
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C2-North EU, C2-Central EU, and C2-South EU

Solutia

Figure
4-3c

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALI\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C2.mxd 9/13/2016 10:07:00 AM



Legend

Sediment Sample Location

Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5

Soil Sample Location

Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- C3-North EU
- C3-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 800 1,600 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

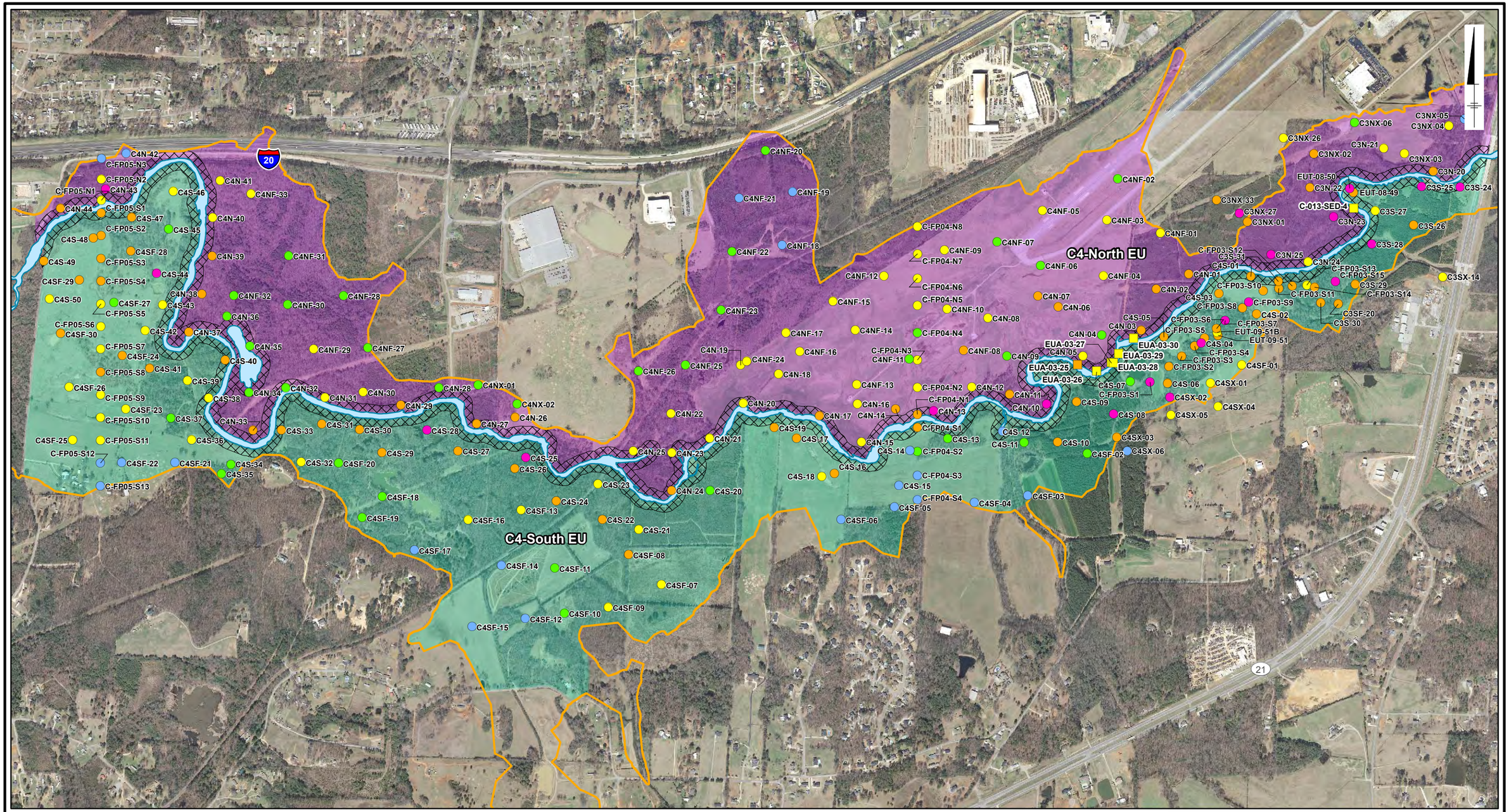
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C3-North EU and C3-South EU

Solutia

Figure
4-3d

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C3.mxd 9/9/2016 2:20:17 PM



Legend

Sediment Sample Location
Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- C4-North EU
- C4-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,175 2,350 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

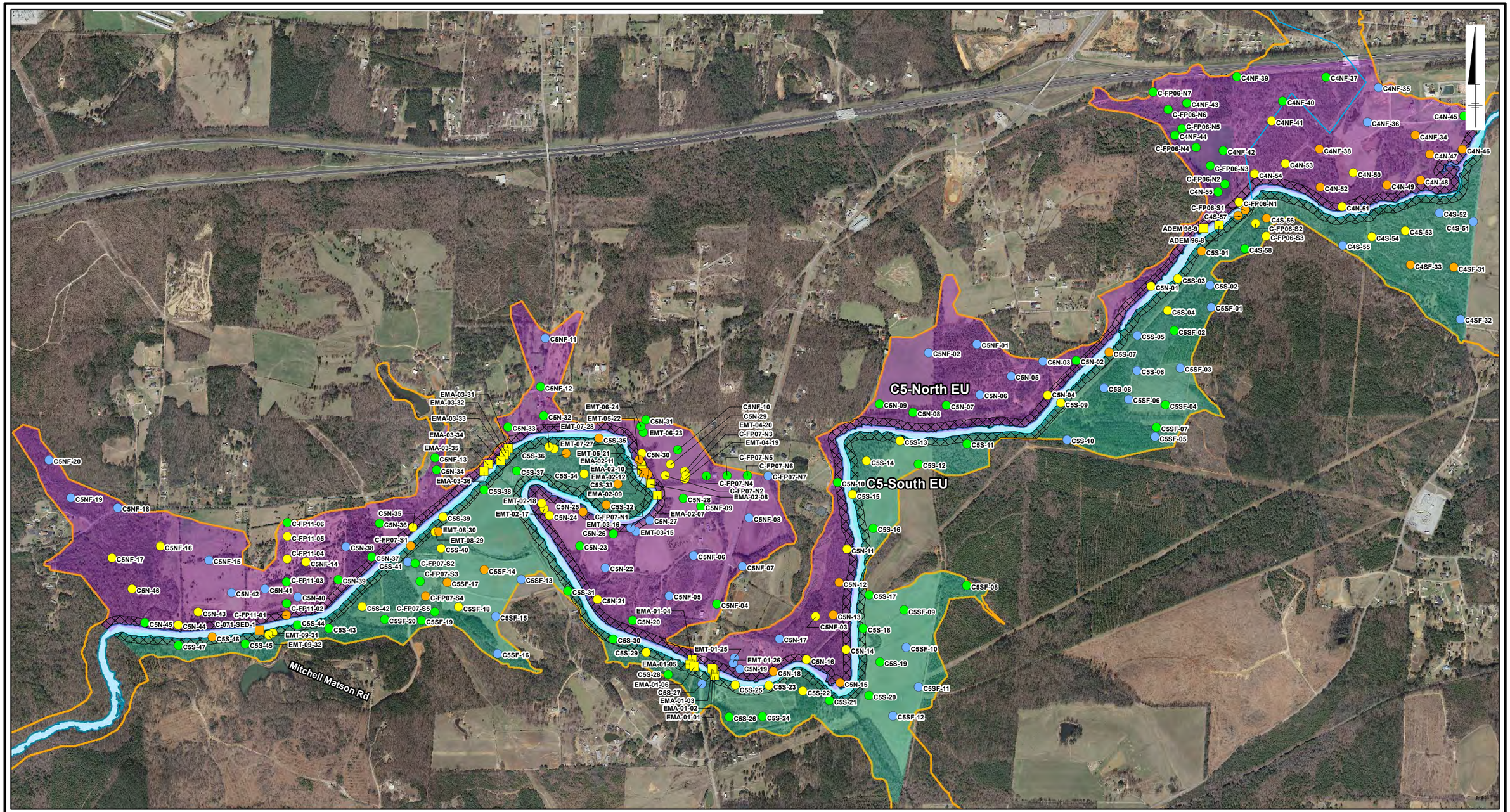
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C4-North EU and C4-South EU

Solutia

Figure
4-3e

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\XDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C4.mxd 9/9/2016 2:46:19 PM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- C5-North EU
- C5-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,325 2,650 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

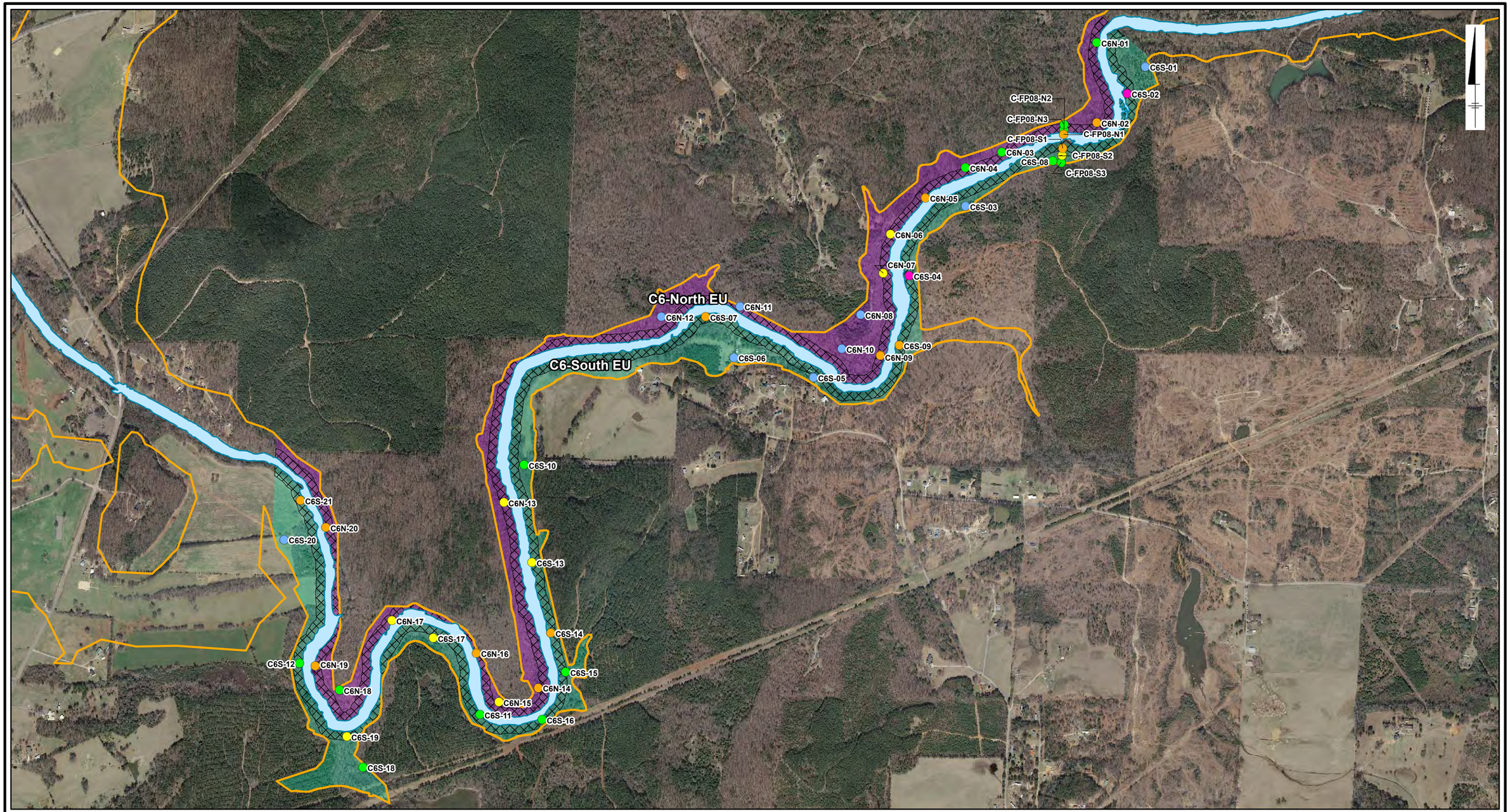
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C5-North EU and C5-South EU

Solutia

Figure
4-3f

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C5.mxd 9/13/2016 10:11:23 AM



Legend

Sediment Sample Location

Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location

Average Mercury Result

- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Choccolocco Creek
- OU-4 100-Year Floodplain
- Riparian EU
- C6-North EU
- C6-South EU

0 1,100 2,200 Feet

Graphic Scale

Notes:

1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

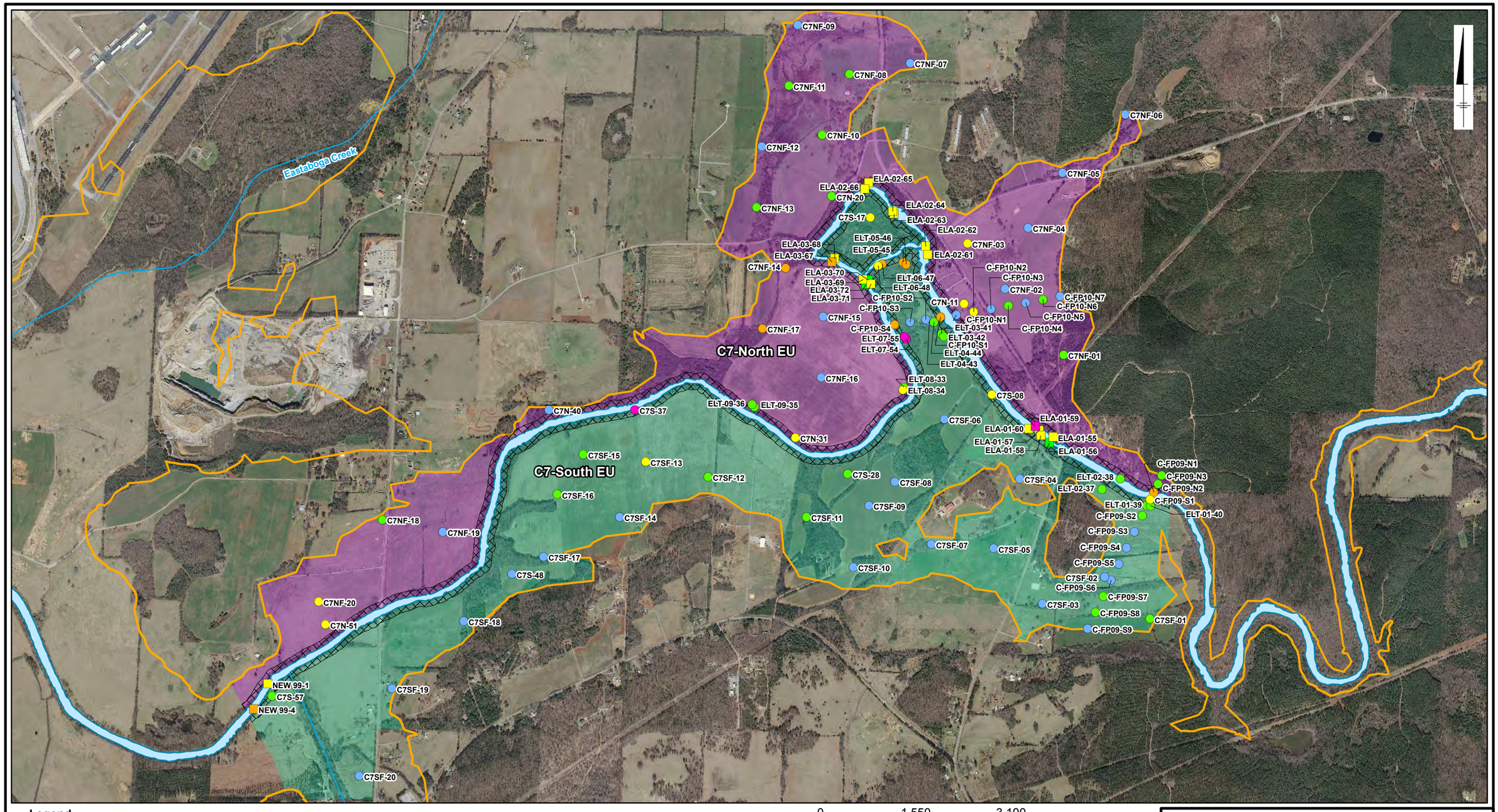
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C6-North EU and C6-South EU

Solutia

Figure
4-3g

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALIMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C6.mxd 9/13/2016 10:11:19 AM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- C7-North EU
- C7-South EU
- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,550 3,100 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

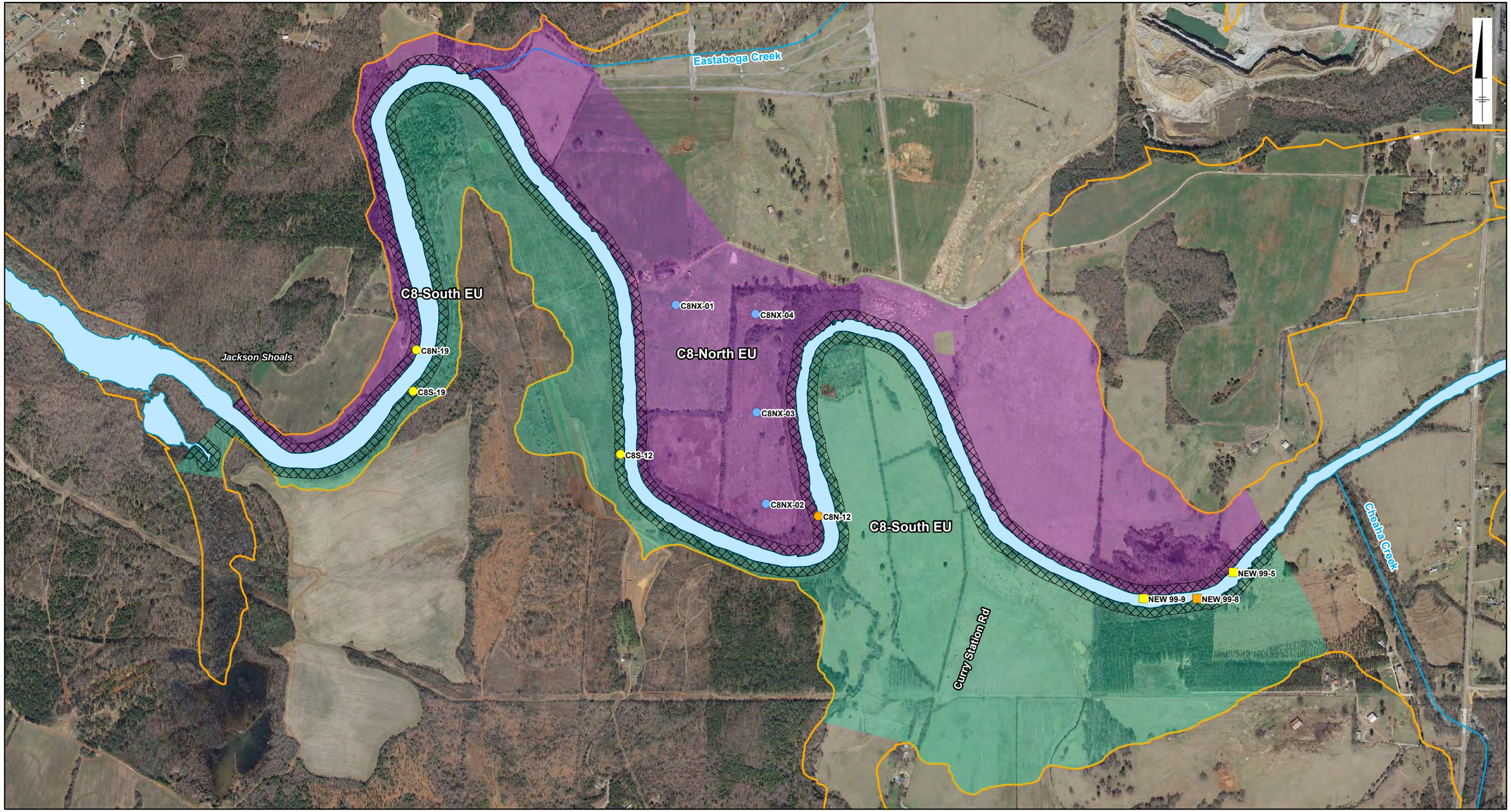
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C7-North EU and C7-South EU

Solutia

Figure
4-3h

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C7.mxd 9/13/2016 10:11:13 AM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- Choccolocco Creek
- OU-4 100-Year Floodplain
- C8-North EU
- C8-South EU

0 1,025 2,050 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

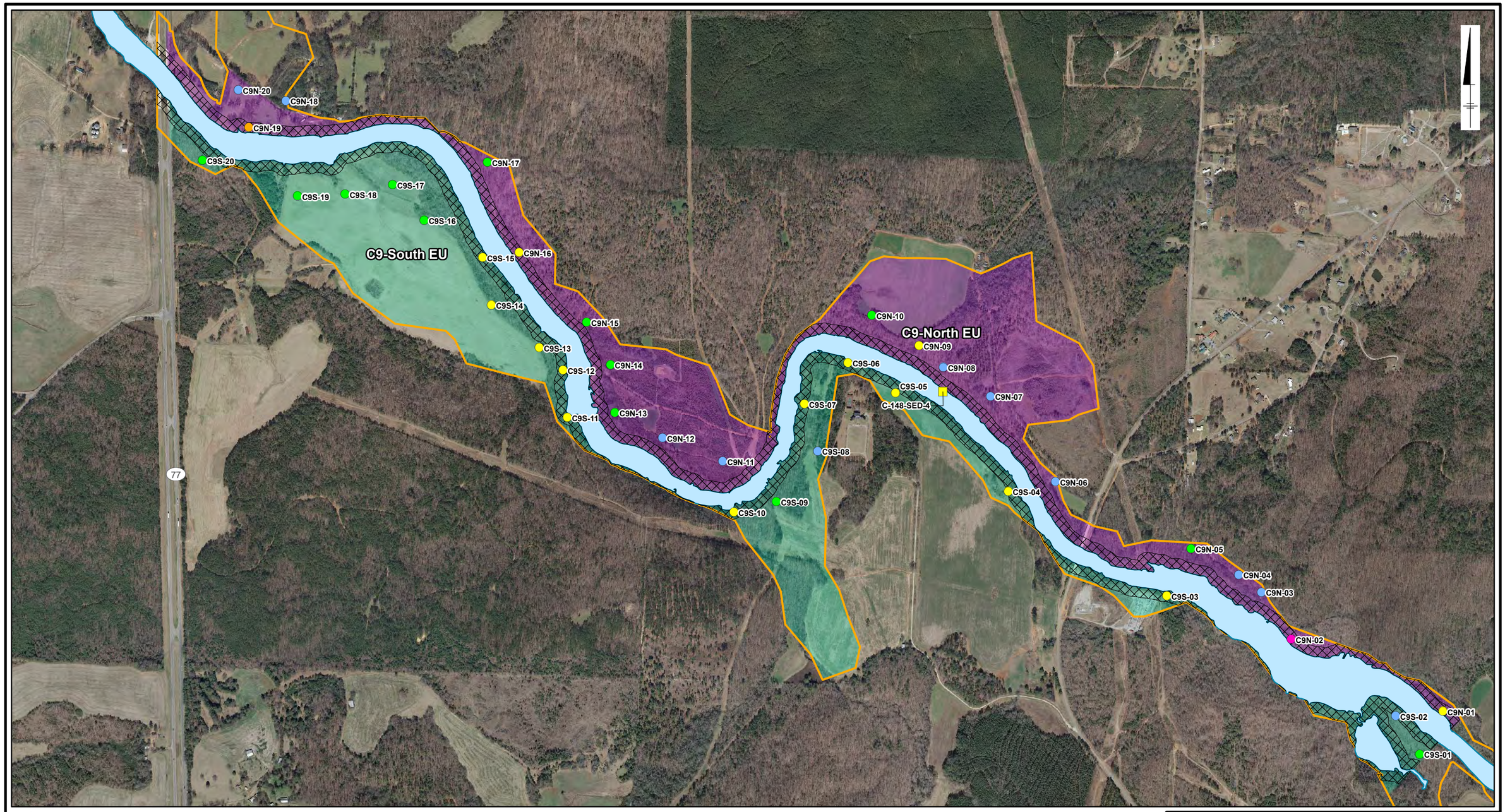
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C8-North EU and C8-South EU

Solutia

Figure
4-3i

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALLMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C8.mxd 9/9/2016 12:57:50 PM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Riparian EU
- Choccolocco Creek
- OU-4 100-Year Floodplain
- C9-North EU
- C9-South EU

0 950 1,900 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

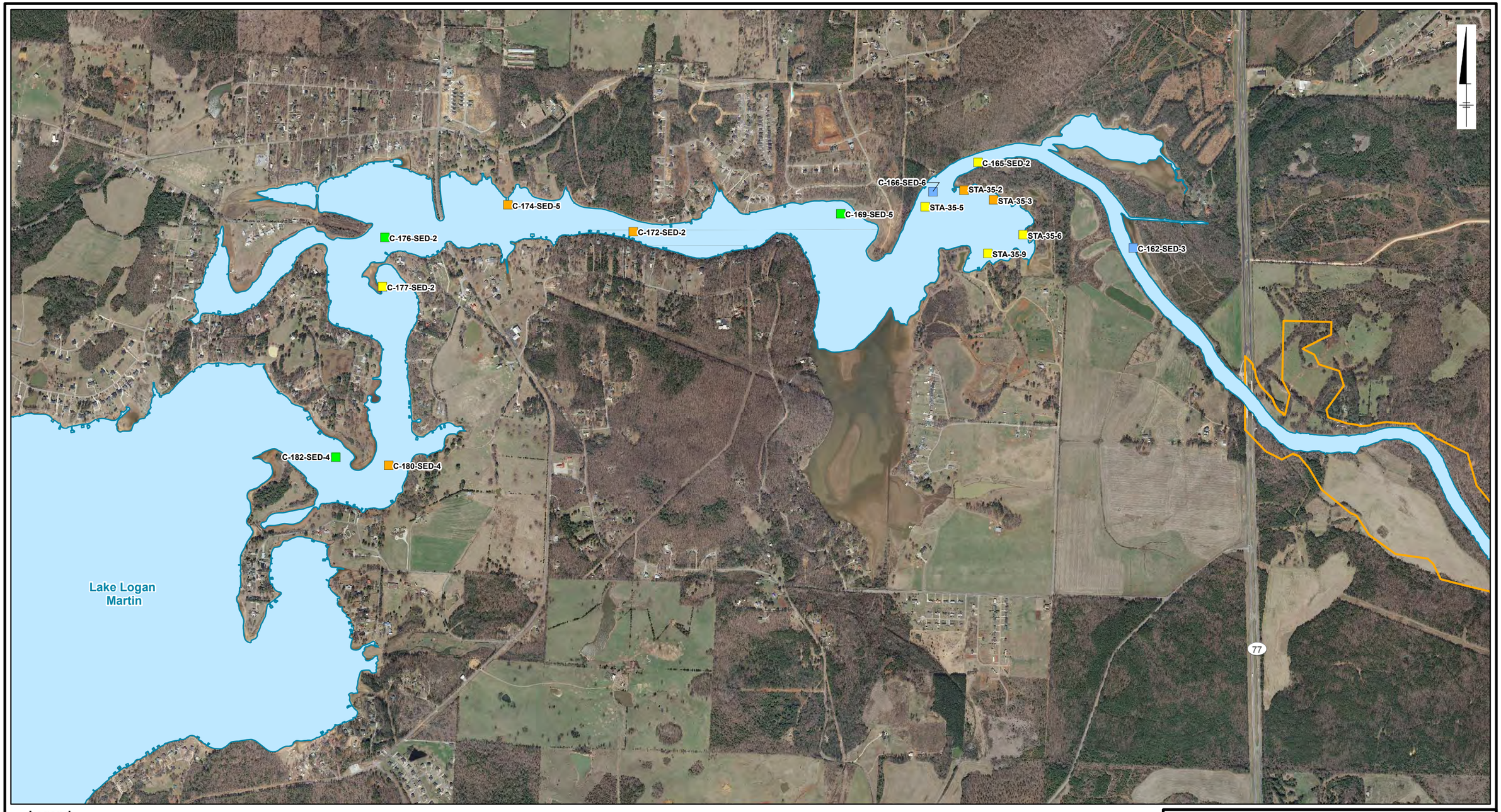
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C9-North EU and C9-South EU

Solutia

Figure
4-3j

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\AnnistonALMXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C9.mxd 9/9/2016 1:00:56 PM



Legend

Sediment Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

Soil Sample Location
Average Mercury Result
- 0 - 0.05
- 0.05 - 0.2
- 0.2 - 1
- 1 - 5
- > 5

- Choccolocco Creek
- OU-4 100-Year Floodplain

0 1,500 3,000 Feet

Graphic Scale

Notes:
1. Surface sediments were collected primarily from the 0- to 2-inch interval (63% of samples) and the 0- to 6-inch interval (26% of samples). A limited number of samples (11%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 6 inches.
2. Surface soils were collected primarily from the 0- to 6-inch interval (93% of samples). A limited number of samples (7%) were collected from various intervals with a top depth of 0 inches and a bottom depth of not more than 24 inches.
3. Aerial imagery provided by Calhoun and Talladega Counties.

Acronyms:
EU: exposure unit
mg/kg: milligrams per kilogram
OU: operable unit
PCB: polychlorinated biphenyl

Anniston PCB Site
Anniston, Alabama

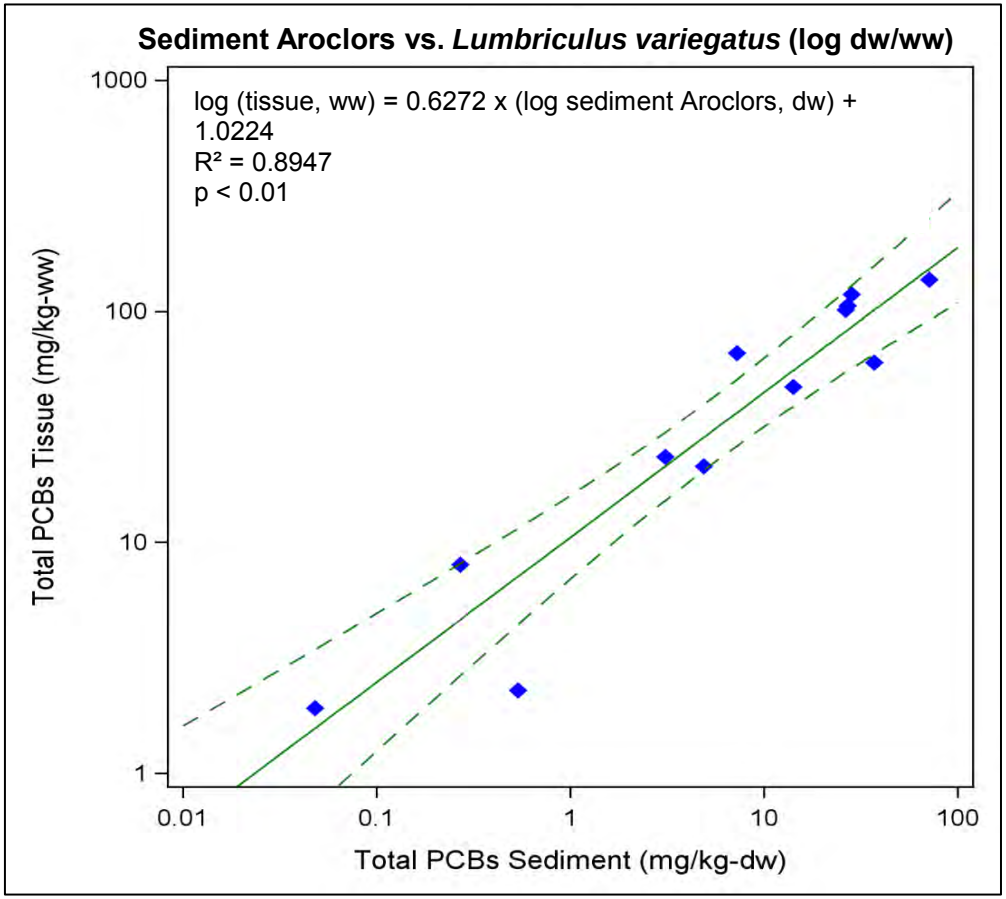
Baseline Ecological Risk Assessment for OU-4

Mercury Soil and Sediment Results for C10

Solutia

Figure
4-3k

City: SYR Div/Group: SWG Created By: K.Ives Last Saved By: Kives
Anniston
Q:\Anniston_PCB_site\Anniston\ALM\MXDs_Printfiles\Reports\OU4_BERA\mxd\OU4_SedSoilMercury_C10.mxd 9/9/2016 12:55:37 PM



Notes:
BAF: bioaccumulation factor
dw: dry weight
mg/kg: milligrams per kilogram
PCB: polychlorinated biphenyl
ww: wet weight

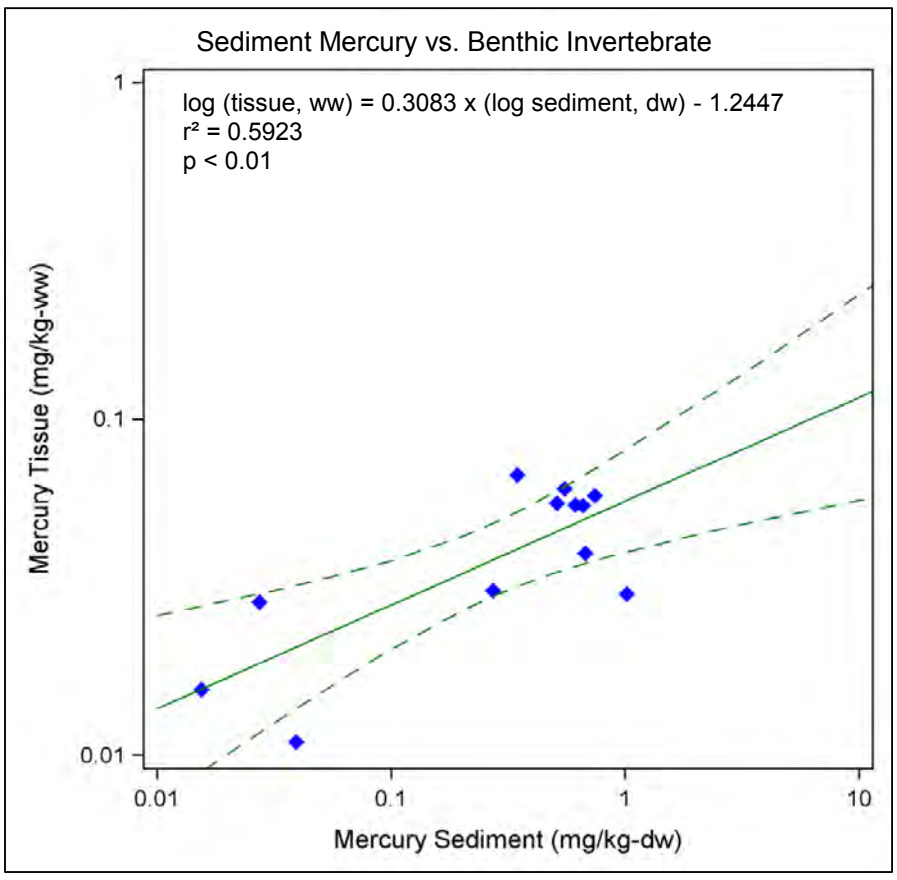
a. Aquatic plants, emergent insects, benthic invertebrates (odonate larvae), crayfish, molluscs, frogs, snakes, and fish evaluated with median BAFs.

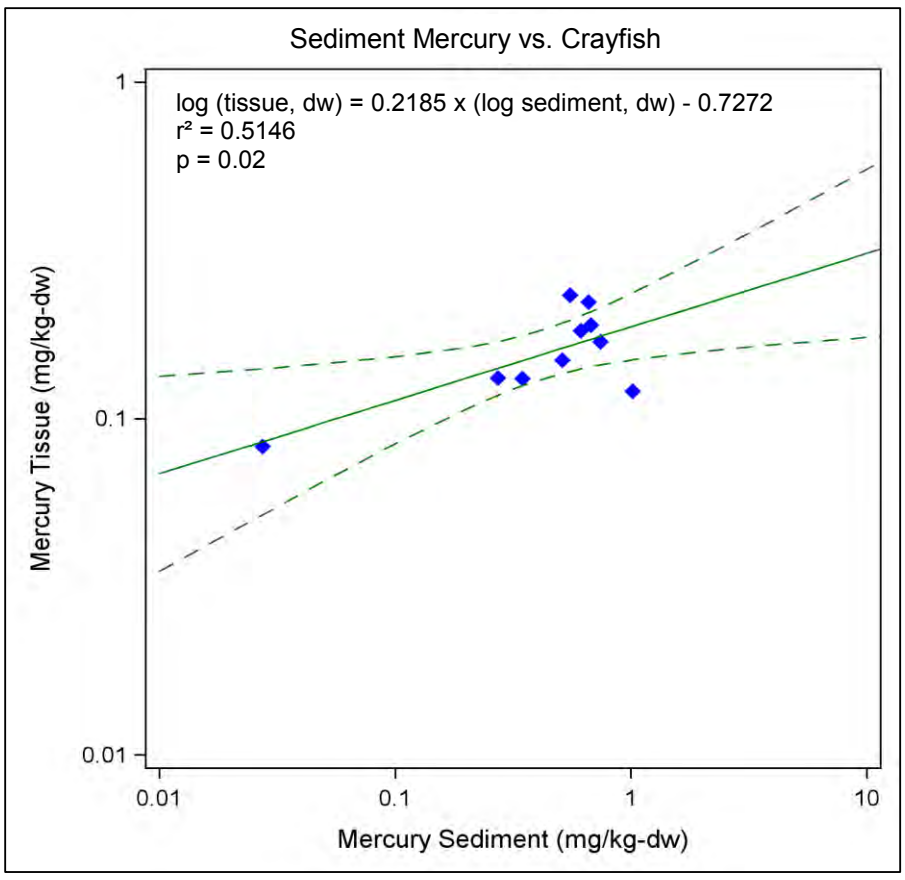
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

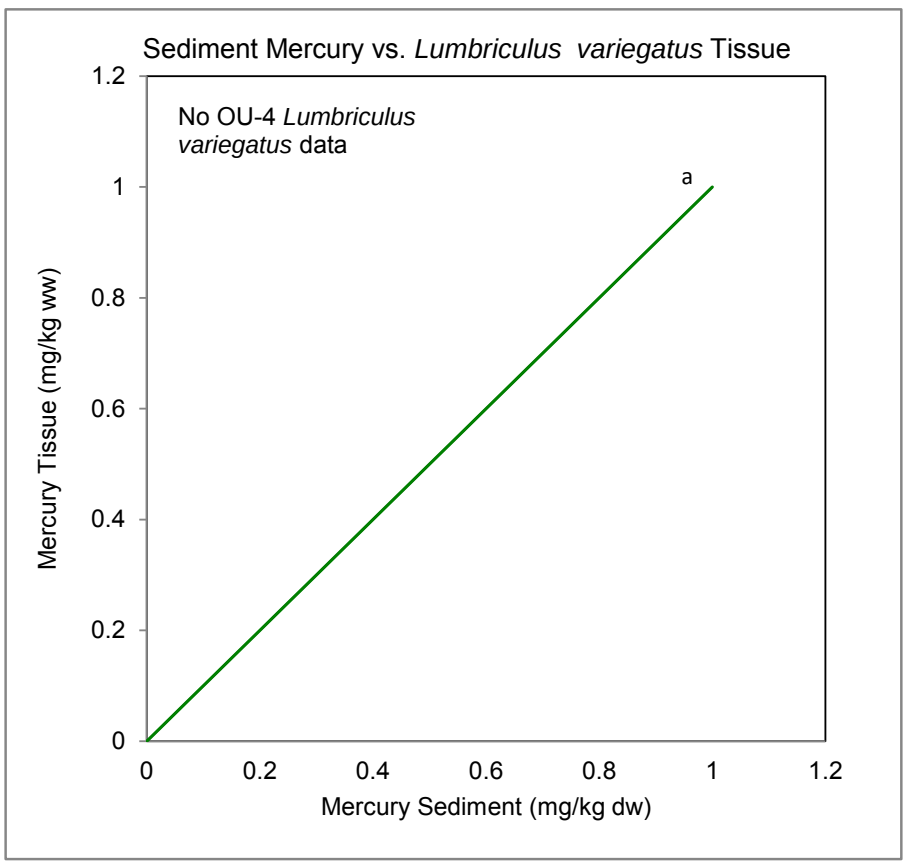
Regression Plots for Selected Bioaccumulation Models for Sediment PCBs

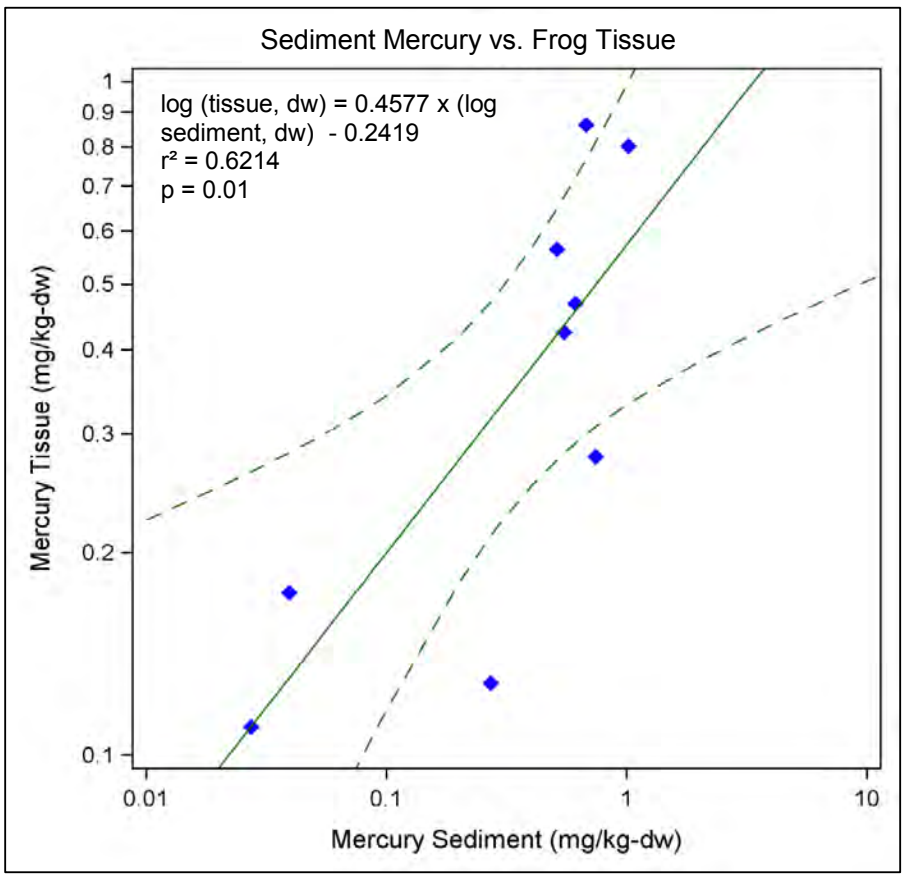
Solutia
Ingenuity Productivity Performance

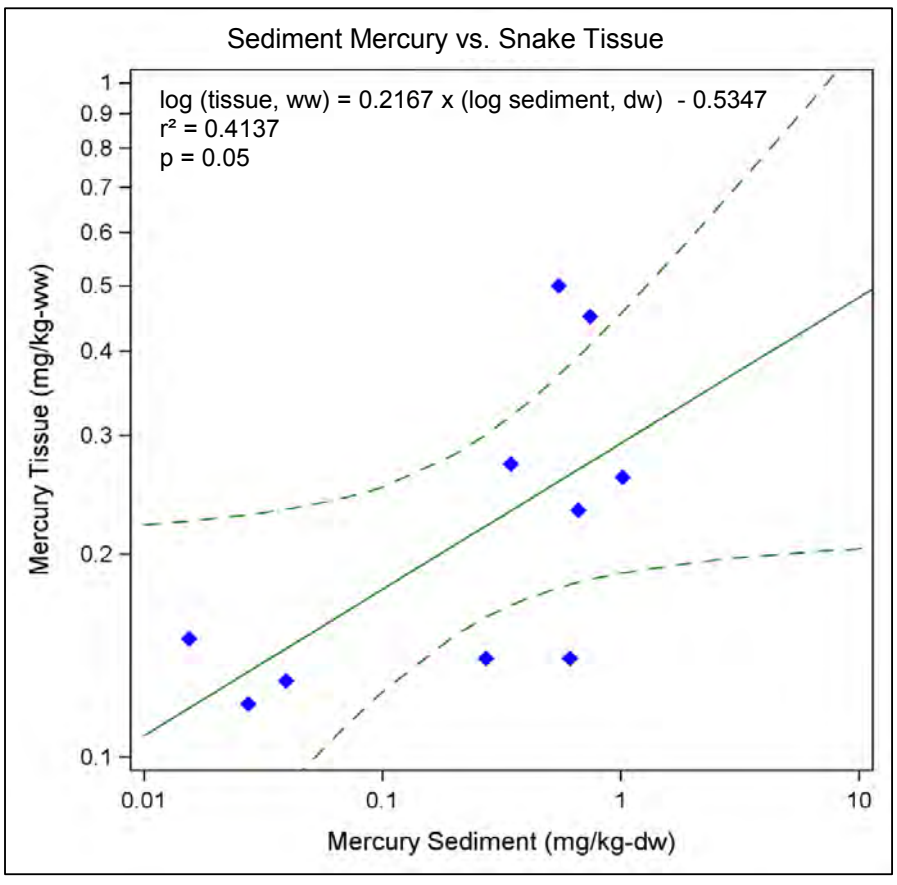
FIGURE 4-4











detected tissue concentration

selected BAF

95% confidence interval

Notes:
BAF: bioaccumulation factor
dw: dry weight
mg/kg: milligrams per kilogram
ww: wet weight

a. *Lumbriculus variegatus* BAF = 1 (Gilmour et al. 2013)
b. Aquatic plants, emergent insects, molluscs, forage fish, bottom fish, predator fish, and all fish evaluated using median BAFs.

Anniston PCB Site

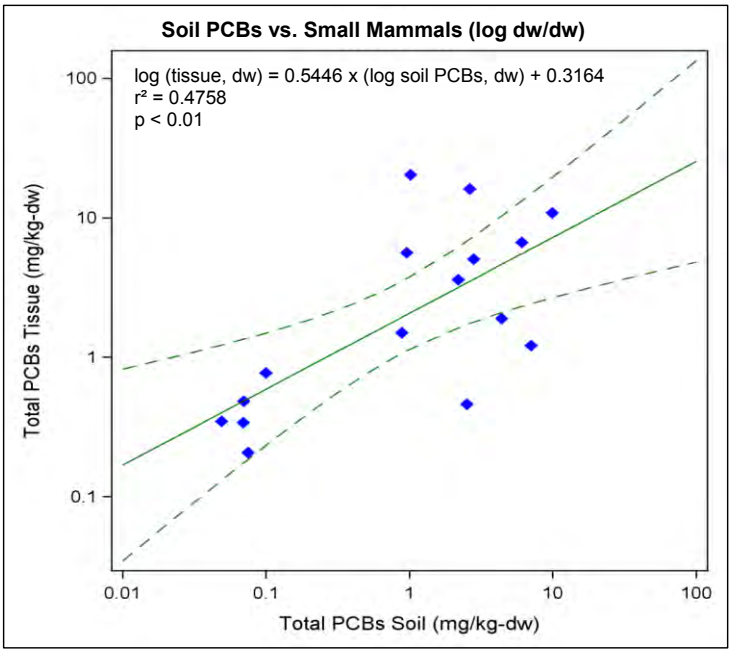
Anniston, Alabama

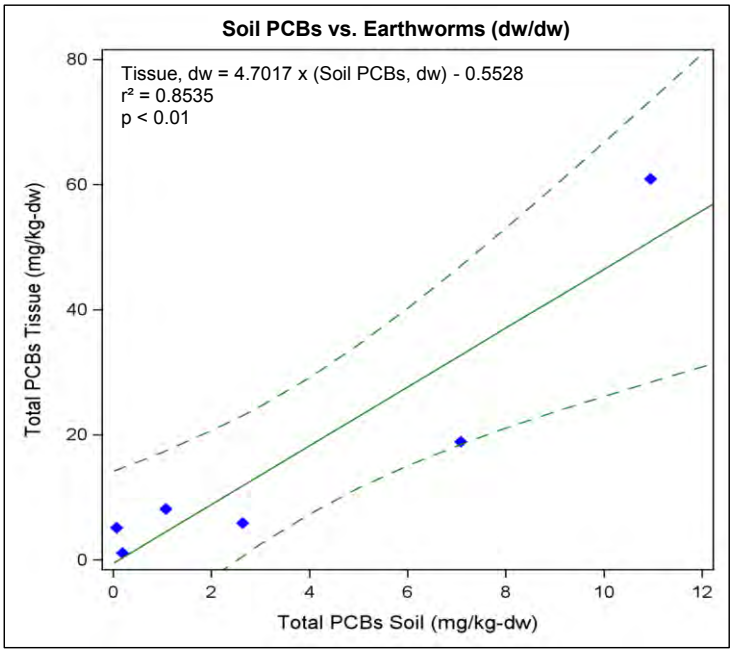
Baseline Ecological Risk Assessment for OU-4

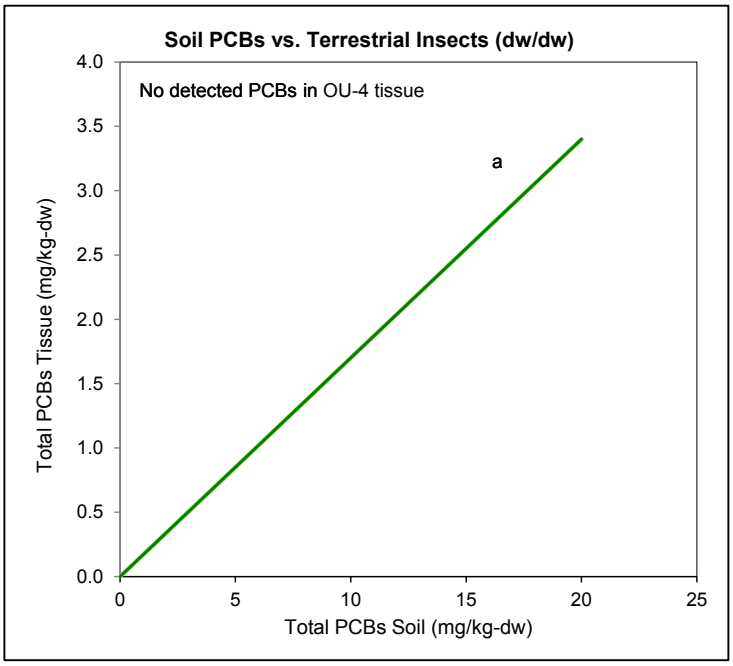
Regression Plots for Selected Bioaccumulation Models for Sediment Mercury

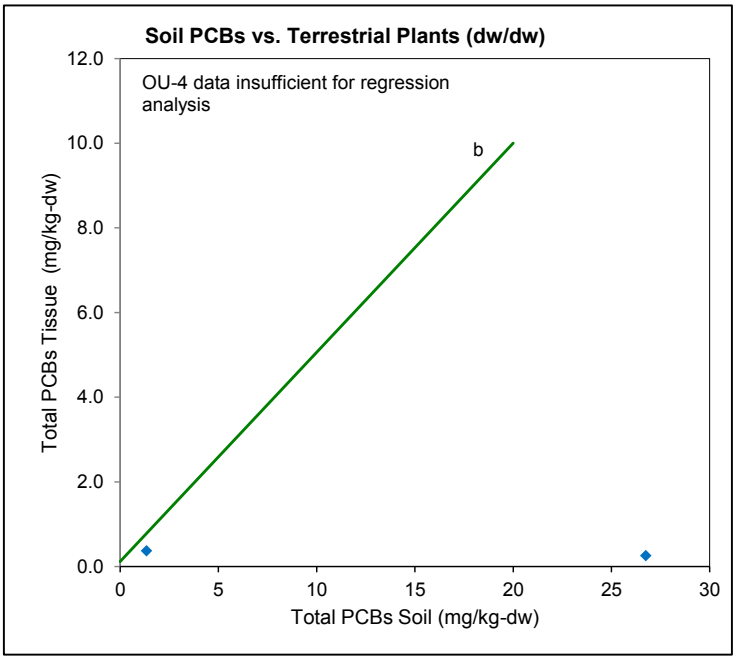
Solutia

FIGURE
4-5









Notes:
BAF: bioaccumulation factor
dw: dry weight
mg/kg: milligrams per kilogram
ng/g: nanograms per gram
PCB: polychlorinated biphenyl
ww: wet weight

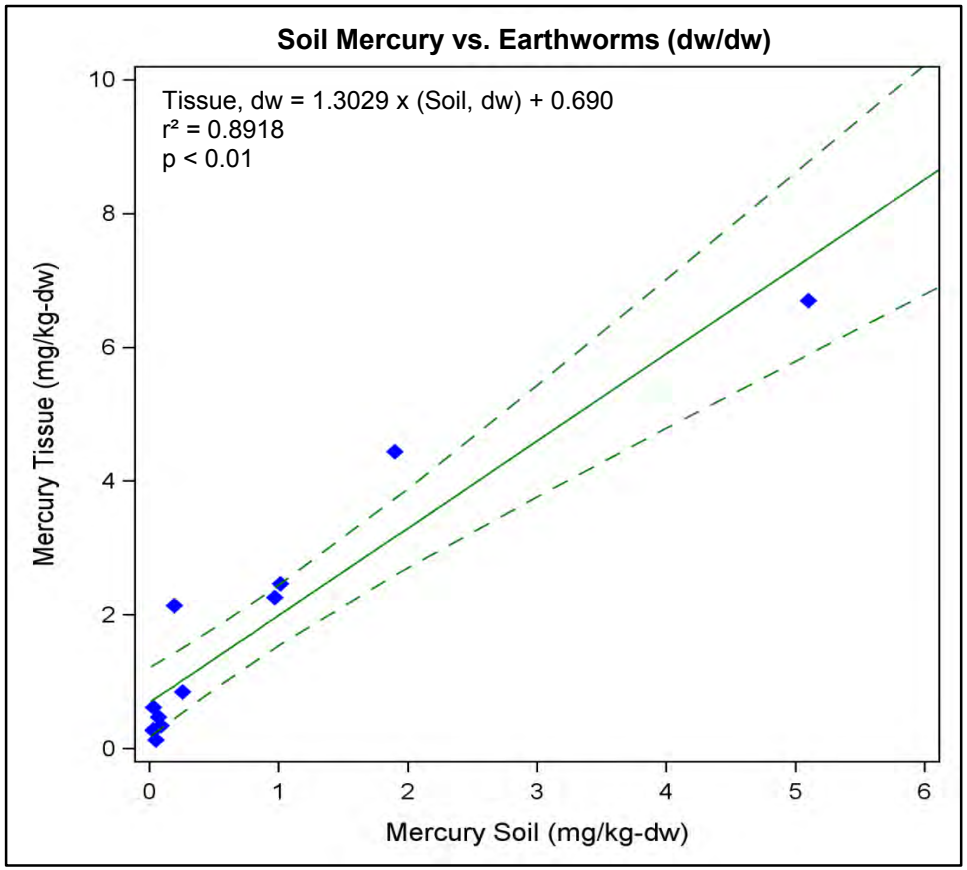
detected tissue concentration
selected BAF
95% confidence interval

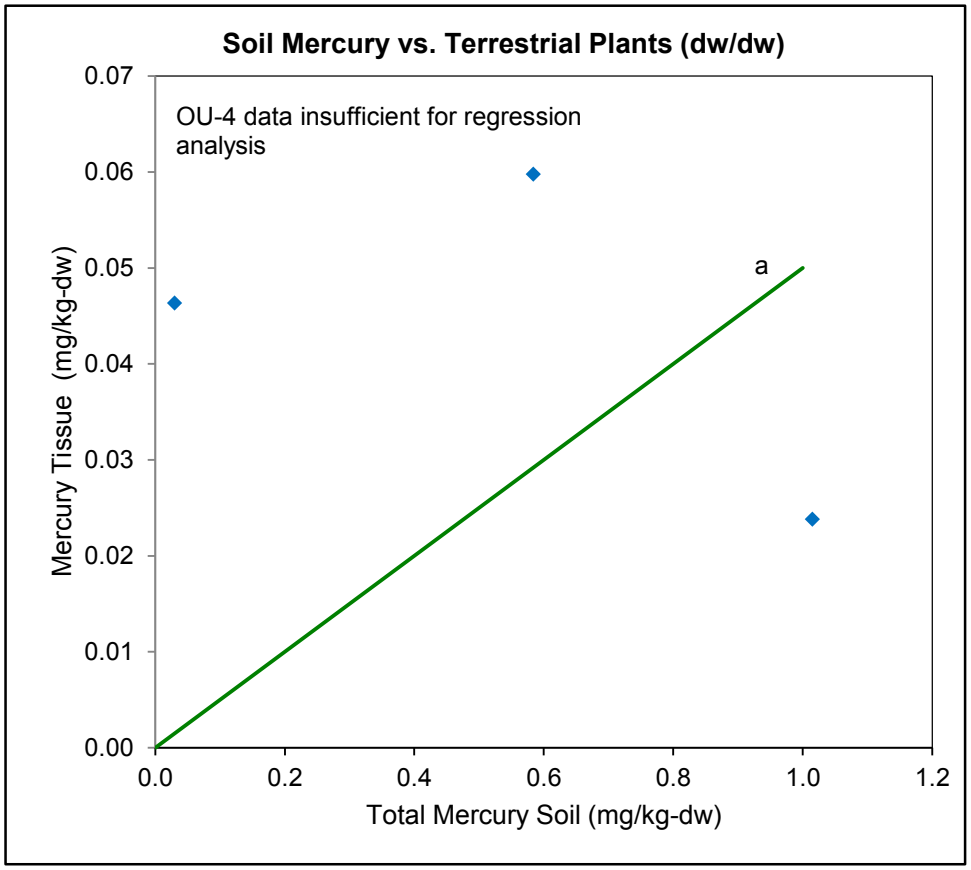
a. Terresrial Insect BAF = 0.17 (Blankenship et al. 2005)
b. Plant PCB regression (Ficko et al. 2013): plant wet weight (ng/g ww) = 0.1433 (soil ng/g dw) + 34.546

Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4
Regression Plots for Selected Bioaccumulation Models for Soil PCBs

Solutia

FIGURE 4-6





Notes:
BAF: bioaccumulation factor
dw: dry weight
mg/kg: milligrams per kilogram

a. Terresrial Insect BAF = 0.05 (Pant et al. 2011)

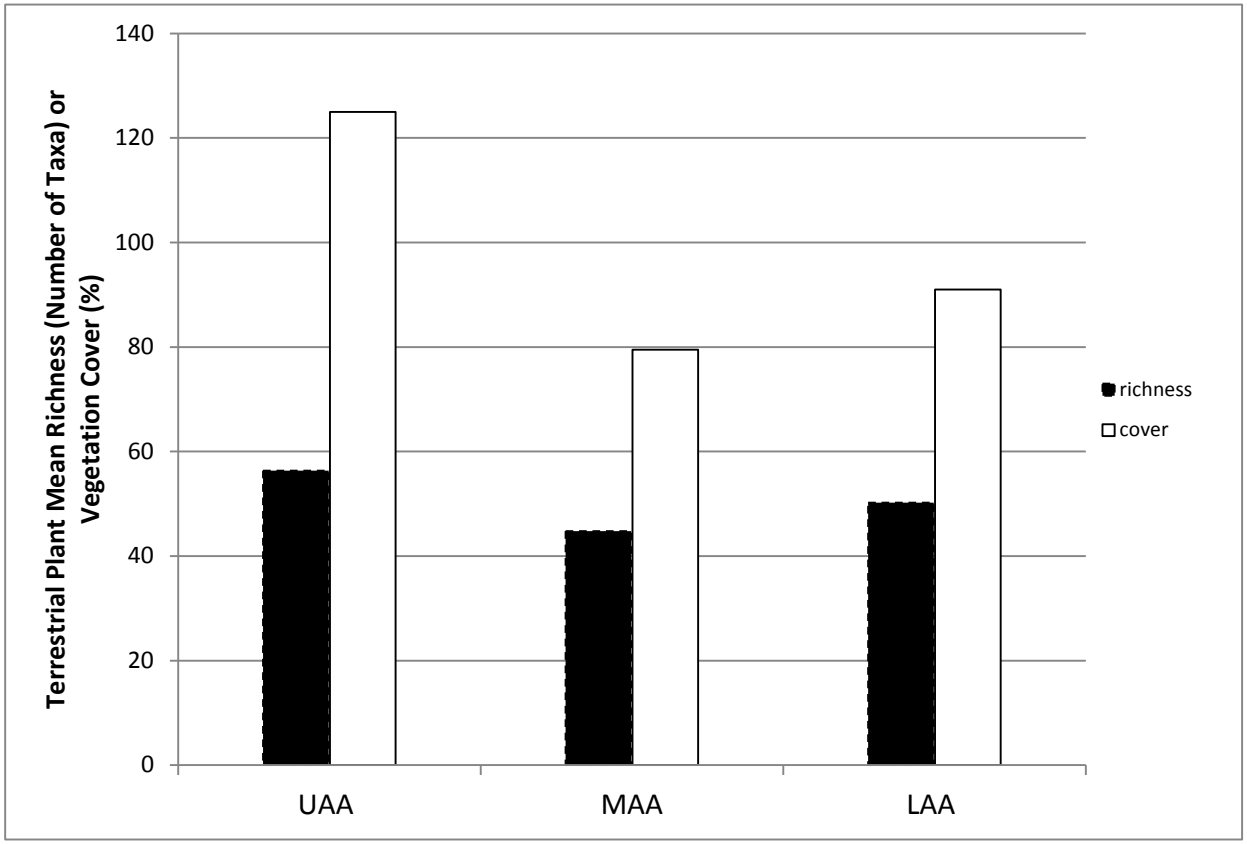
◆ detected tissue concentration
— selected BAF
- - - 95% confidence interval

Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

Regression Plots for Selected Bioaccumulation Models for Soil Mercury

Solutia
Ingenuity Productivity Performance

FIGURE 4-7



Notes:
LAA: lower assessment area
MAA: middle assessment area
UAA: upper assessment area

Data Source:
BBL, Inc., 2005. Data summary report for Operable Unit 4, Anniston PCB Site, Anniston, Alabama. September 2005, revision 1.

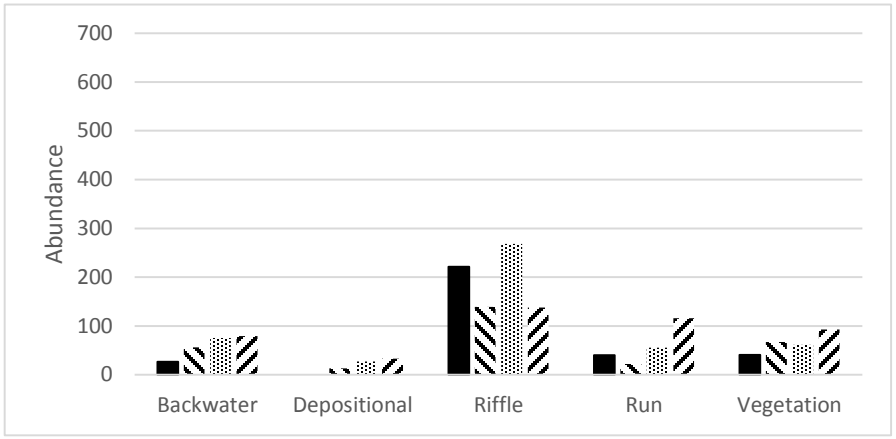
Arcadis BBL, 2007. Operable Unit 4 Phase 1 Ecological Survey Report, Anniston PCB Site, Anniston Alabama, December 2007.

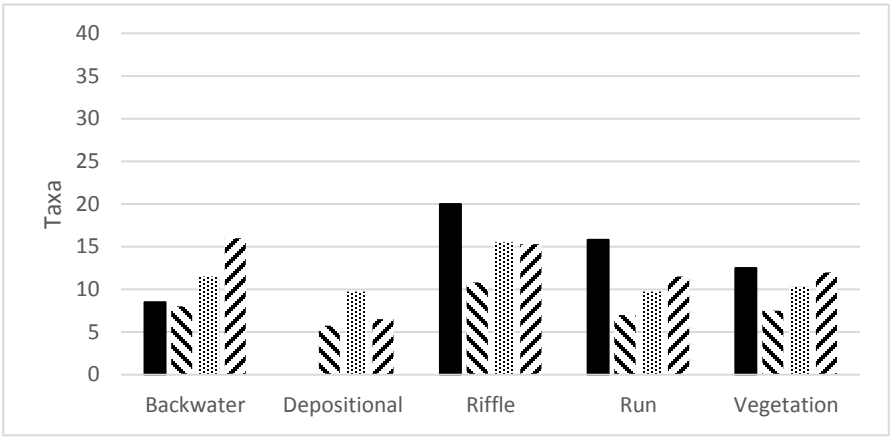
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

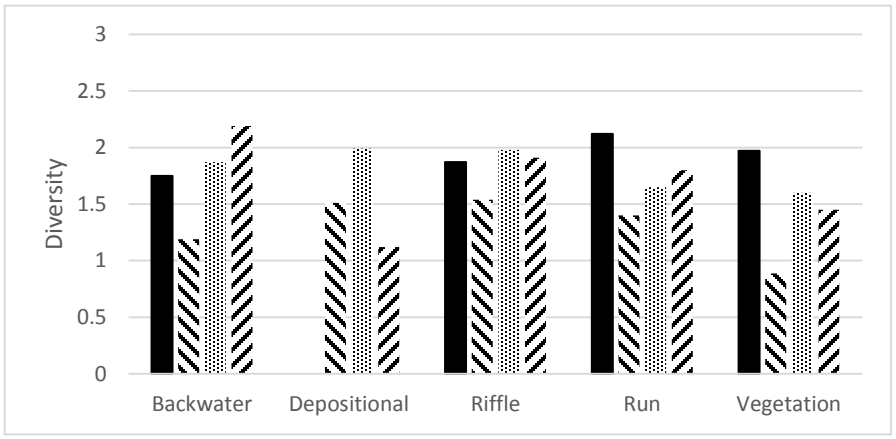
Plant Cover and Species Richness by Floodplain Reach

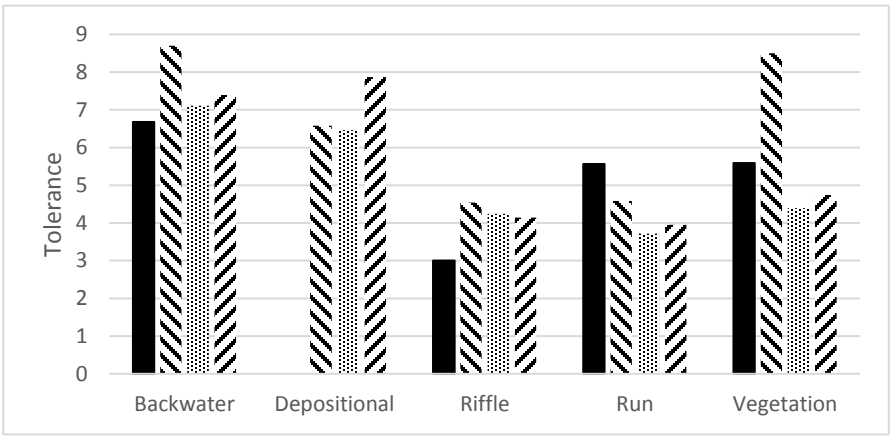
Solutia

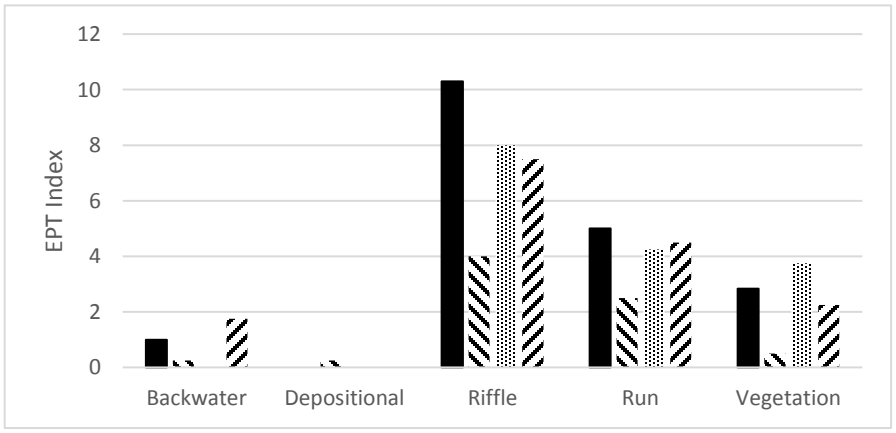
FIGURE
5-1



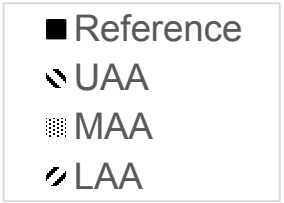








UAA = Upper Assessment Area; MAA = Middle Assessment Area
LAA = Lower Assessment Area



Anniston PCB Site
Anniston, Alabama

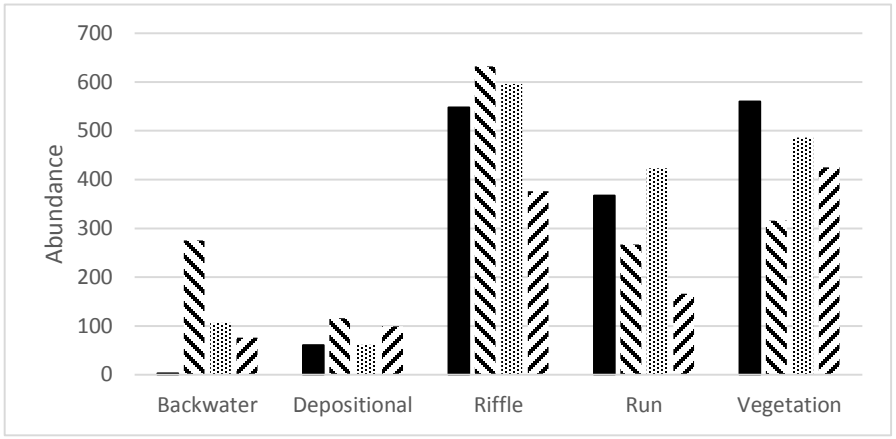
Baseline Ecological Risk Assessment for OU-4

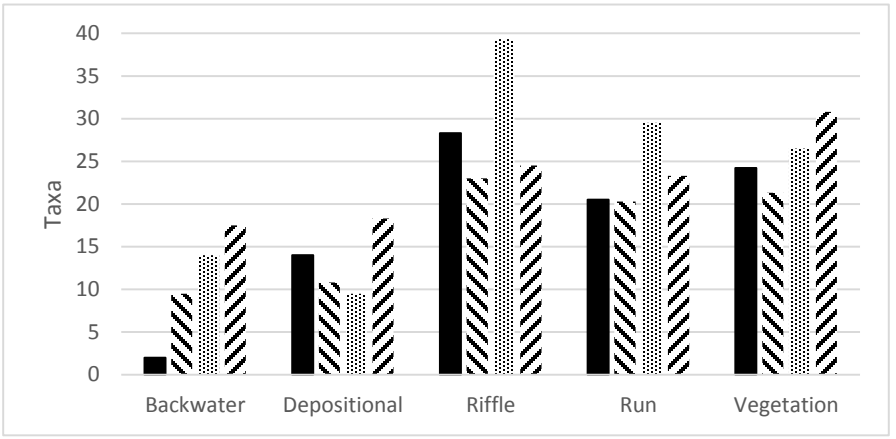
Mean Benthic Measures by Habitat and Season: Fall 2006

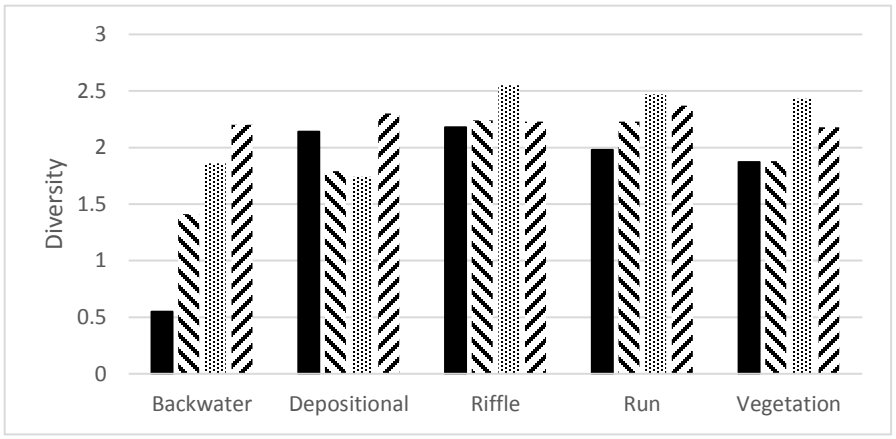
Solutia
Ingenuity Productivity Performance

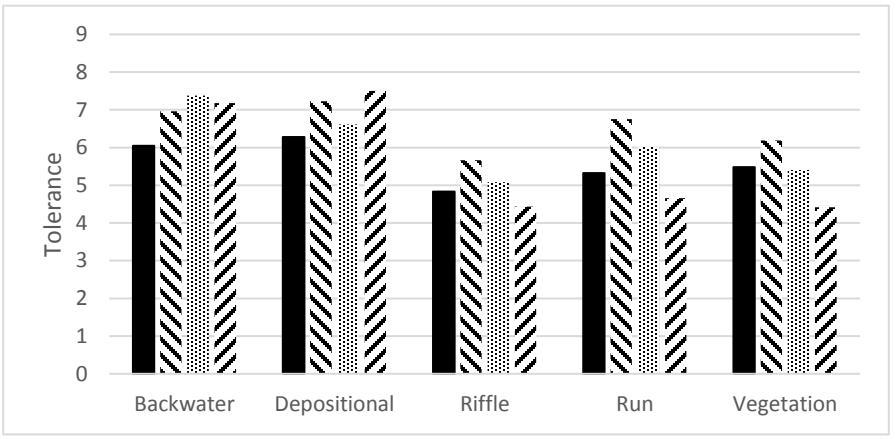
Figure

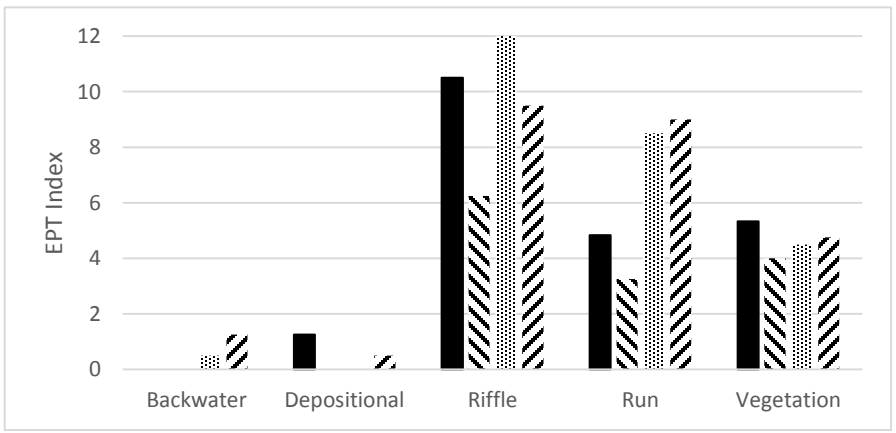
5-2a



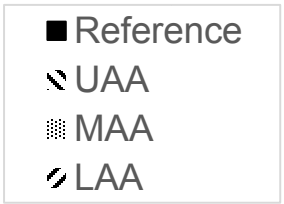








UAA = Upper Assessment Area; MAA = Middle Assessment Area
LAA = Lower Assessment Area



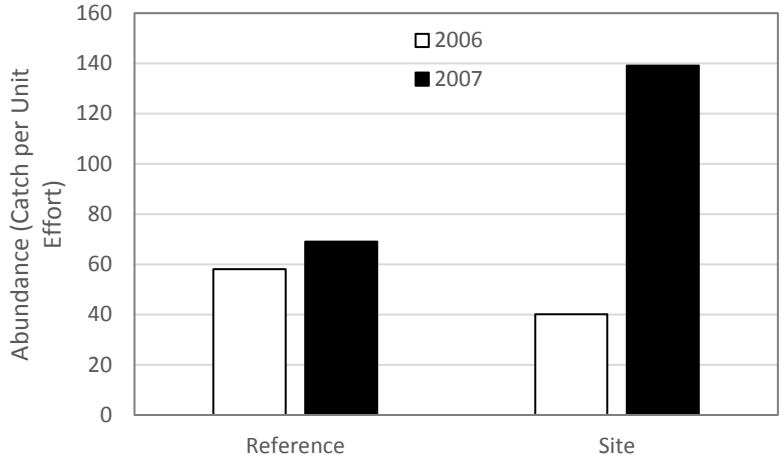
Anniston PCB Site
Anniston, Alabama

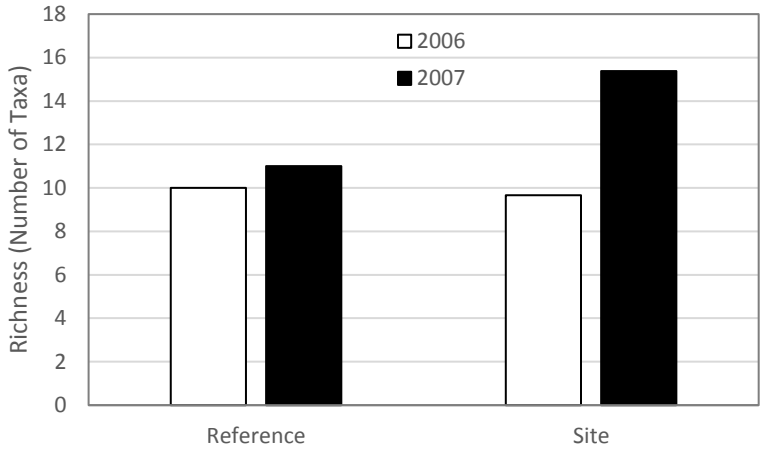
Baseline Ecological Risk Assessment for OU-4

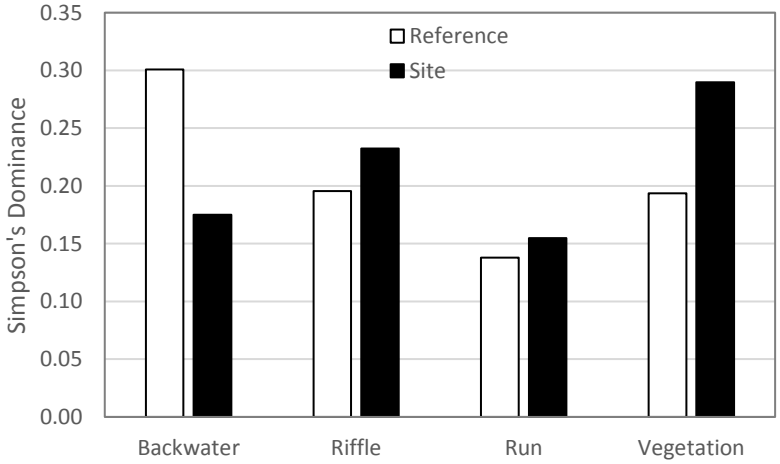
Mean Benthic Measures by Habitat and Season: Spring 2007

Solutia
Ingenuity Productivity Performance

Figure
5-2b







Data Source:
Arcadis BBL, 2007. Operable Unit 4 Phase 1 Ecological Survey Report, Anniston PCB Site, Anniston Alabama, December 2007.

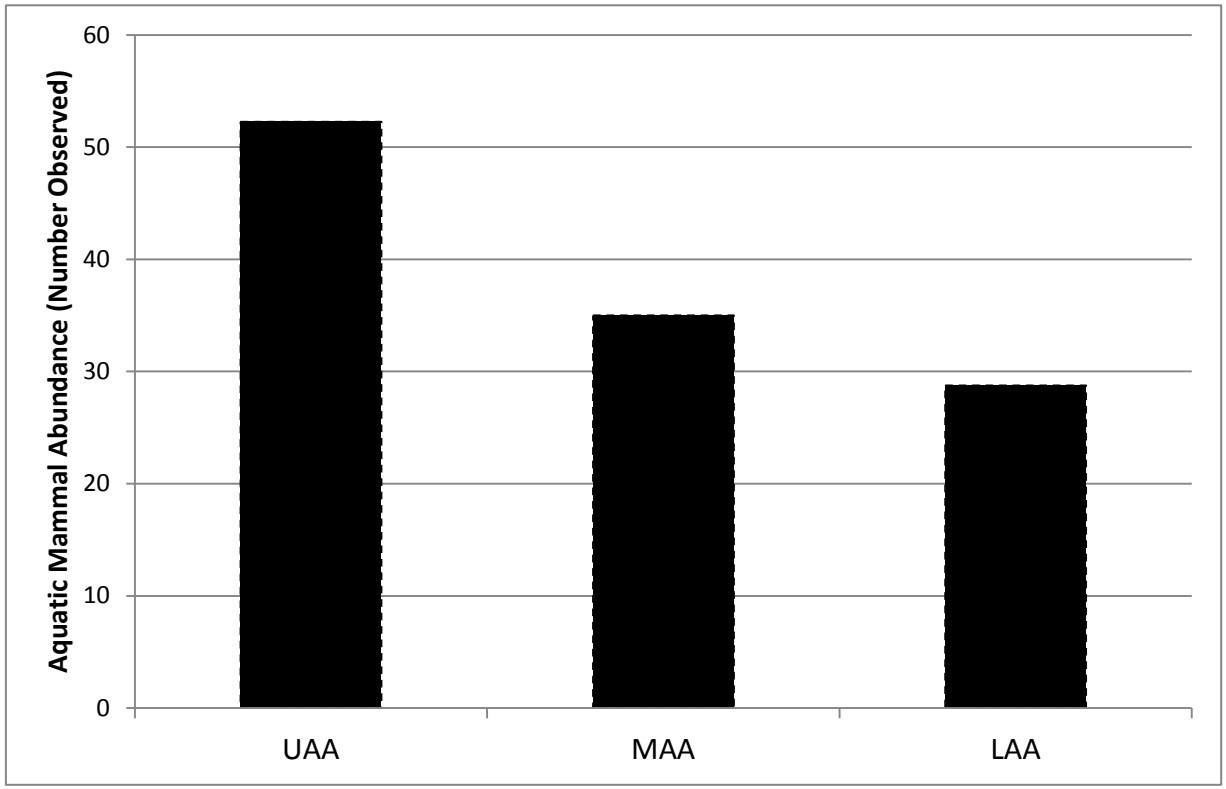
Notes:
Figures compare change from reference to site, which for example is higher in the site in 2007 but not in 2006, indicating a non-parallel trend.

Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

Trends in Means in Fish Metrics Between OU-4 and Reference by Year and Habitat

Solutia

FIGURE
5-3



Notes:
LAA: lower assessment area
MAA: middle assessment area
UAA: upper assessment area

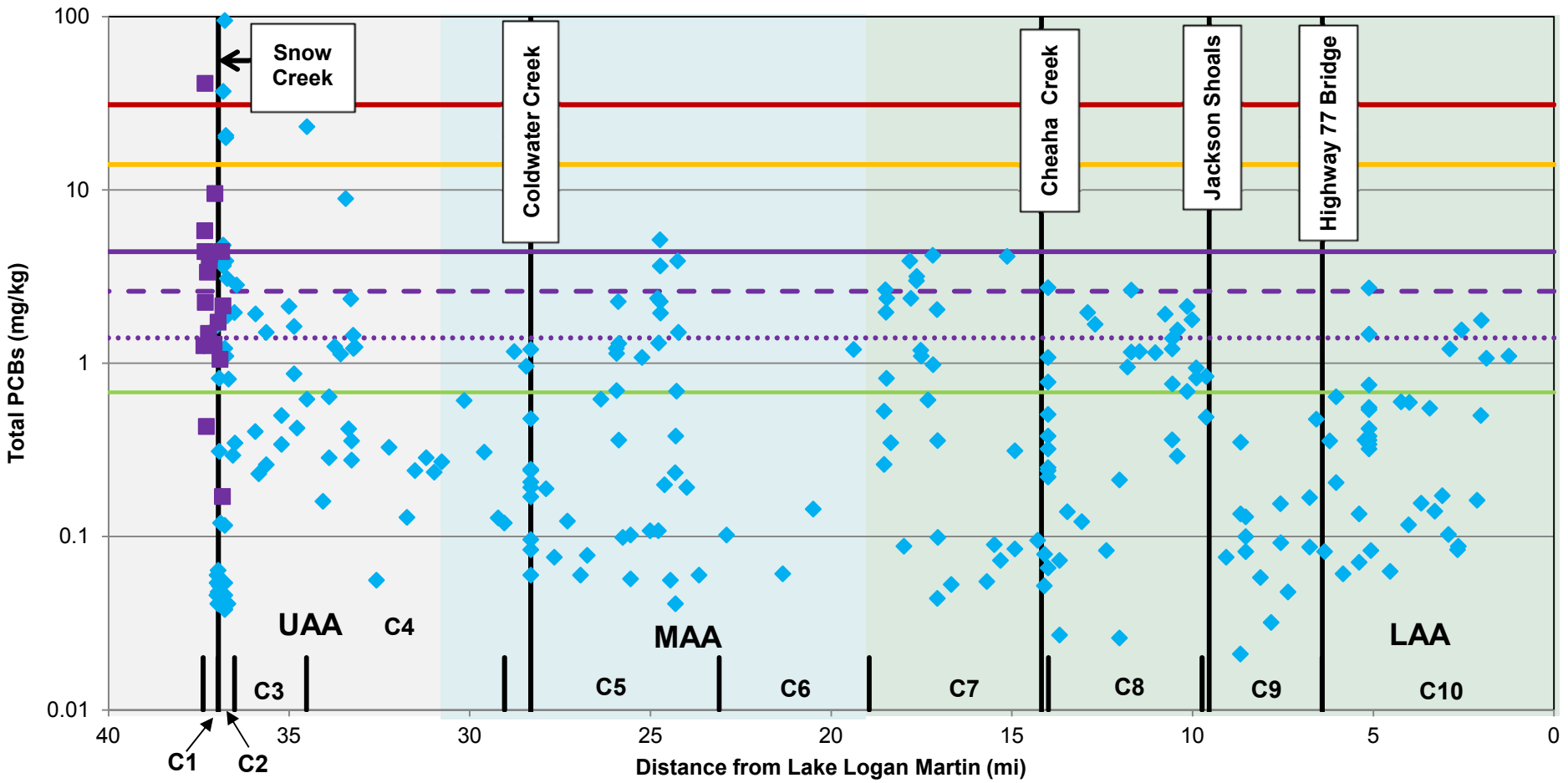
Data Source:
Arcadis BBL, 2007. Operable Unit 4 Phase 1 Ecological Survey Report, Anniston PCB Site, Anniston Alabama, December 2007.

Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

Aquatic Mammal Community - Abundance by Reach

Solutia

FIGURE
5-4



- Choccolocco Creek
- Snow Creek
- EC0*
- EC10*
- EC20*
- C.dilutis 13-day Survival (EC0*)
- H.azteca 42-day Survival (EC0*)
- Probable Effects Concentration

Notes:
EC0*, EC10*, and EC20* are representative of the most sensitive endpoint, for either organism which is *H. azteca,* young/female (normalized to survival).
Shading shows limits of Assessment Areas.
UAA: Upper Assessment Area
MAA: Middle Assessment Area
LAA: Lower Assessment Area
mg/kg: milligrams per kilogram
mi: miles
PCB: polychlorinated biphenyl

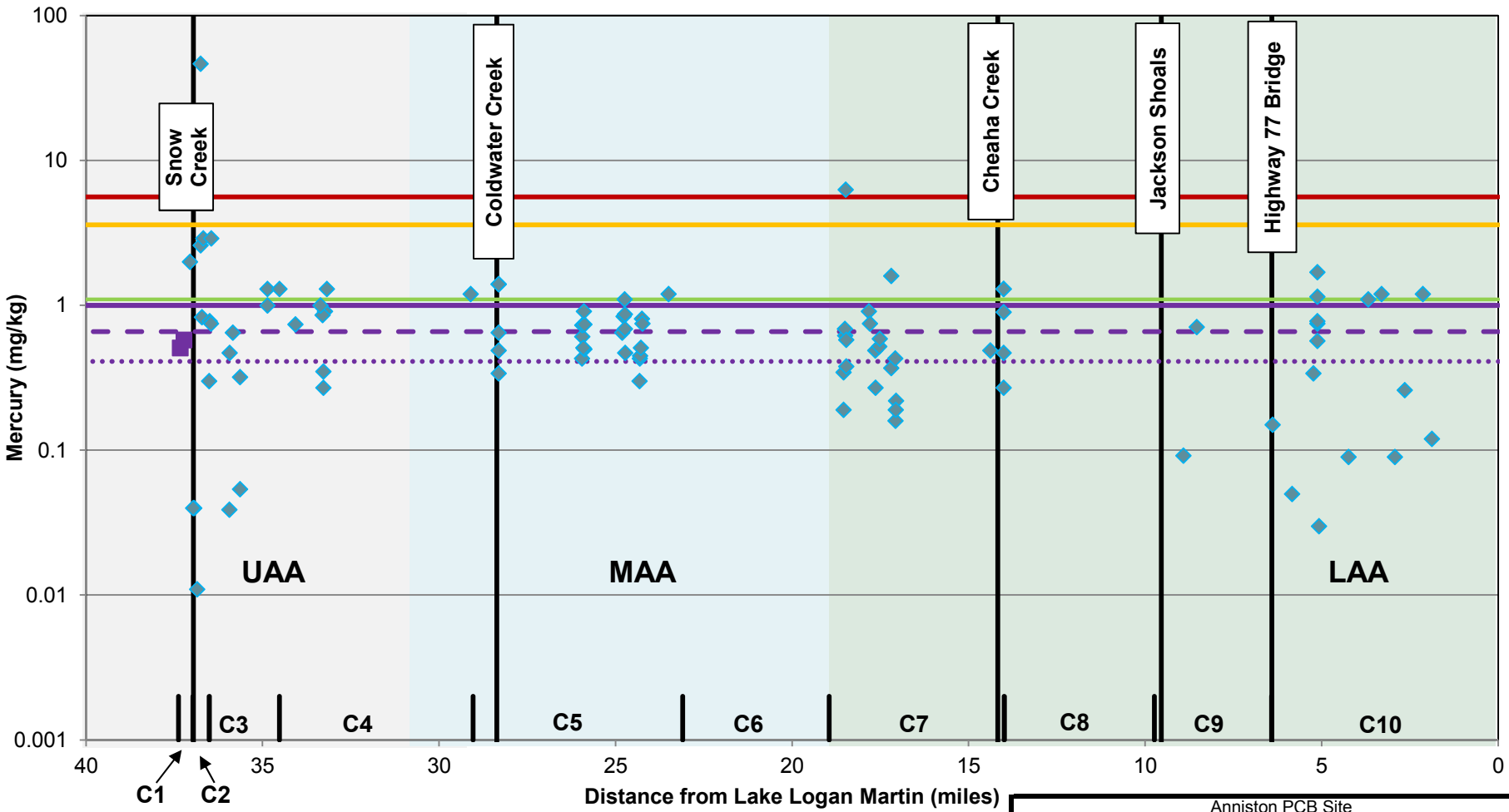
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Total PCBs in Sediment by River Mile and Sediment Toxicity Thresholds

Solutia
Ingenuity Productivity Performance

Figure 6-1



Notes:
EC0*, EC10*, and EC20* are representative of the most sensitive endpoint, for either organism which is *H. azteca,* young/female (normalized to survival).
Shading shows limits of Assessment Areas.
UAA: Upper Assessment Area
MAA: Middle Assessment Area
LAA: Lower Assessment Area
mg/kg: milligrams per kilogram
mi: miles

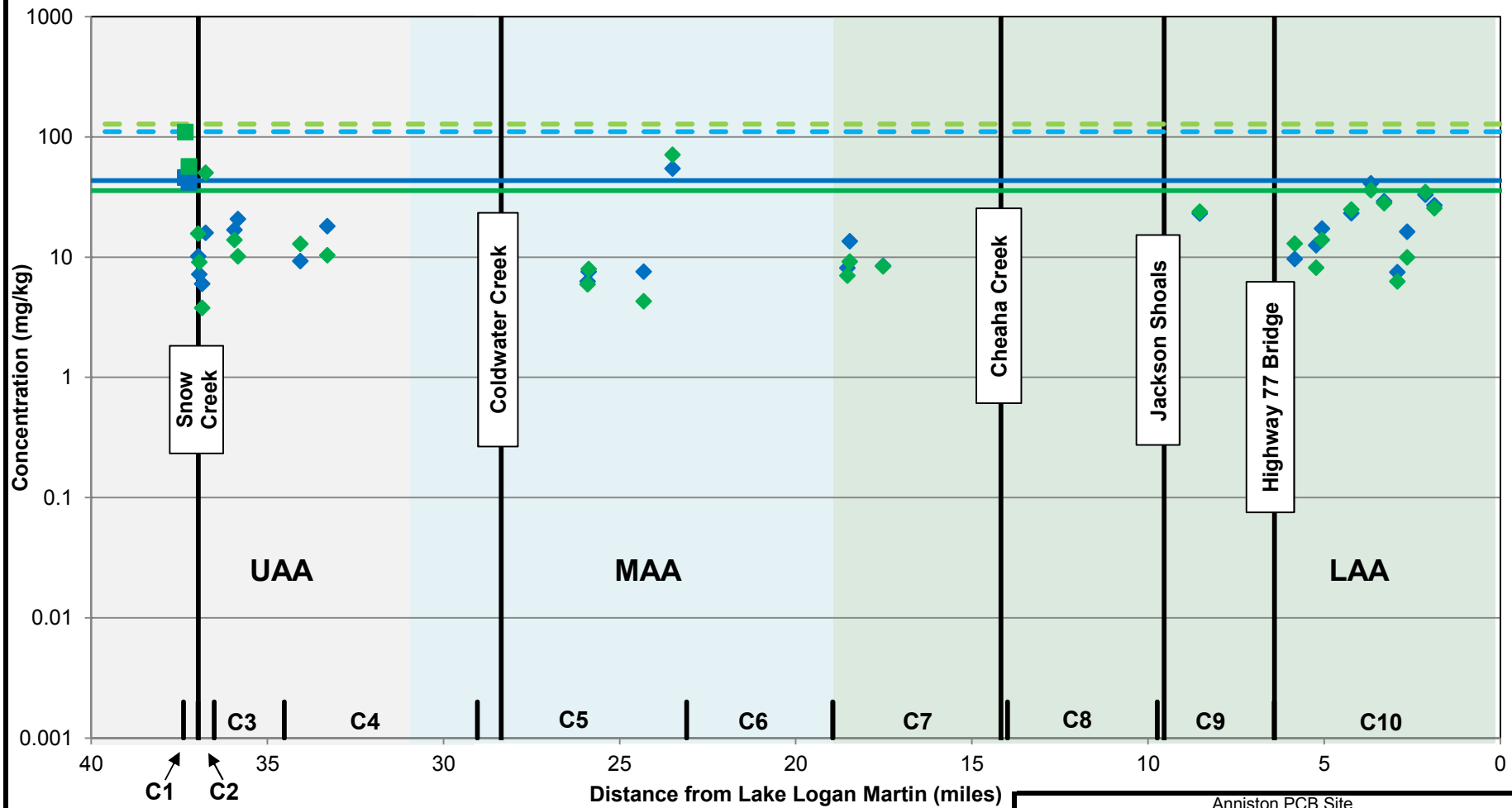
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Mercury in Sediment by River Mile and Sediment Toxicity Thresholds

Solutia

Figure
6-2



Notes:
UAA: Upper Assessment Area
MAA: Middle Assessment Area
LAA: Lower Assessment Area
mg/kg: milligrams per kilogram
mi: miles

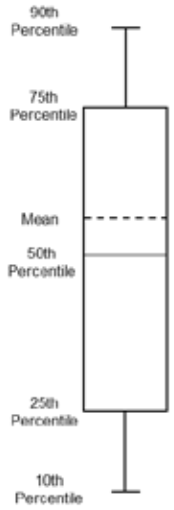
Anniston PCB Site
Anniston, Alabama

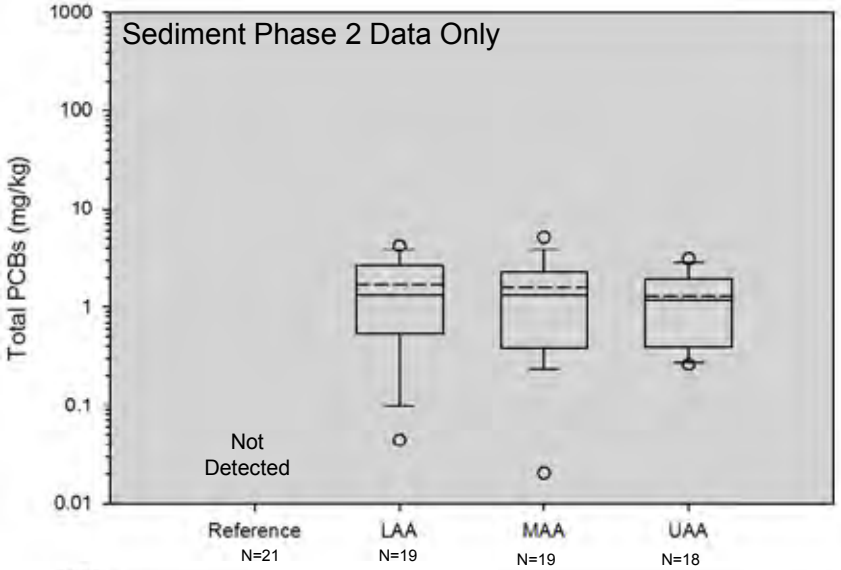
Baseline Ecological Risk Assessment for OU-4

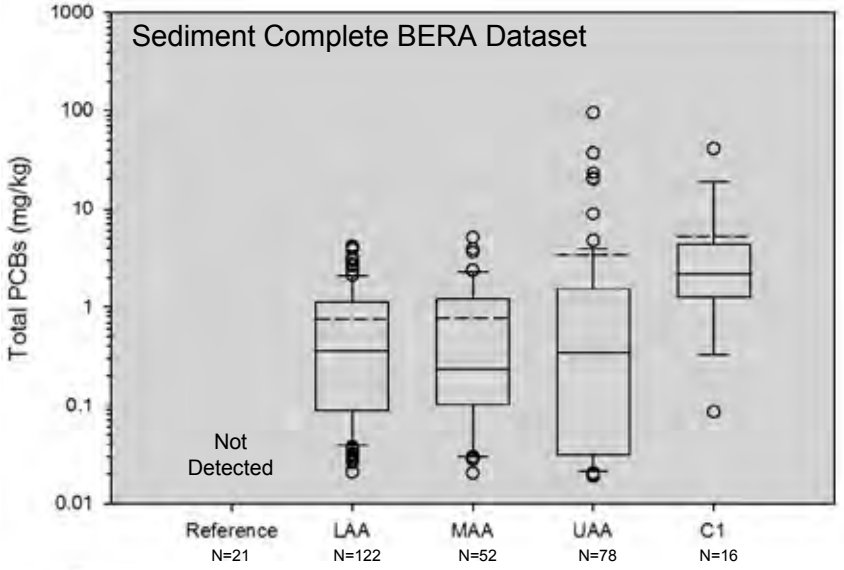
Metals in Sediment by River Mile and Sediment Toxicity Benchmarks

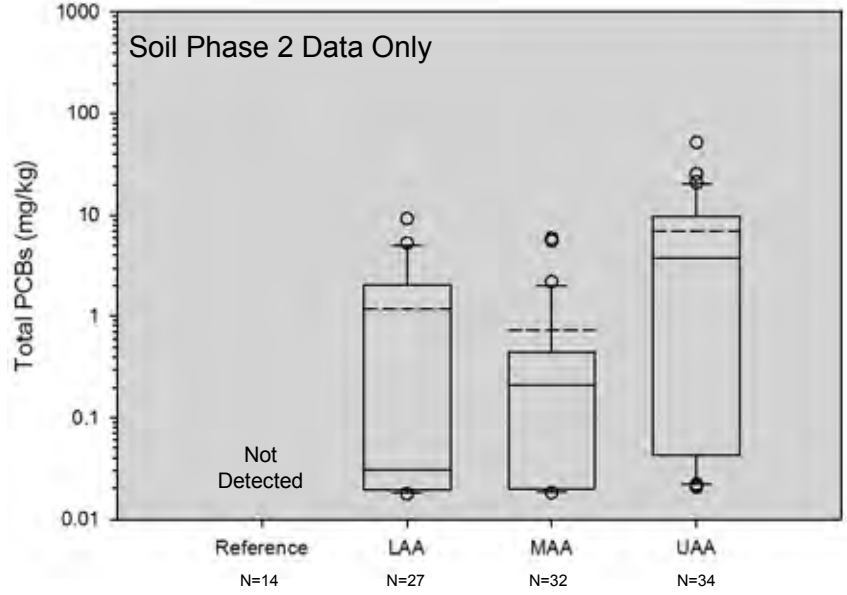
Solutia

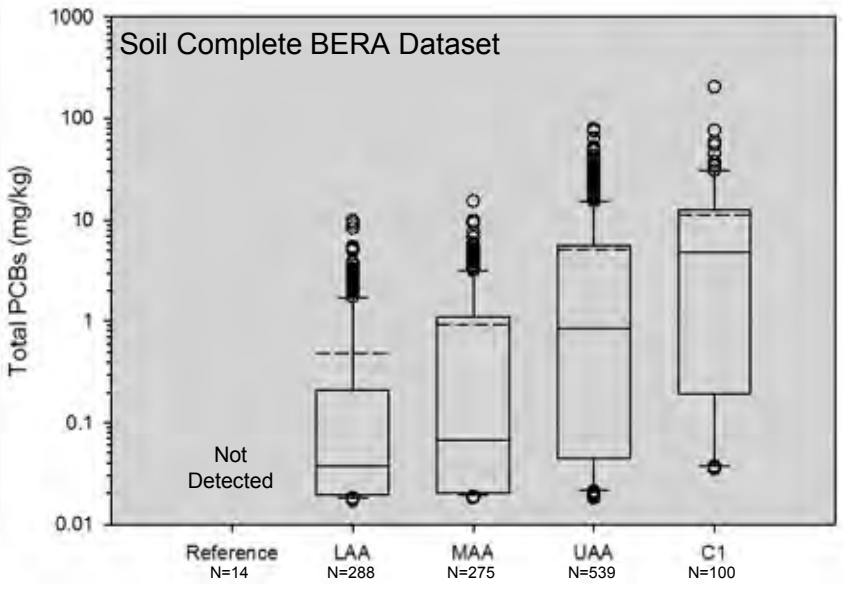
Figure 6-3











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

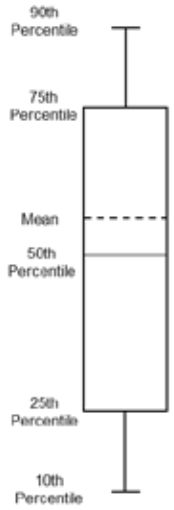
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

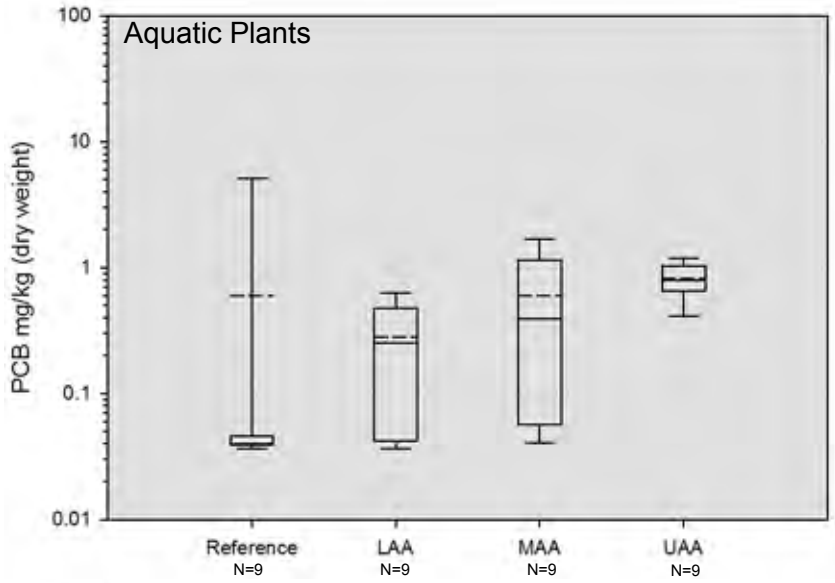
Summary of OU-4 and Reference PCB Concentrations in Soil and Sediment

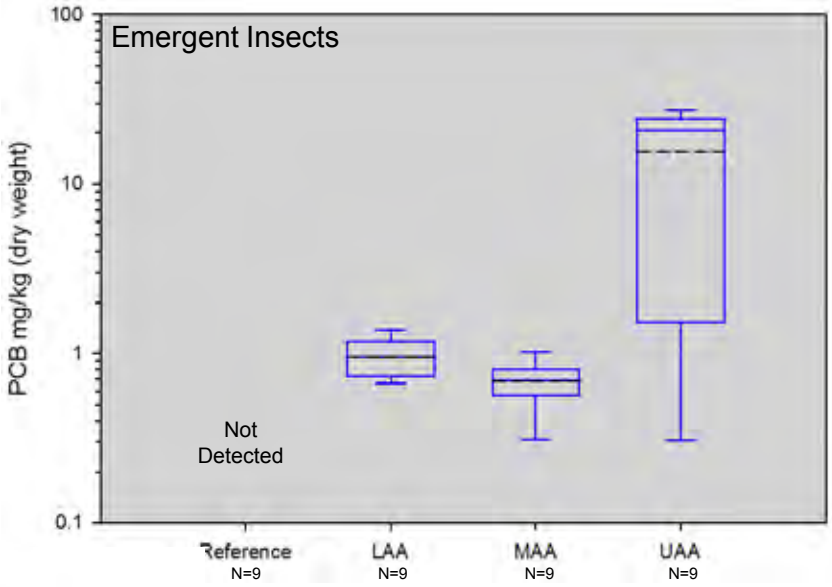
Solutia

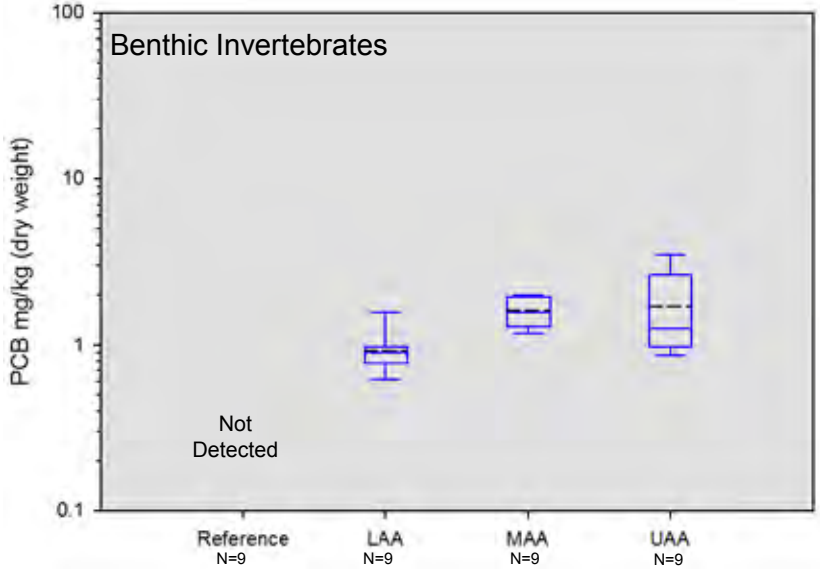
Figure 6-4

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\









Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

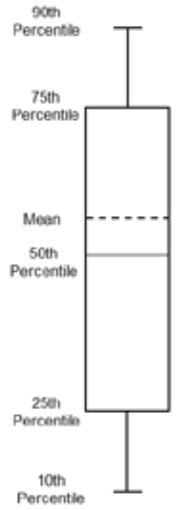
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

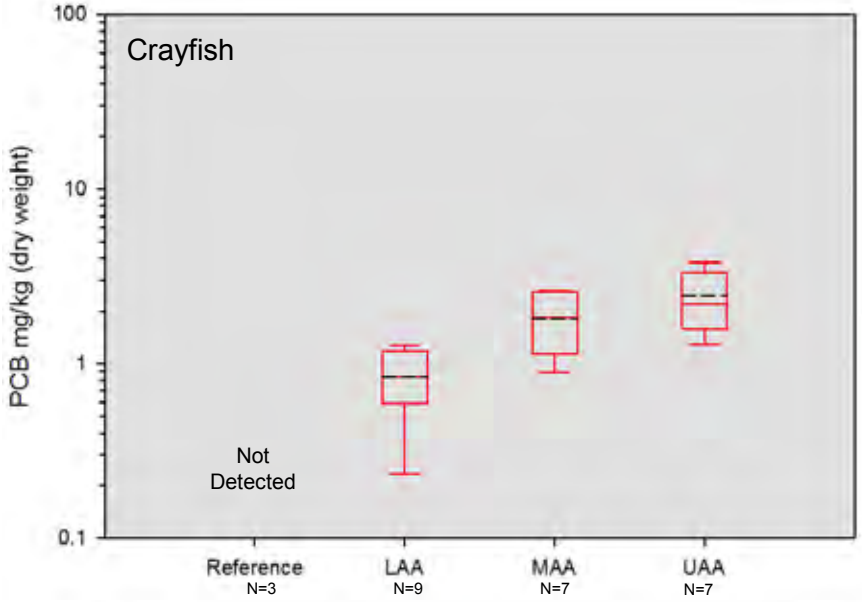
Summary of OU-4 and Reference PCB Concentrations in Aquatic Tissues

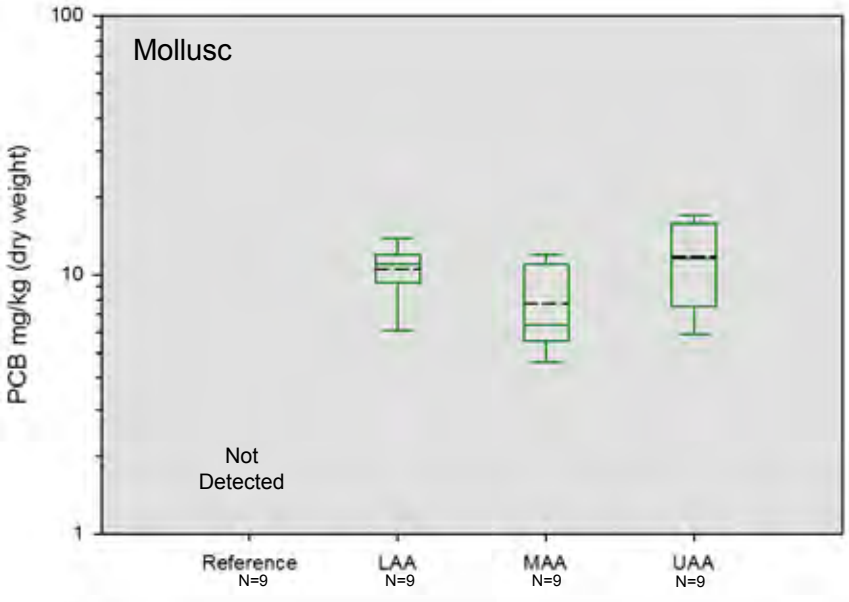
Solutia

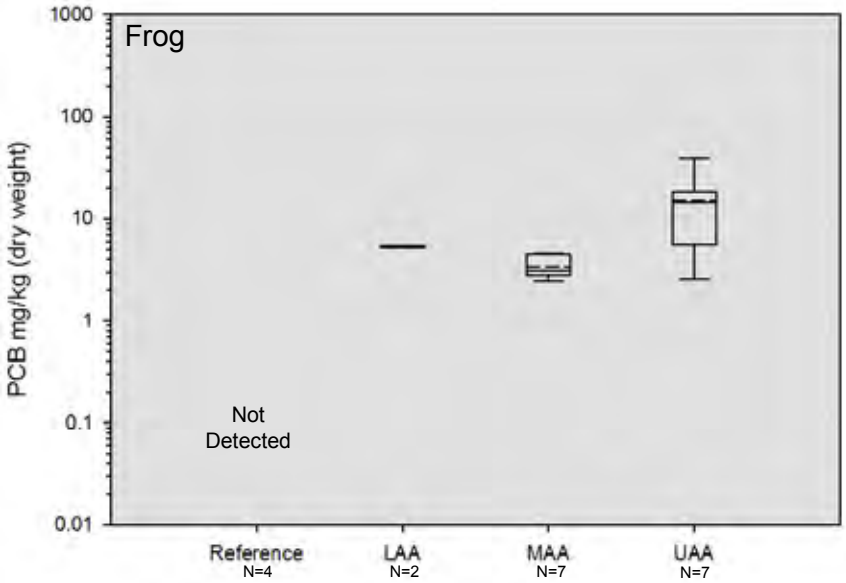
Figure 6-5a

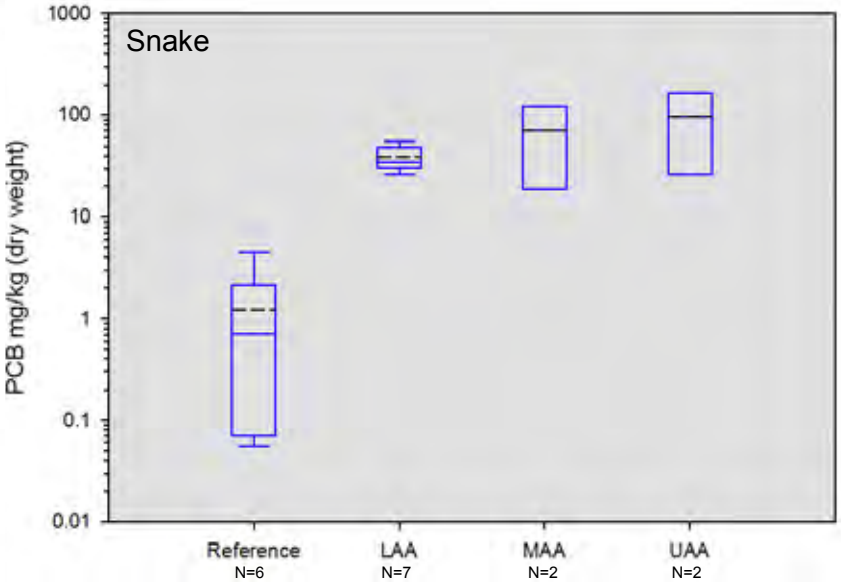
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

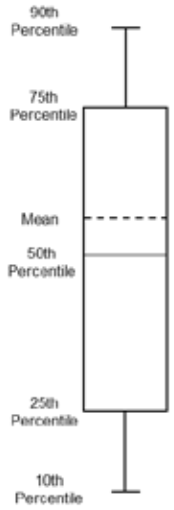
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

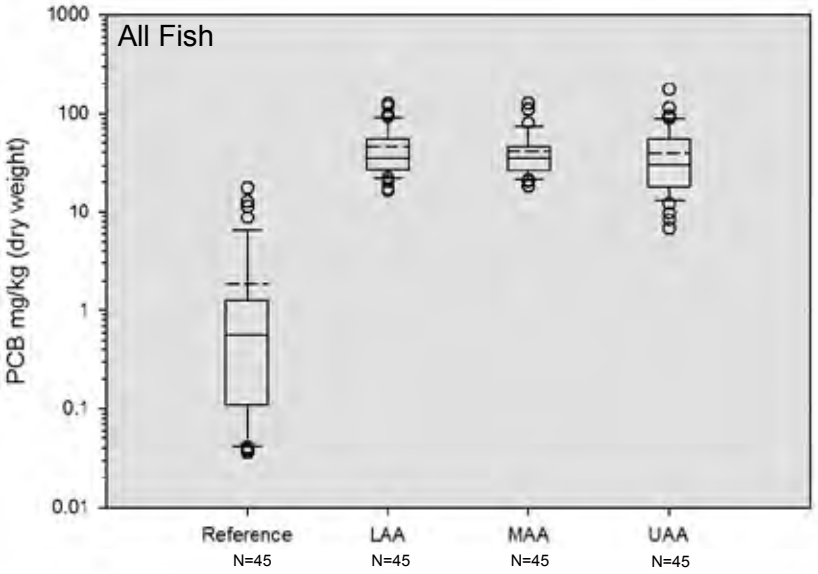
Summary of OU-4 and Reference PCB Concentrations in Aquatic Tissues

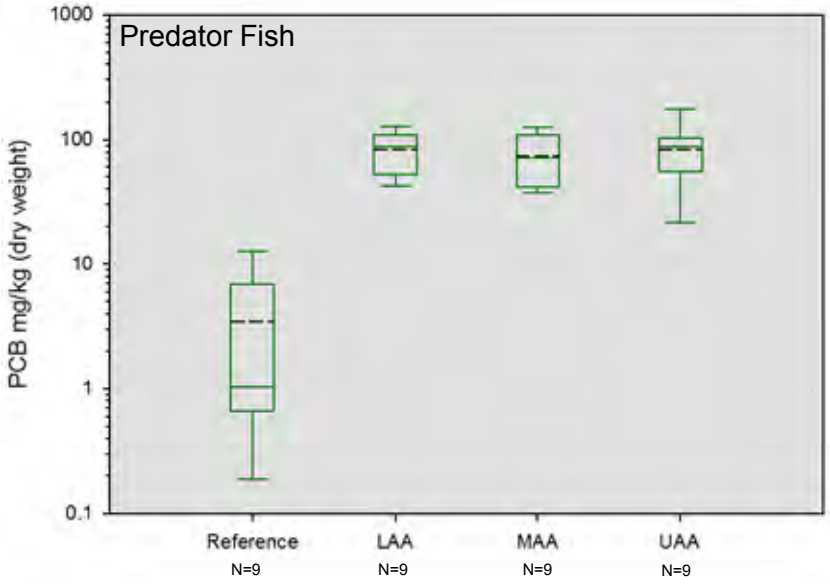
Solutia

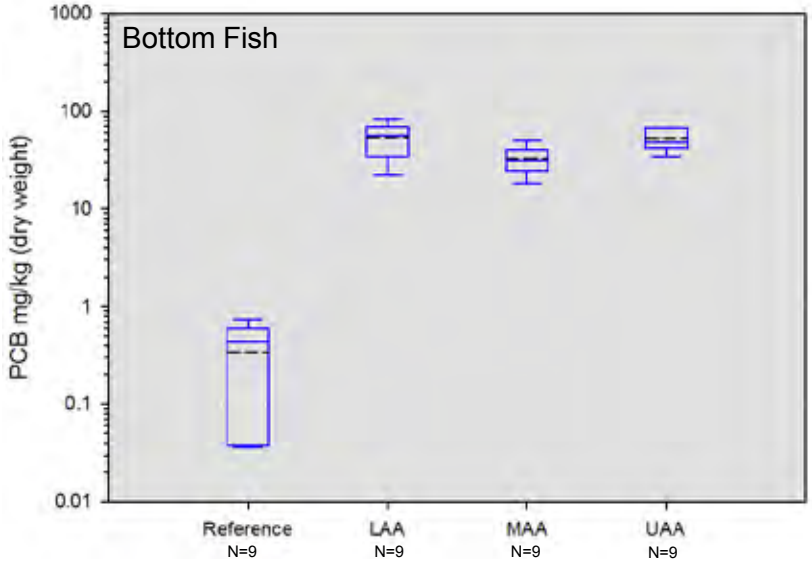
Figure 6-5b

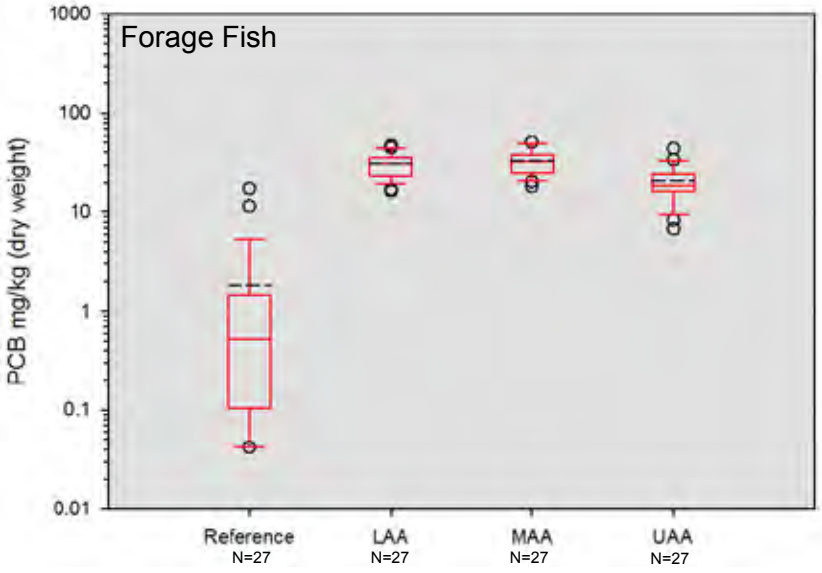
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

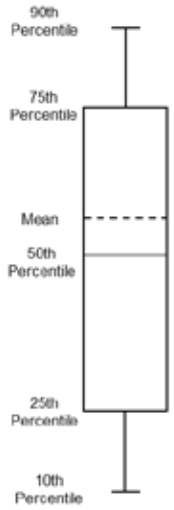
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

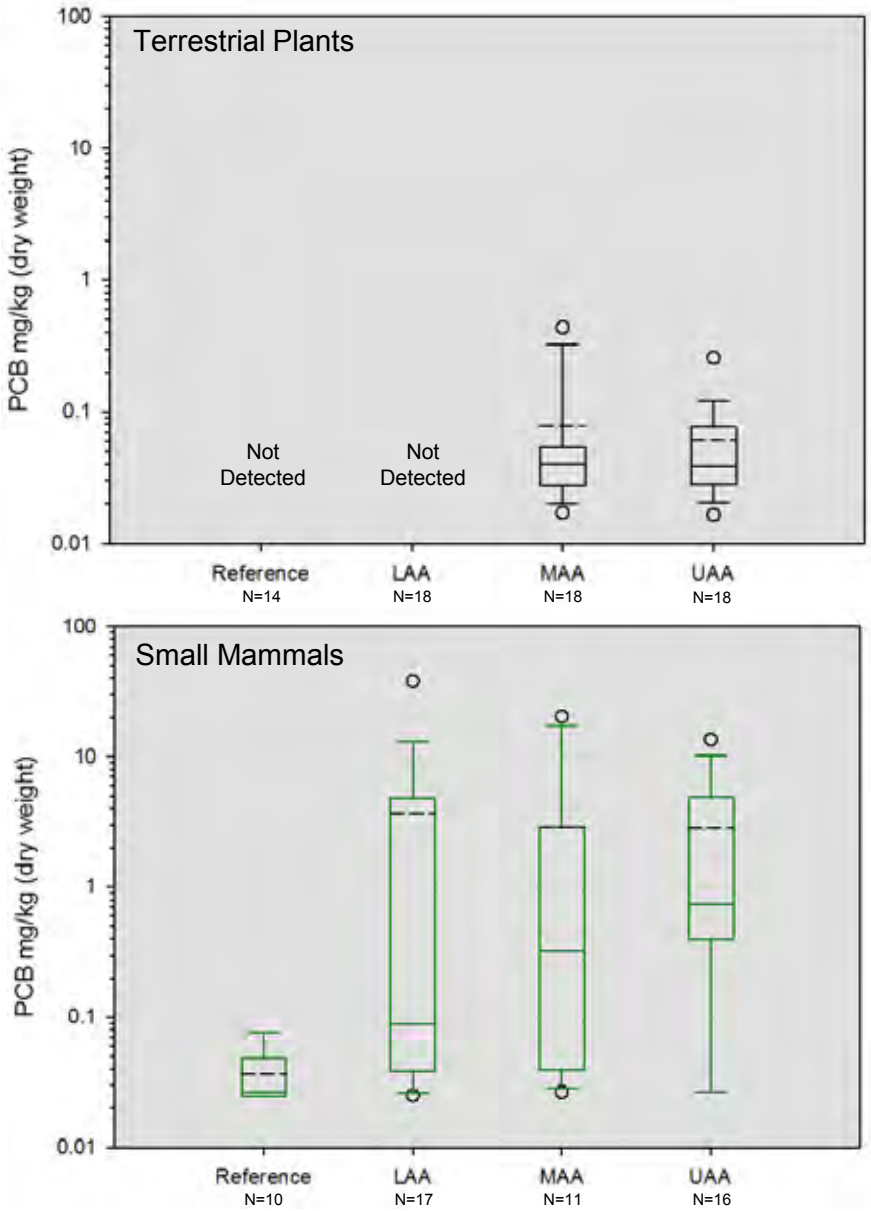
Summary of OU-4 and Reference PCB Concentrations in Aquatic Tissues

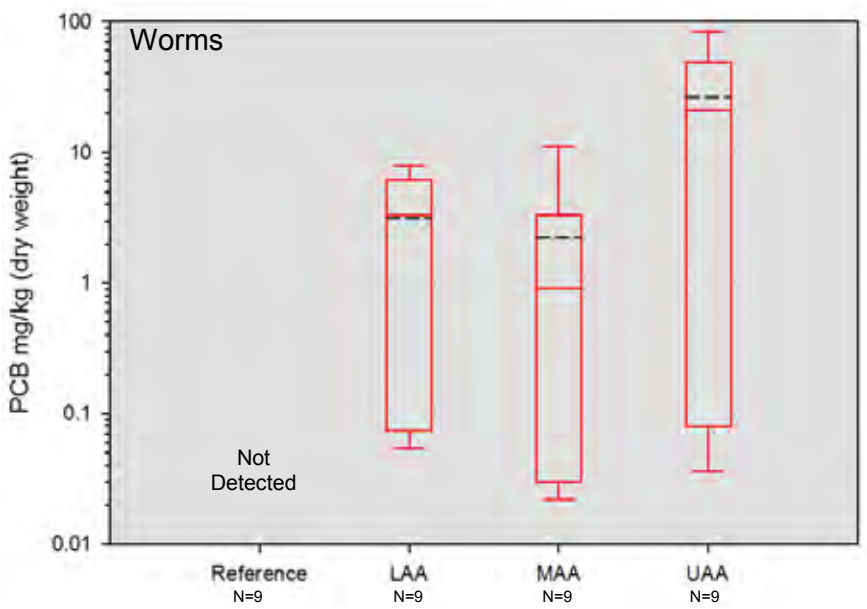
Solutia

Figure 6-5c

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\







Terrestrial Insects:
PCBs were not detected in any OU-4 or reference samples

Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

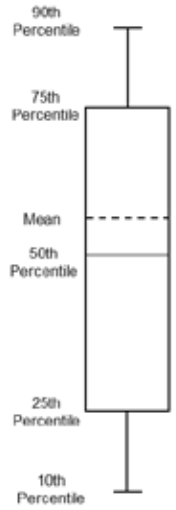
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

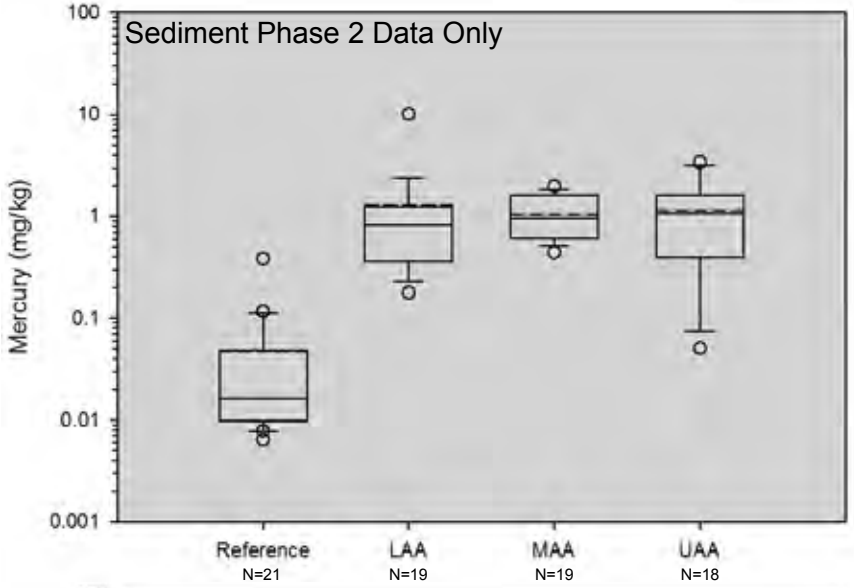
Summary of OU-4 and Reference PCB Concentration in Terrestrial Tissues

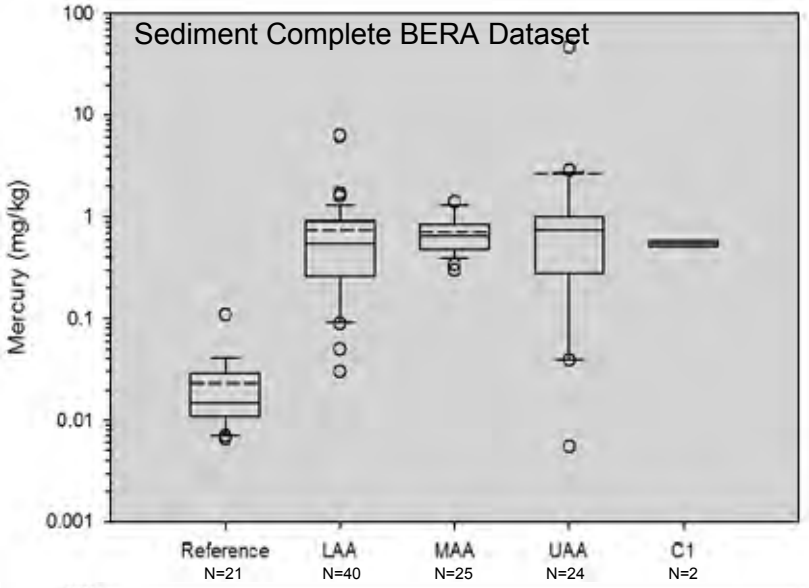
Solutia

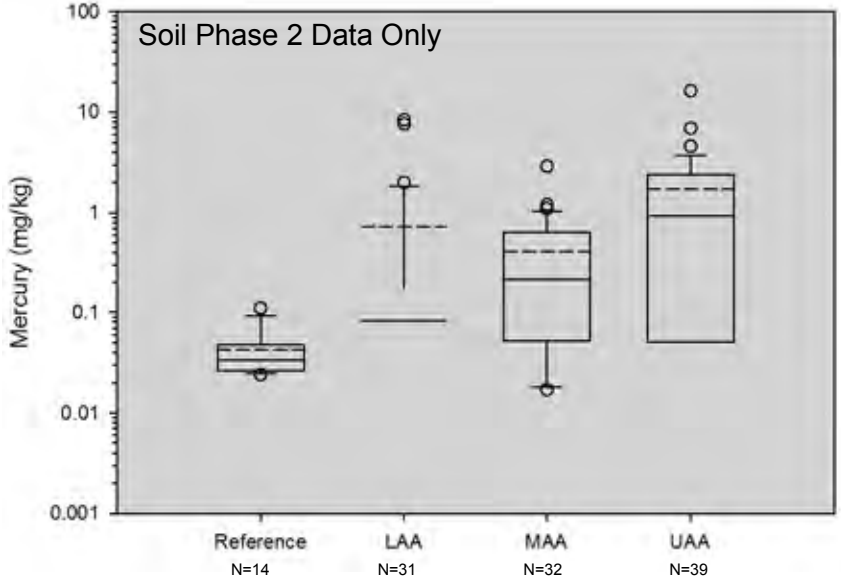
Figure 6-6

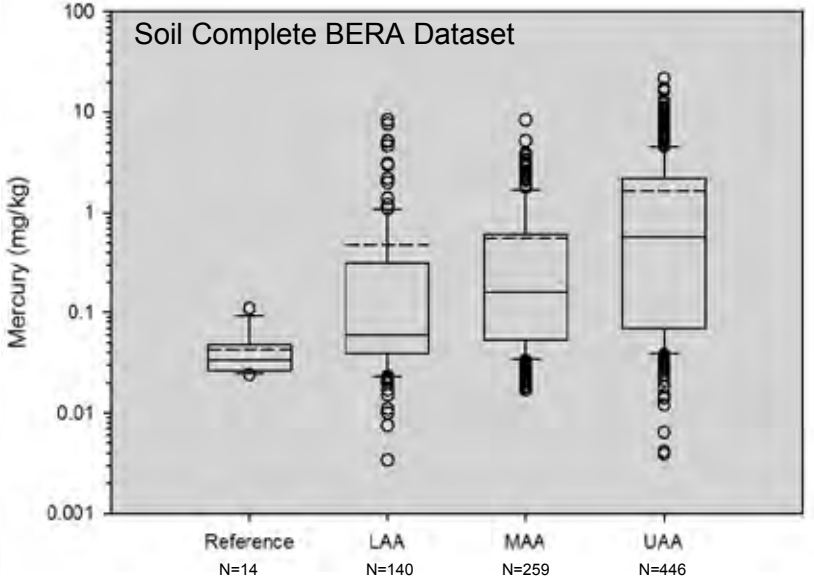
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

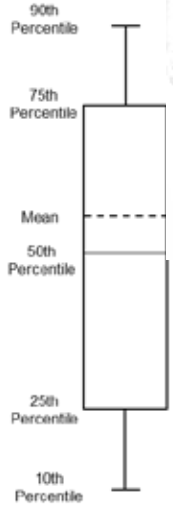
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

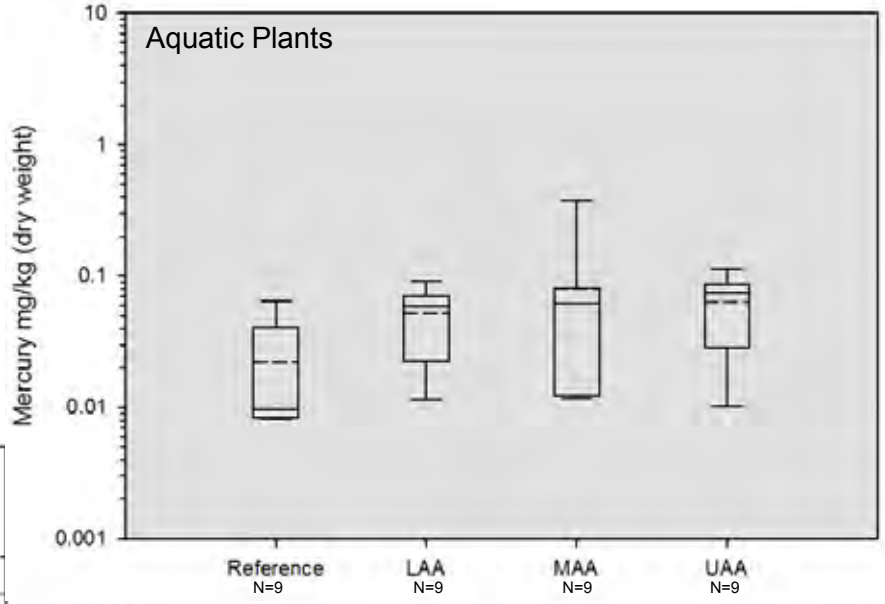
Summary of OU-4 and Reference Mercury Concentrations in Soil and Sediment

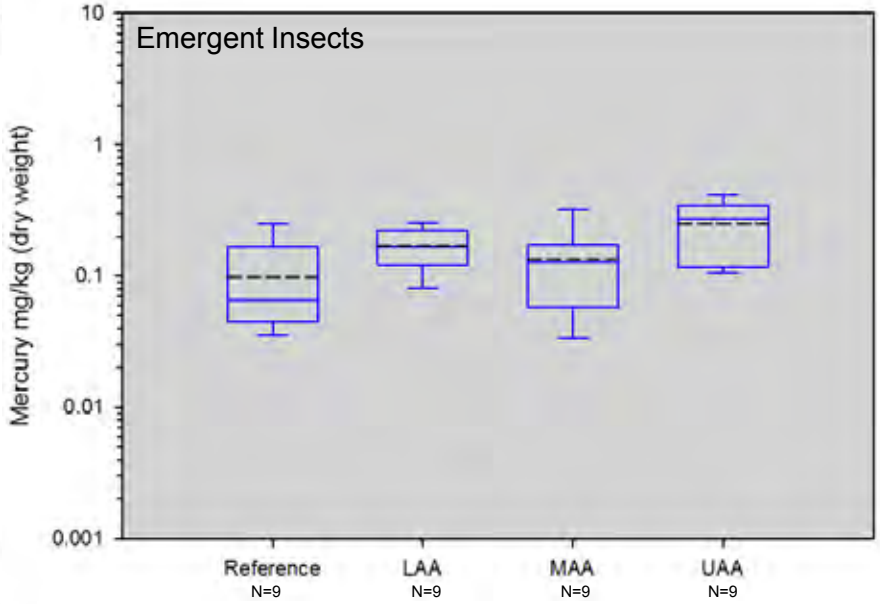
Solutia

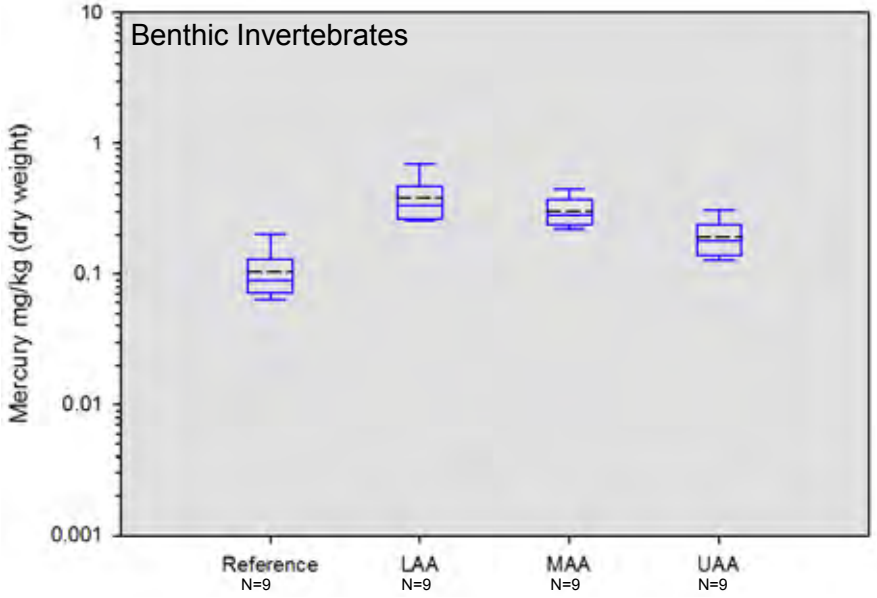
Figure 6-7

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\









Notes:

○ Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

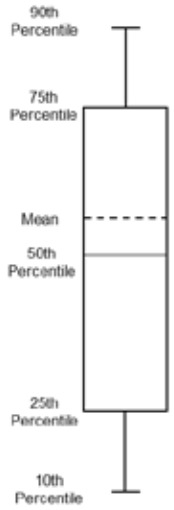
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

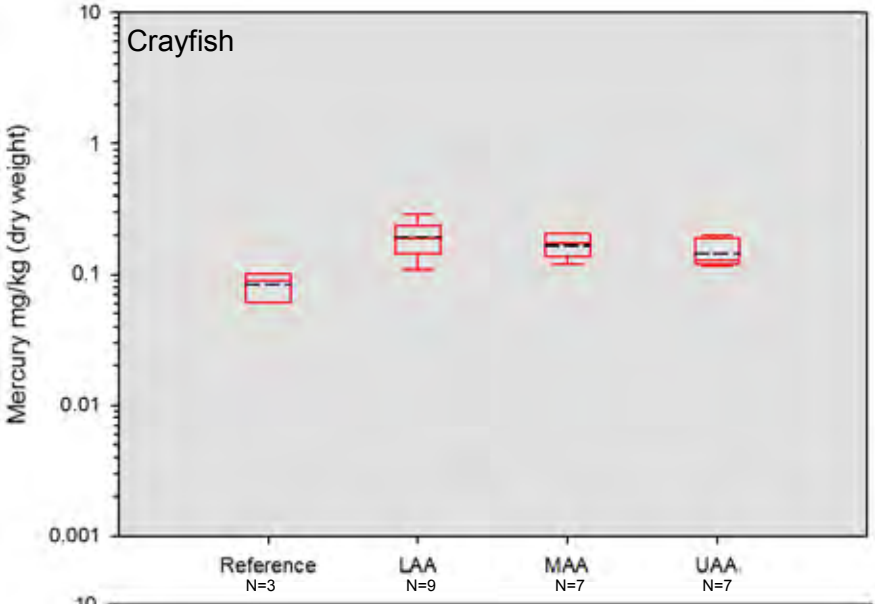
Summary of OU-4 and Reference Mercury Concentrations in Aquatic Tissues

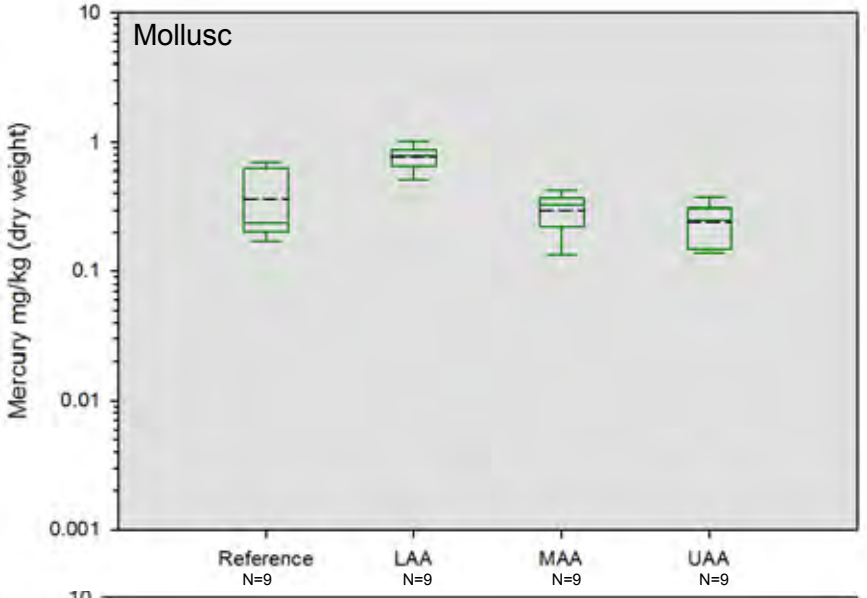
Solutia

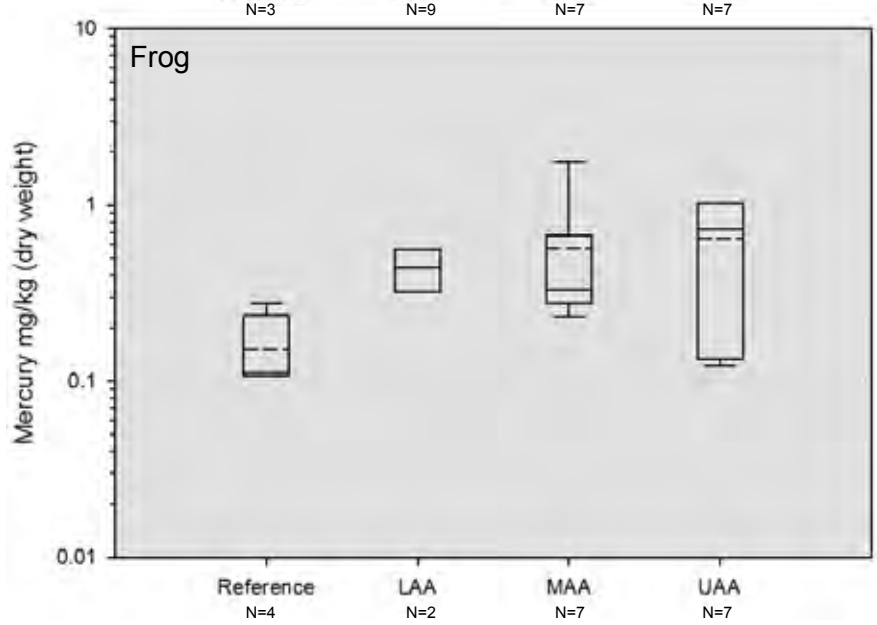
Figure 6-8a

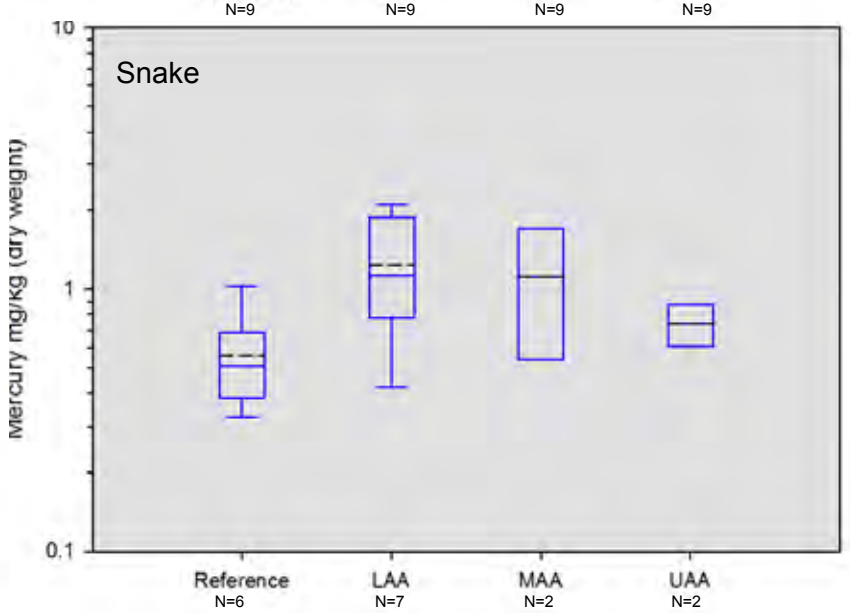
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

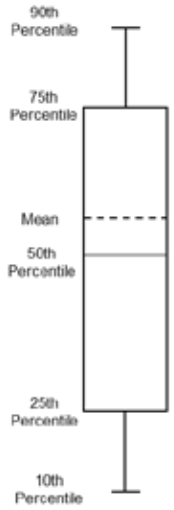
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

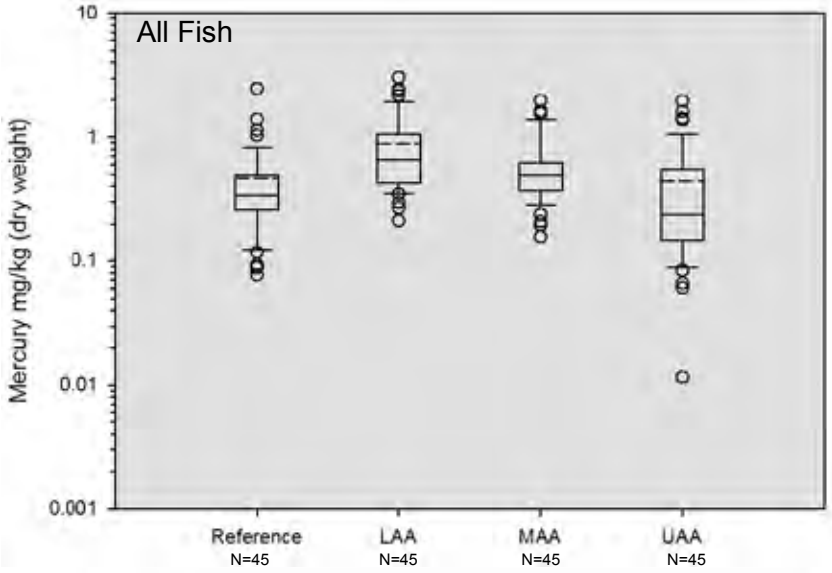
Summary of OU-4 and Reference Mercury Concentrations in Aquatic Tissues

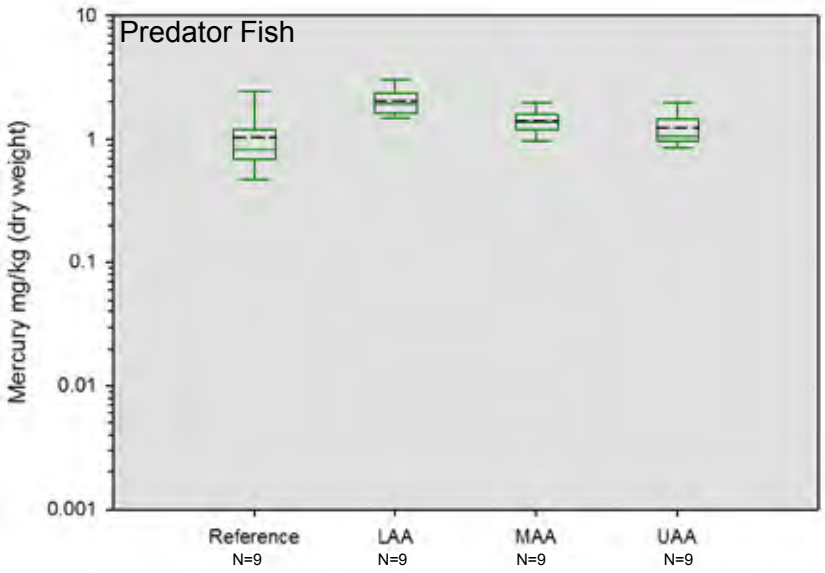
Solutia

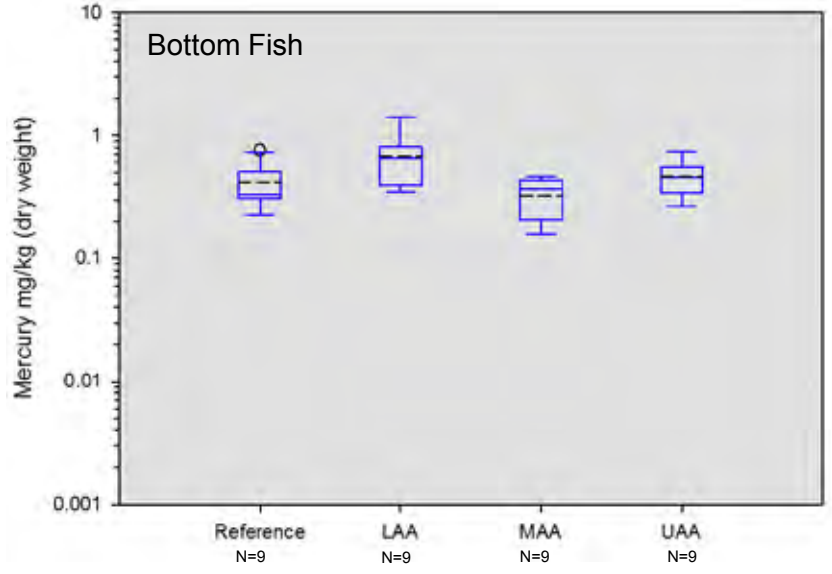
Figure 6-8b

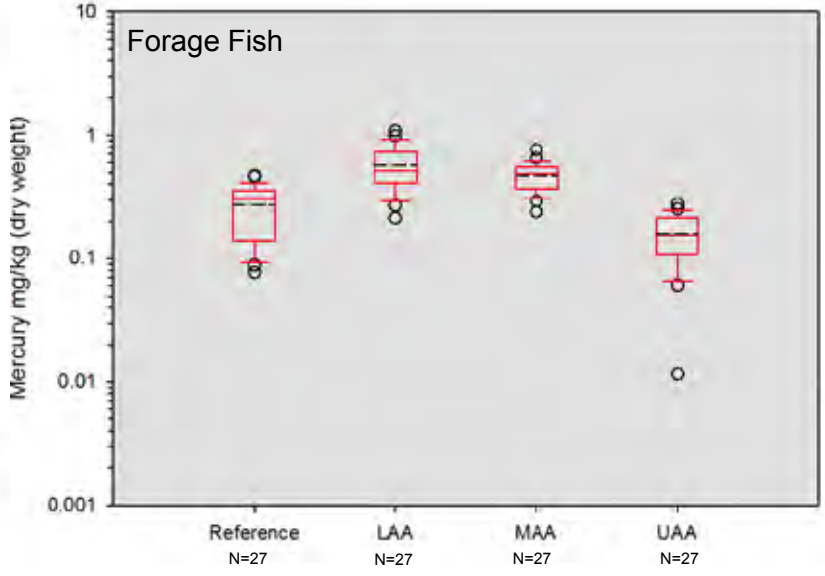
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

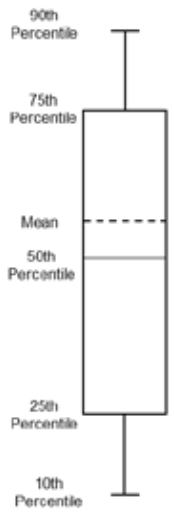
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

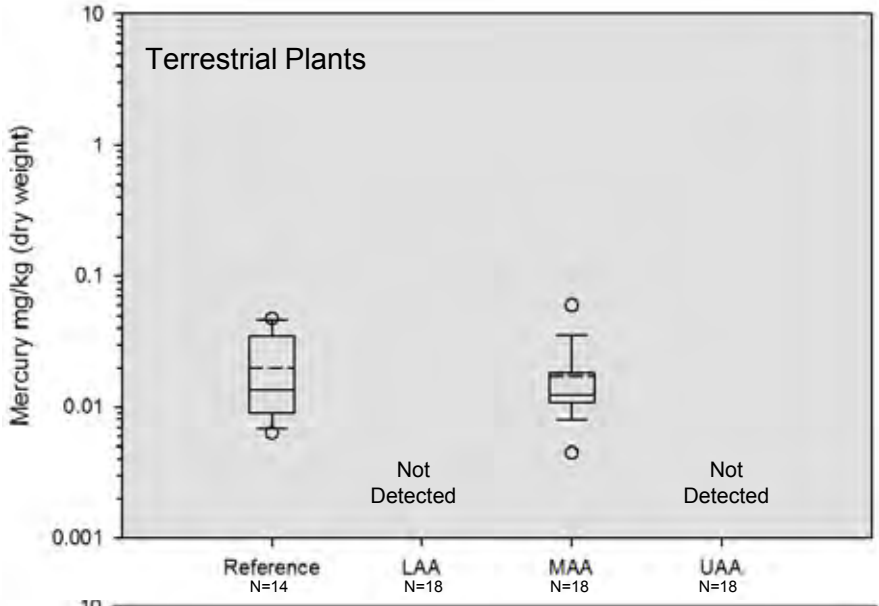
Summary of OU-4 and Reference Mercury Concentrations in Aquatic Tissues

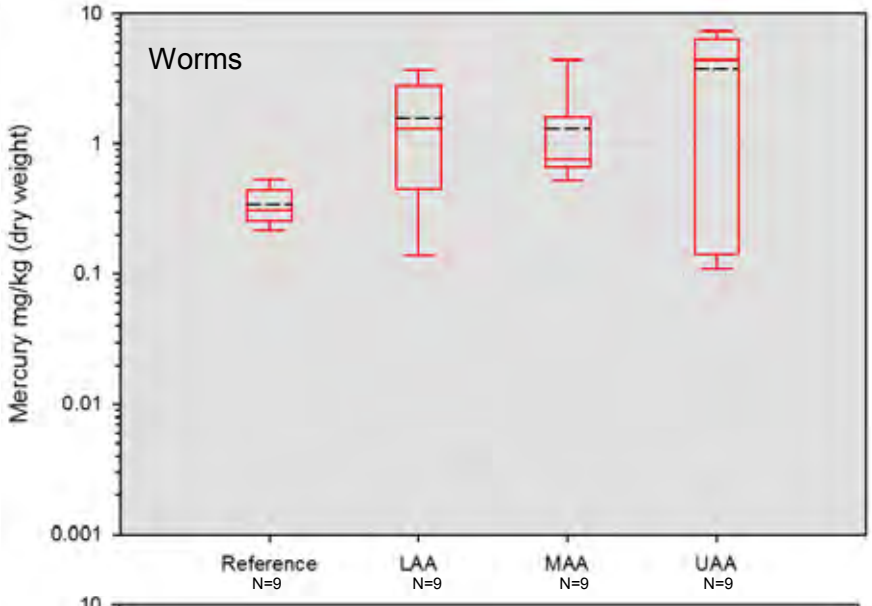
Solutia

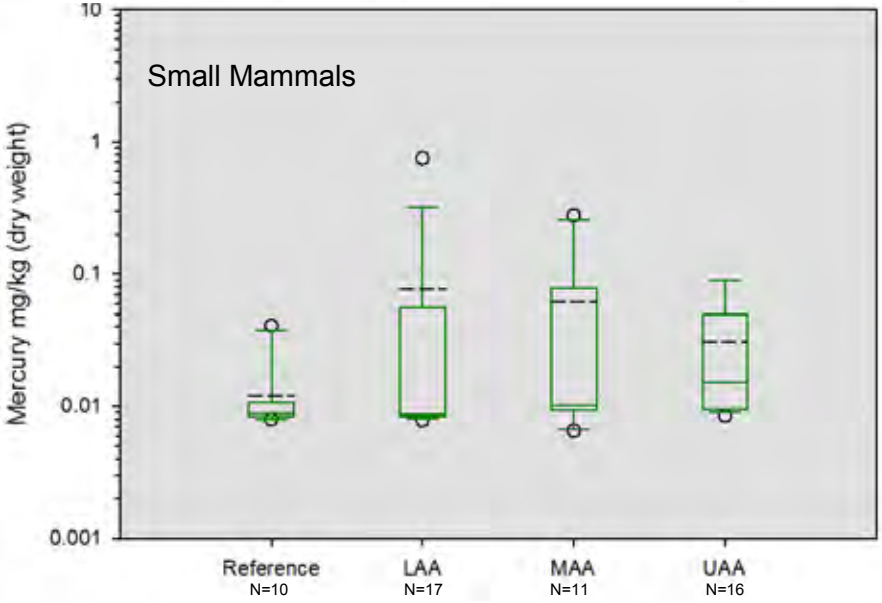
Figure 6-8c

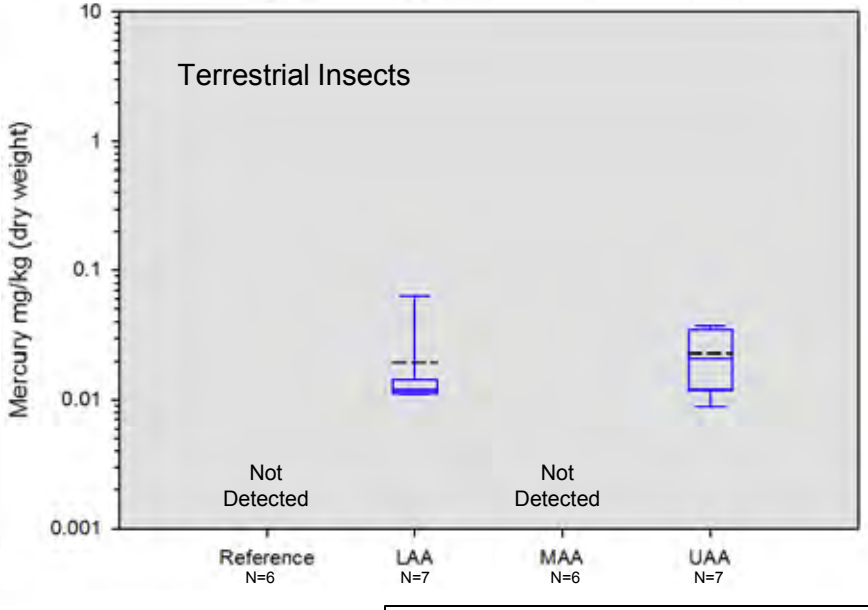
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

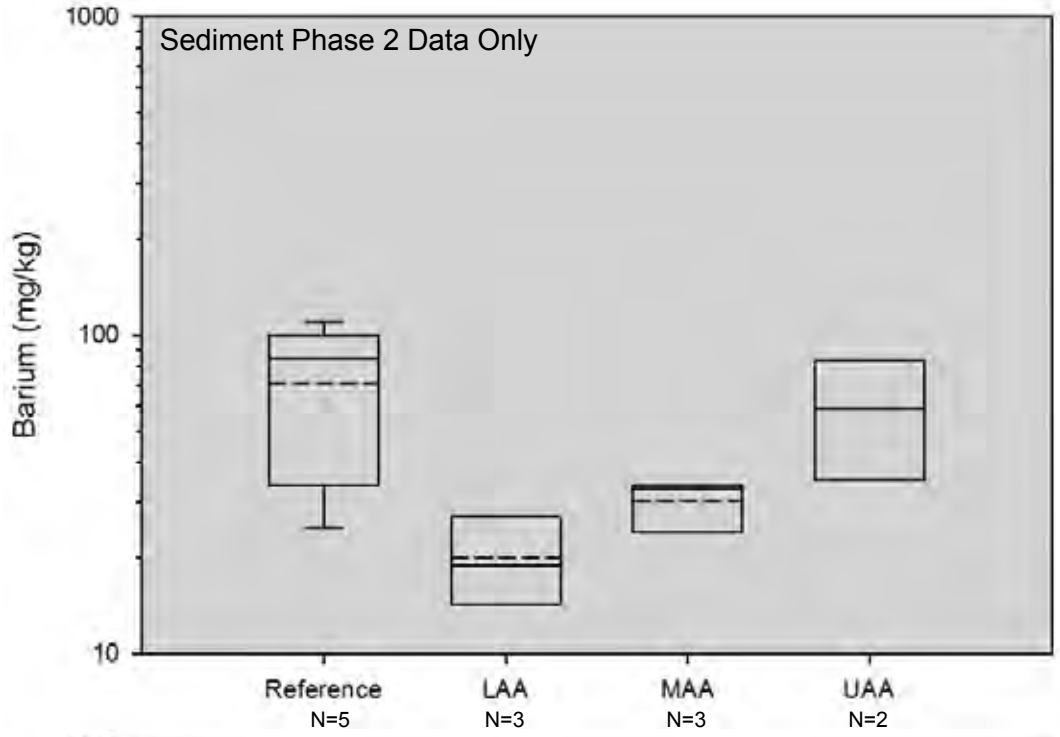
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

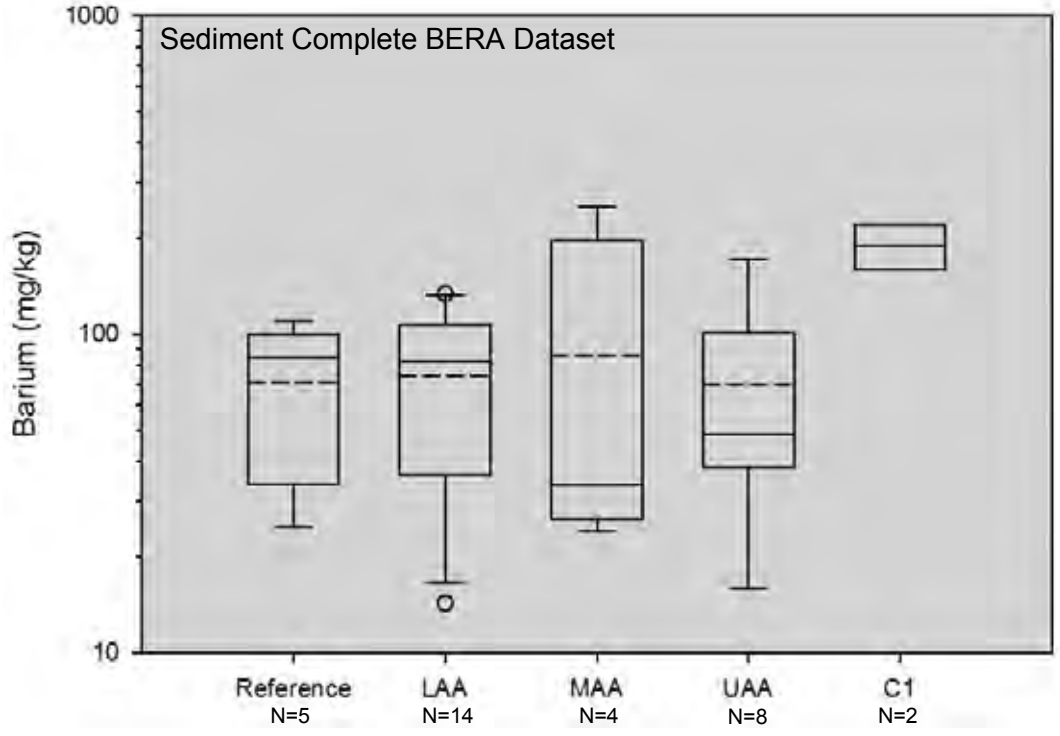
Summary of OU-4 and Reference Mercury Concentration in Terrestrial Tissues

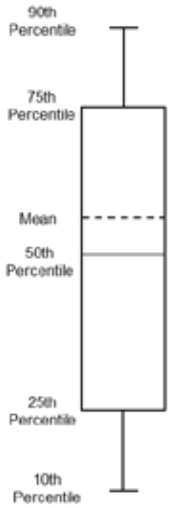
Solutia

Figure 6-9

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\







Notes:

○ Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

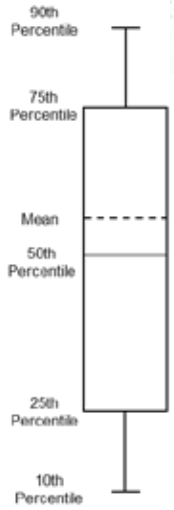
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

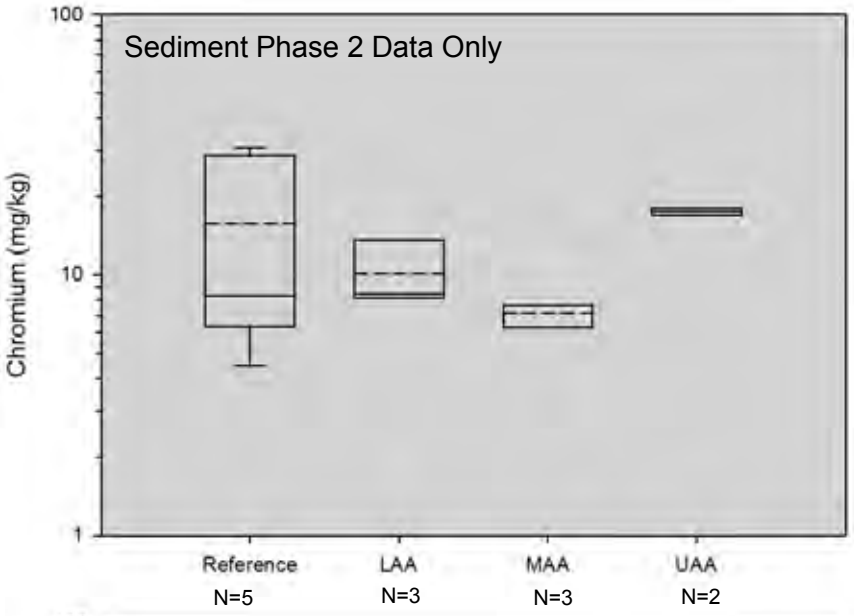
Summary of OU-4 and Reference Barium Concentrations in Sediment

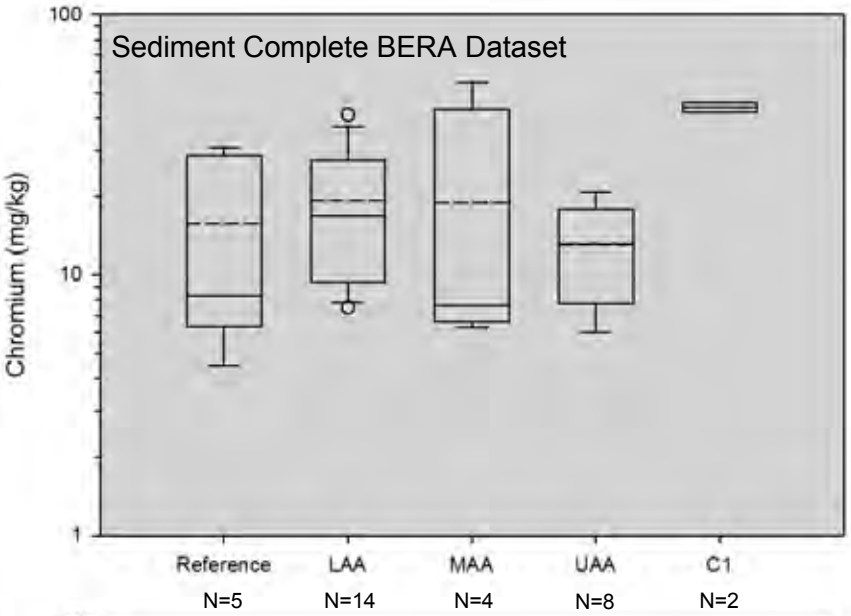
Solutia

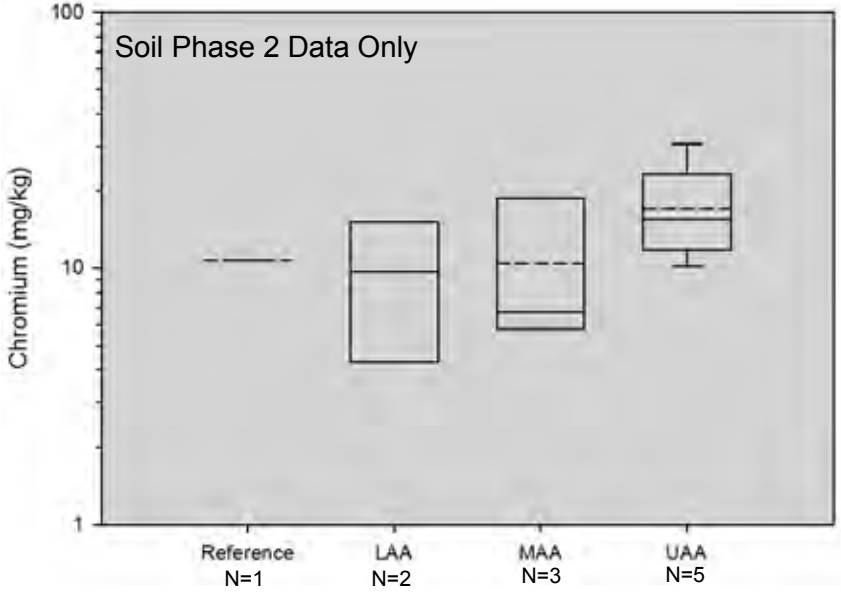
Figure 6-10

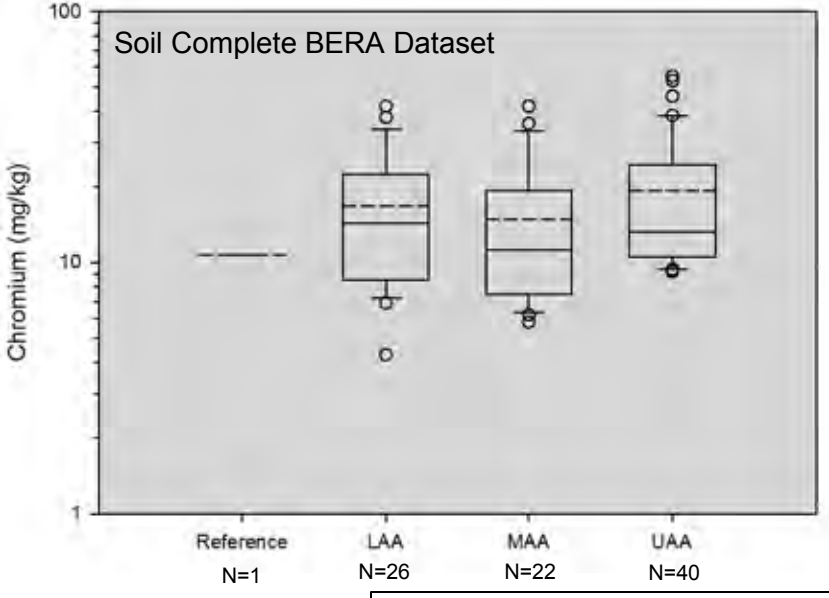
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○ Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

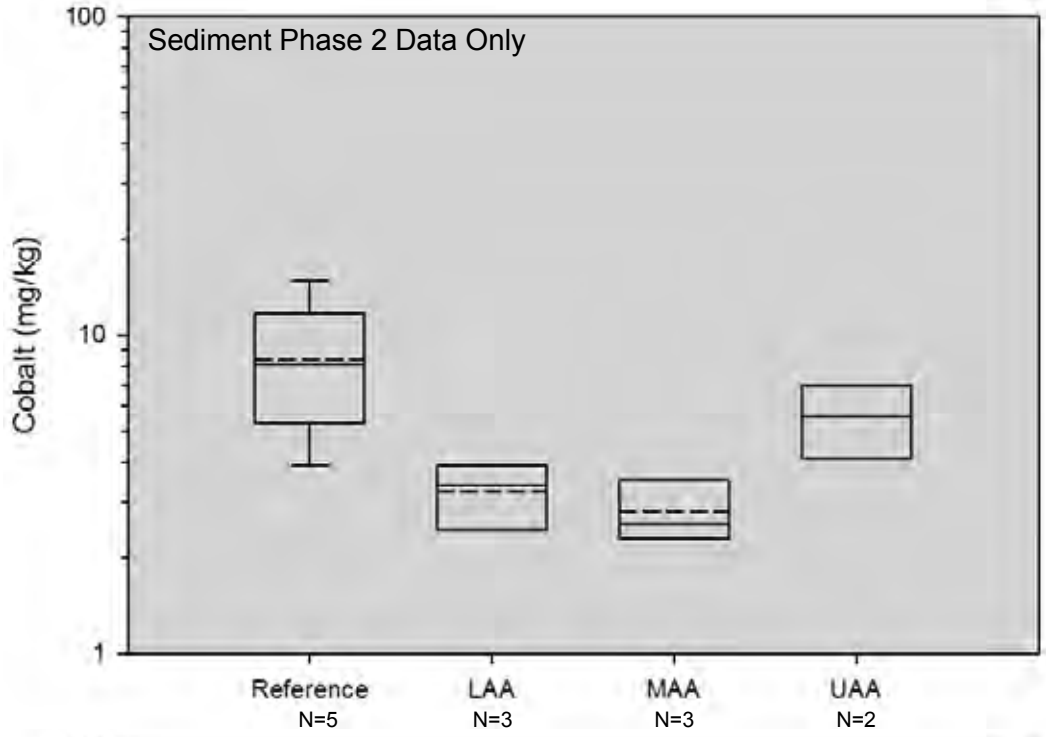
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

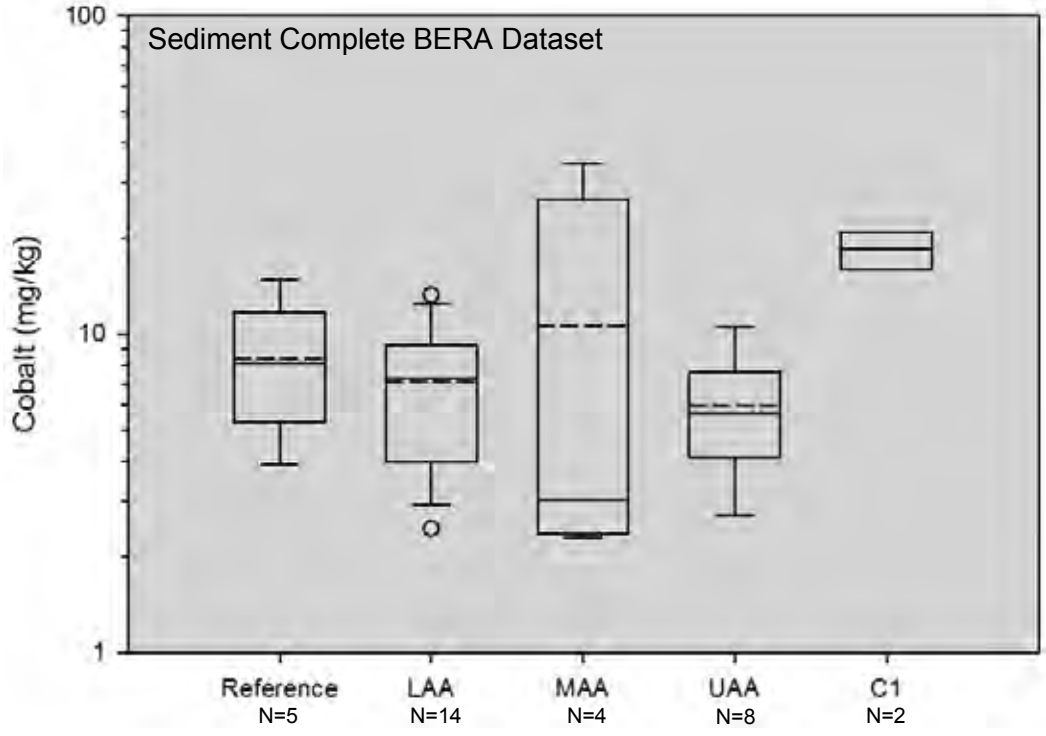
Summary of OU-4 and Reference Chromium Concentrations in Soil and Sediment

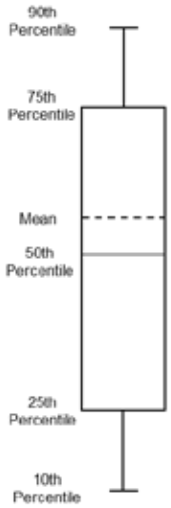
Solutia

Figure 6-11

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\







Notes:

○ Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

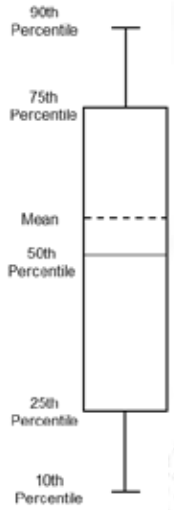
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

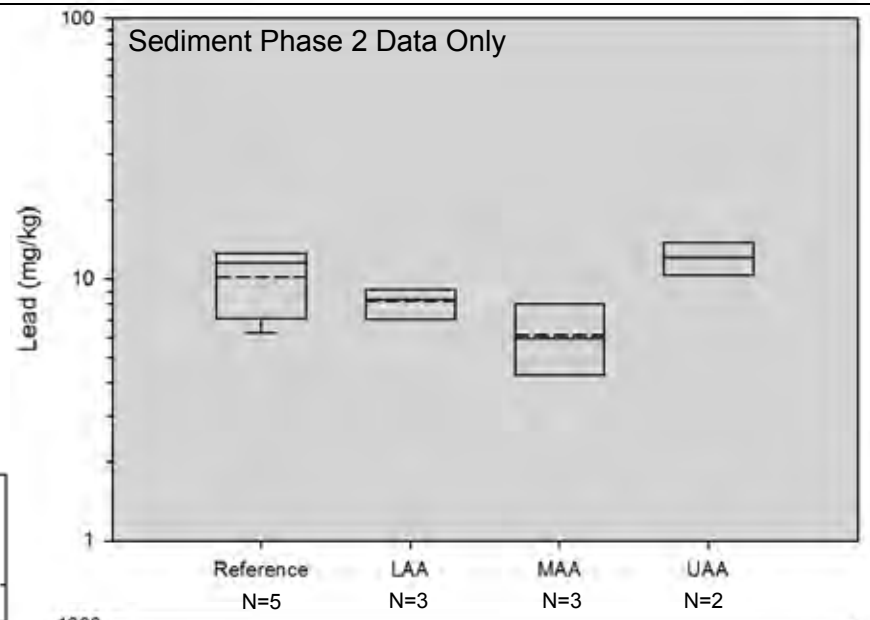
Summary of OU-4 and Reference Cobalt Concentrations in Sediment

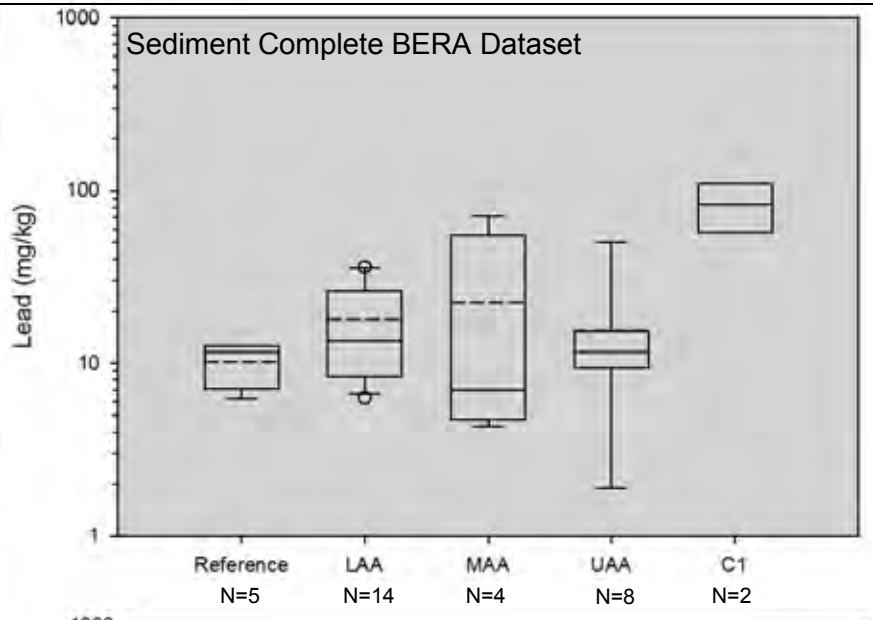
Solutia

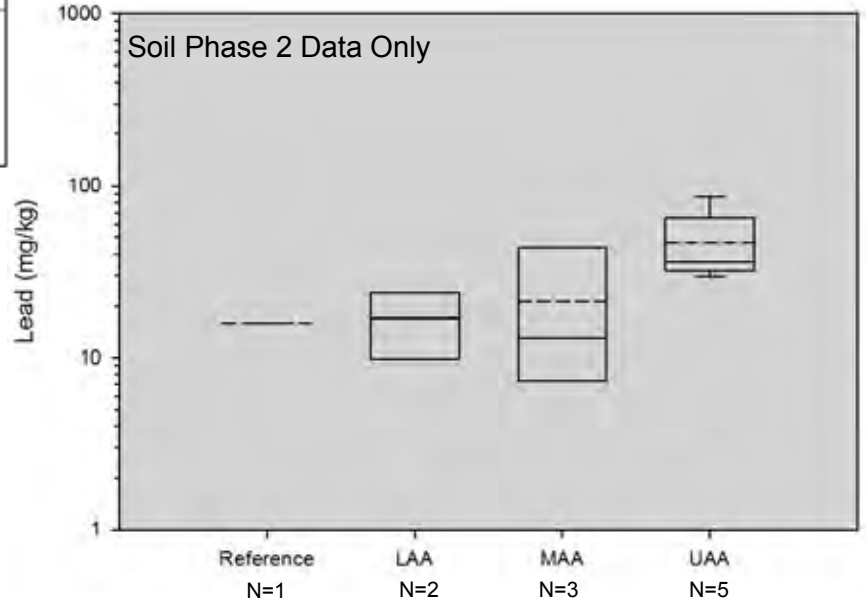
Figure 6-12

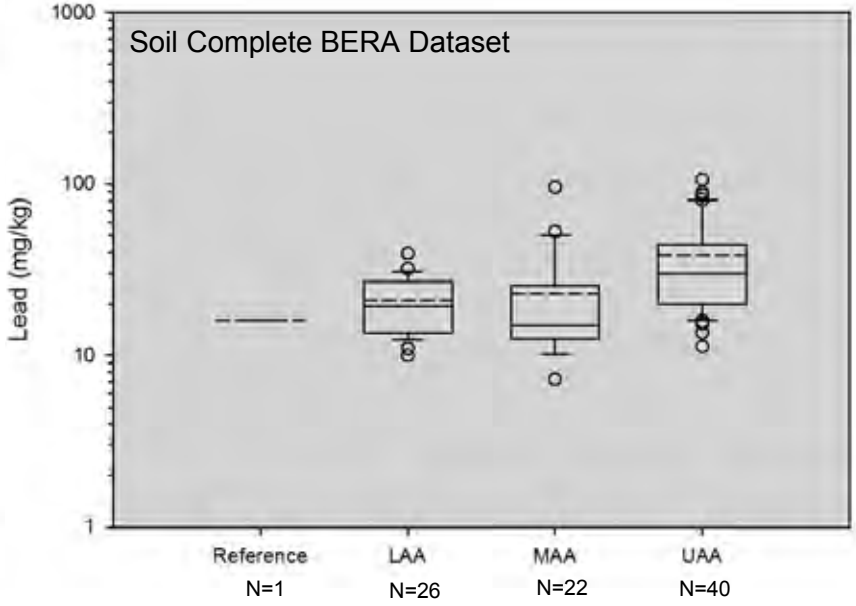
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○ Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

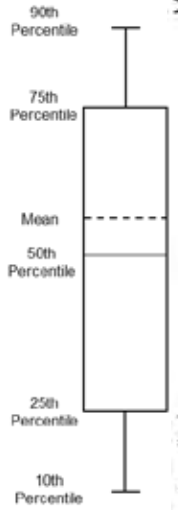
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

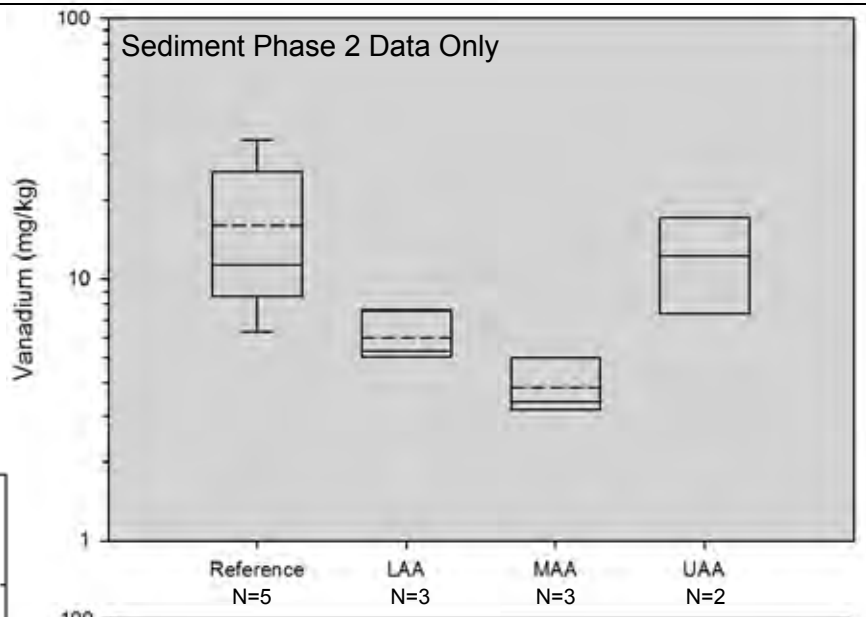
Summary of OU-4 and Reference Lead Concentrations in Soil and Sediment

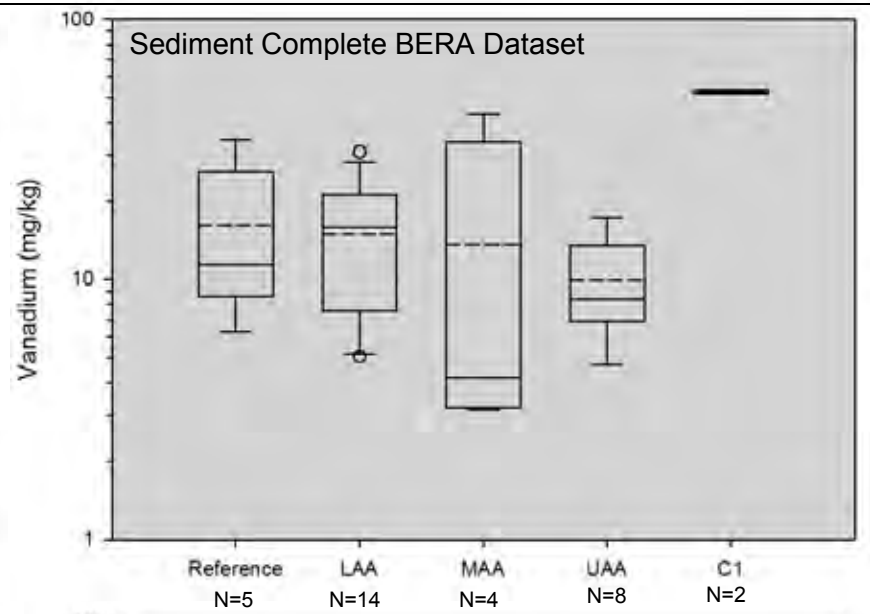
Solutia

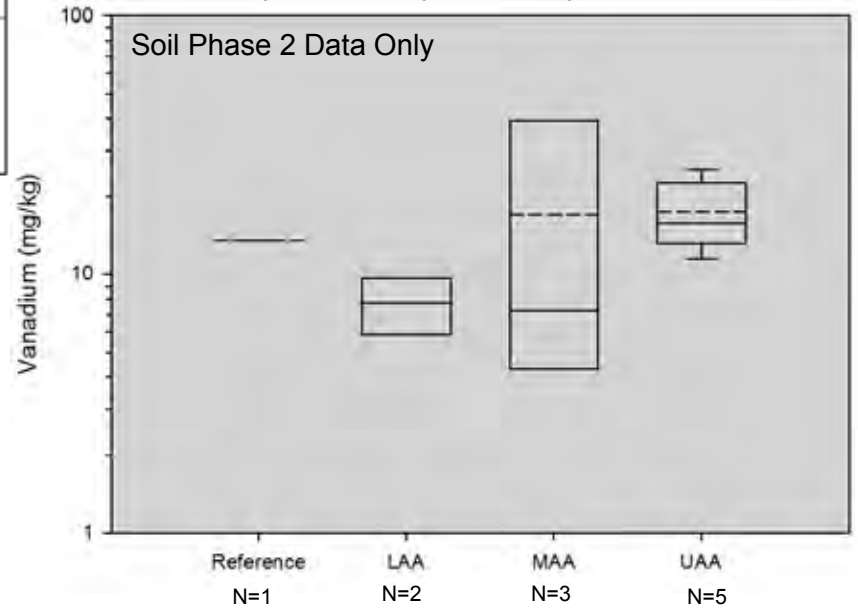
Figure 6-13

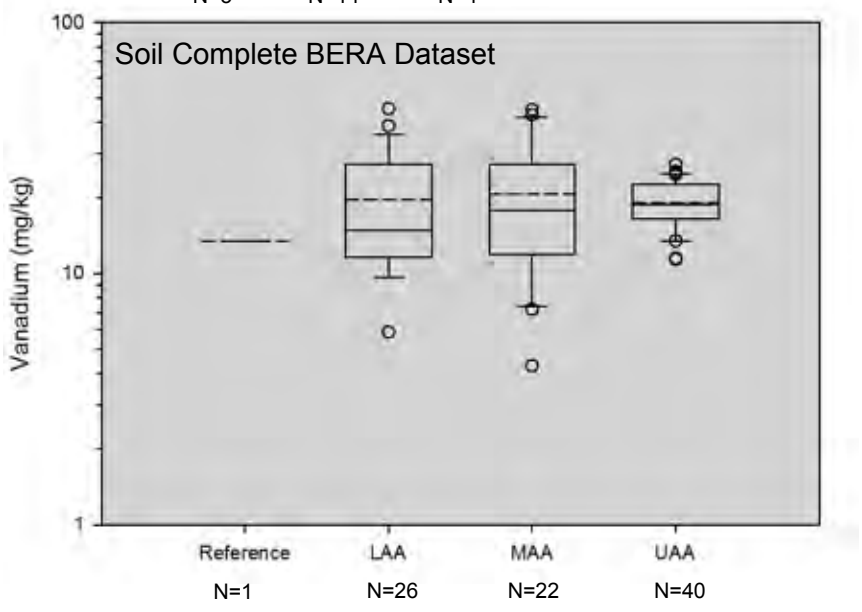
\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\











Notes:
○: Result value is < 10th percentile or > 90th percentile

Statistics calculated using one-half the reporting limit for non-detect results
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
UAA: upper assessment area

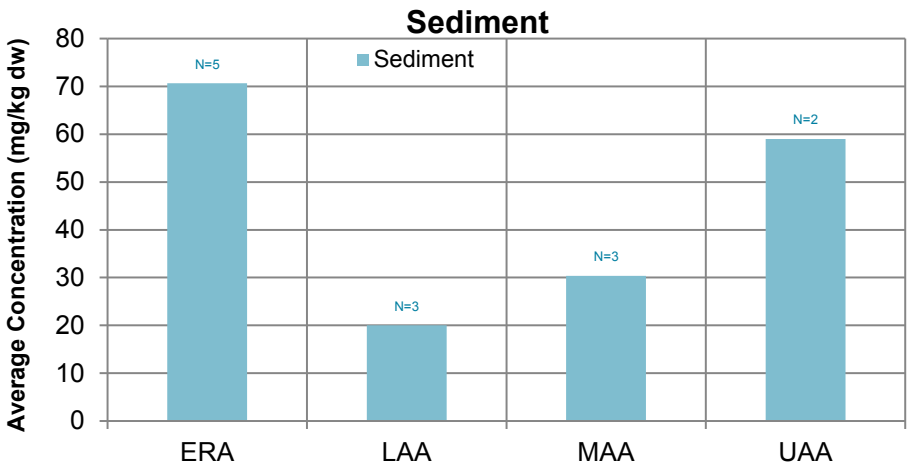
Anniston PCB Site
Anniston, Alabama
Baseline Ecological Risk Assessment for OU-4

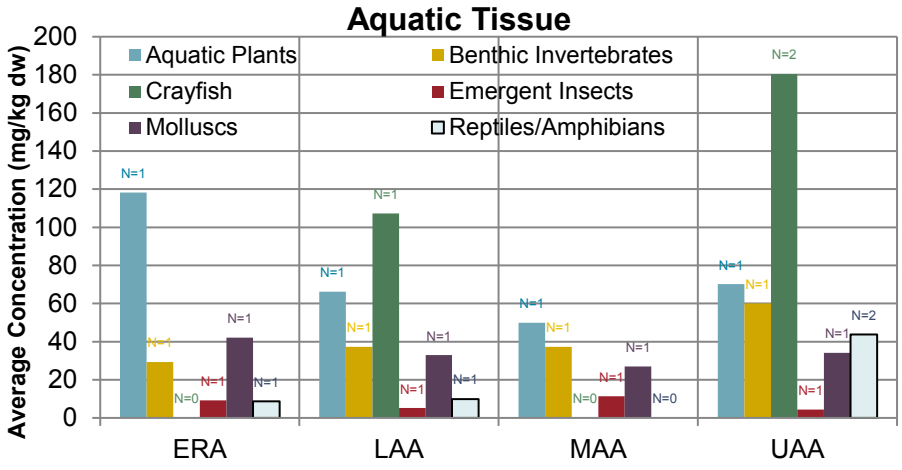
Summary of OU-4 and Reference Vanadium Concentrations in Soil and Sediment

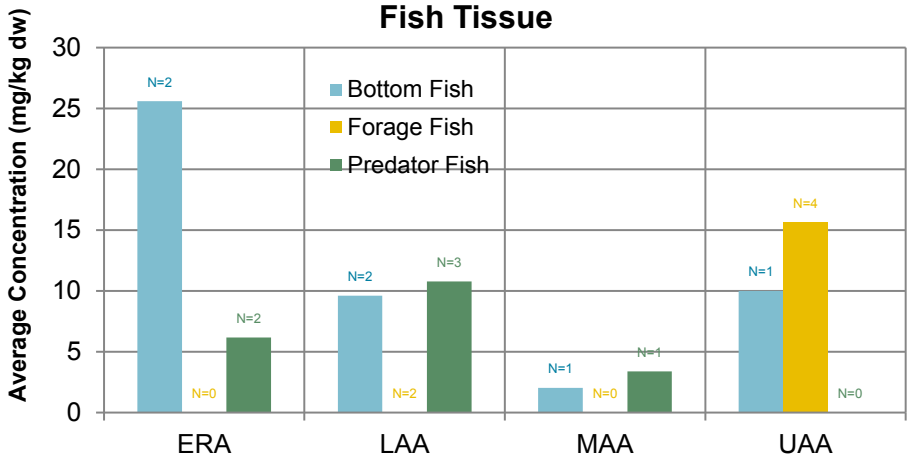
Solutia

Figure 6-14

\\arcadis-us.com\officedata\SanFrancisco-CA\Projects-Active\Anniston\OU4 BERA\Figures\5. Sept 2016 Revised\







Notes:
1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
N: sample number
UAA: upper assessment area

Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

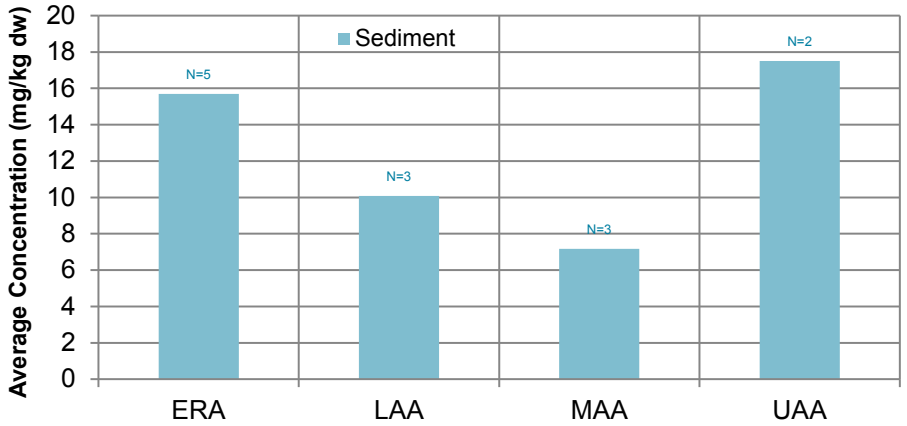
Mean Barium Concentrations for Tissue Data by Ecological Area

Solutia
Ingenuity Productivity Performance

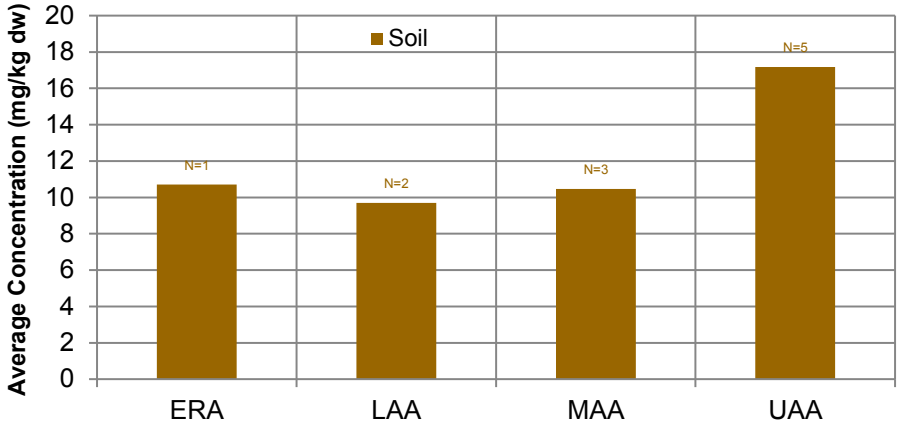
FIGURE

6-15

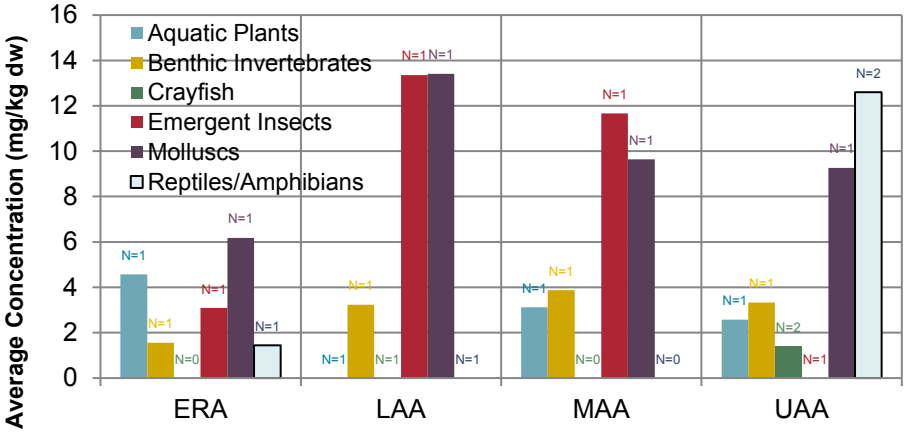
Sediment



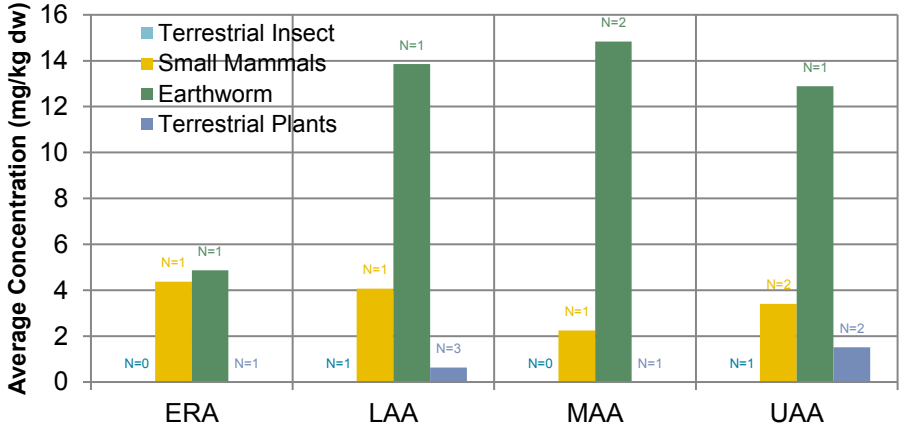
Soil



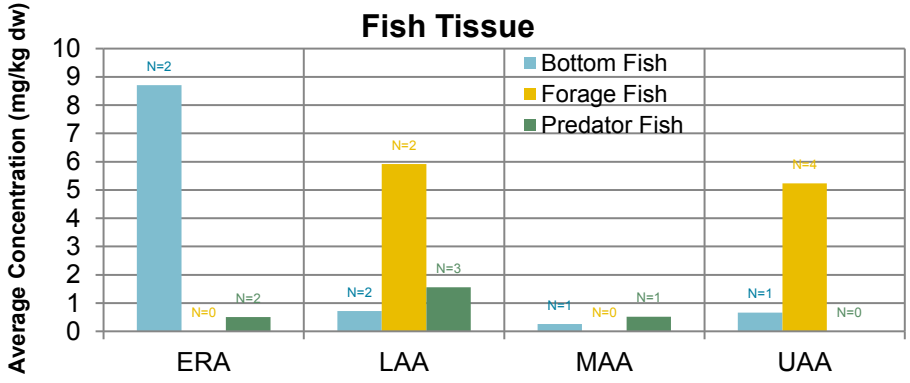
Aquatic Tissue



Terrestrial Tissue



Fish Tissue



Notes:

1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
N: sample number
UAA: upper assessment area

Anniston PCB Site
Anniston, Alabama

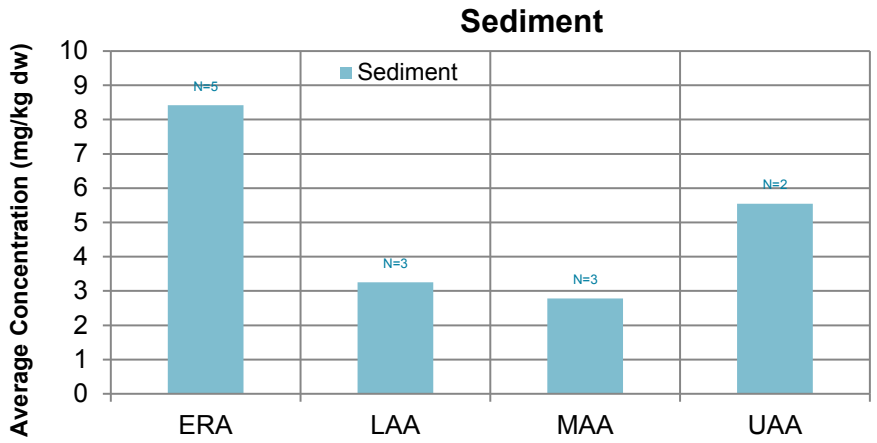
Baseline Ecological Risk Assessment for OU-4

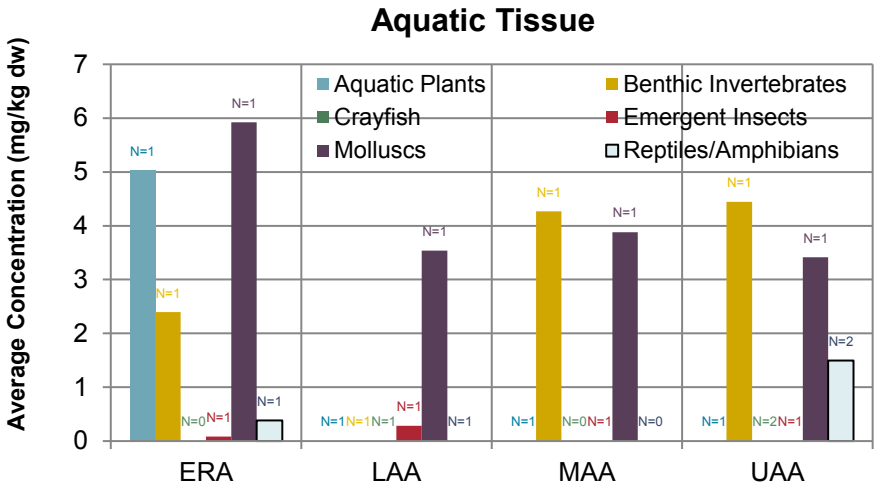
Mean Chromium Concentrations for Tissue Data by Ecological Area

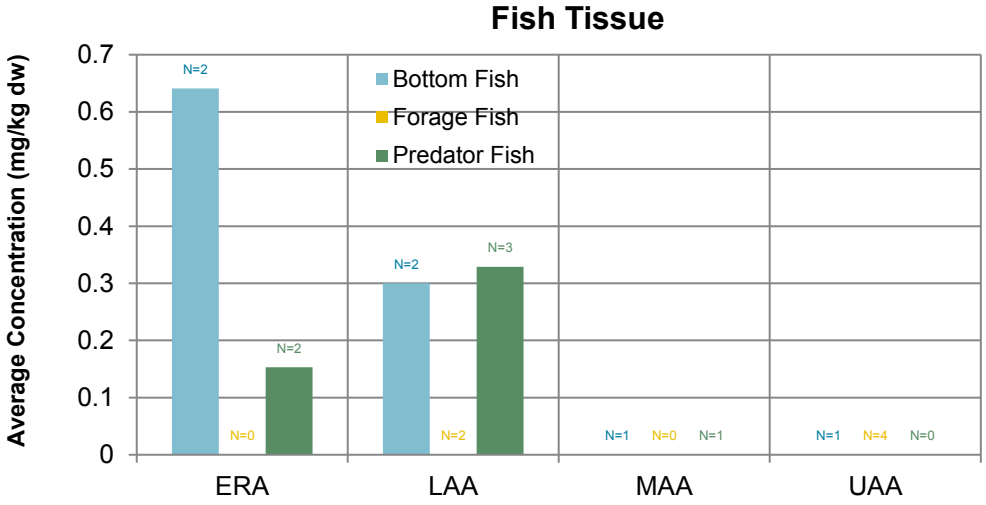
Solutia
Ingenuity Productivity Performance

FIGURE

6-16







Notes:
1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
N: sample number
UAA: upper assessment area

Anniston PCB Site
Anniston, Alabama

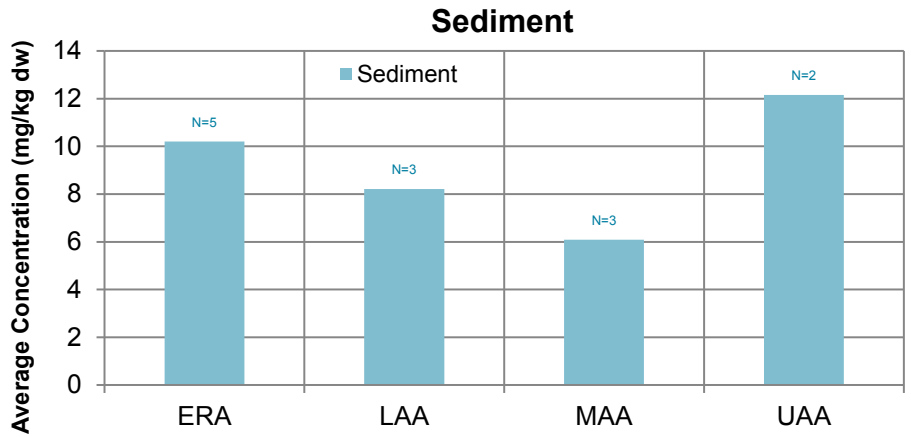
Baseline Ecological Risk Assessment for OU-4

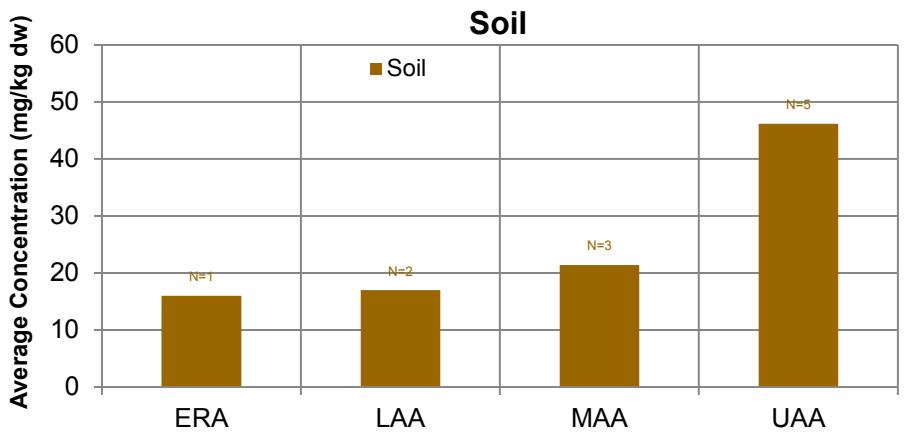
Mean Cobalt Concentrations for Tissue Data by Ecological Area

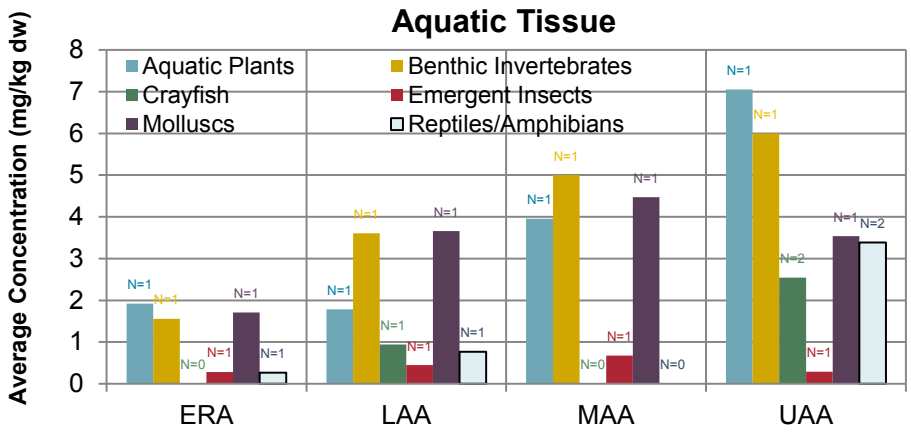
Solutia Ingenuity Productivity Performance

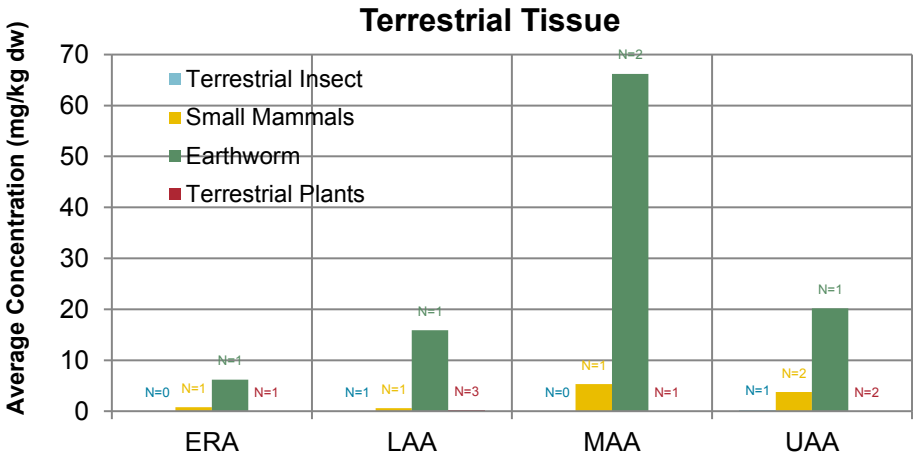
FIGURE

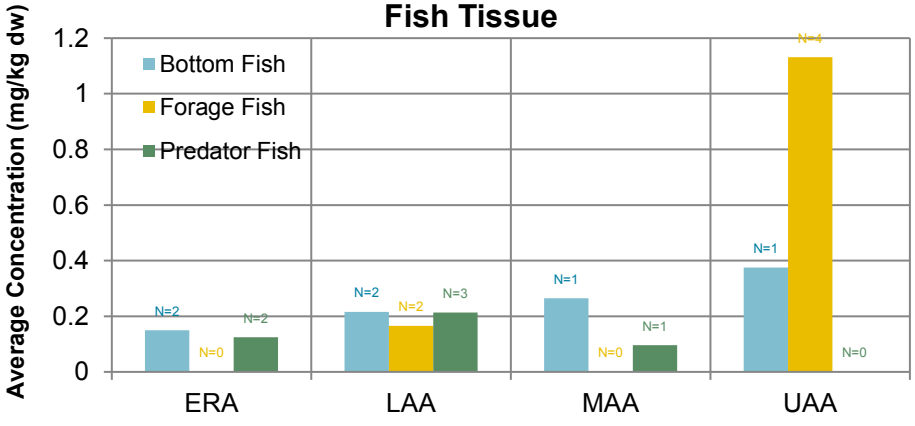
6-17











Notes:

1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
N: sample number
UAA: upper assessment area

Anniston PCB Site
Anniston, Alabama

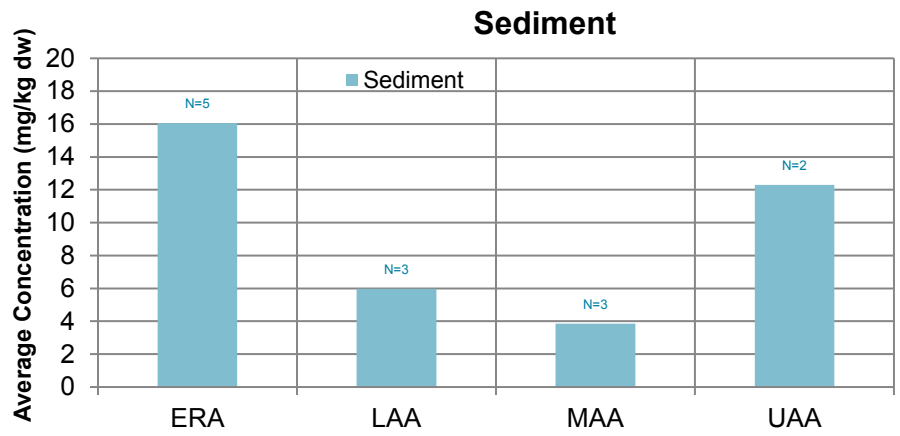
Baseline Ecological Risk Assessment for OU-4

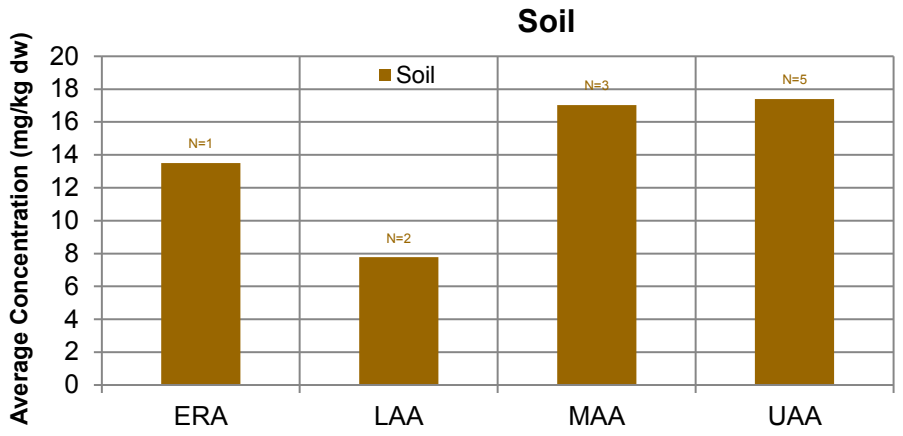
Mean Lead Concentrations for Tissue Data by Ecological Area

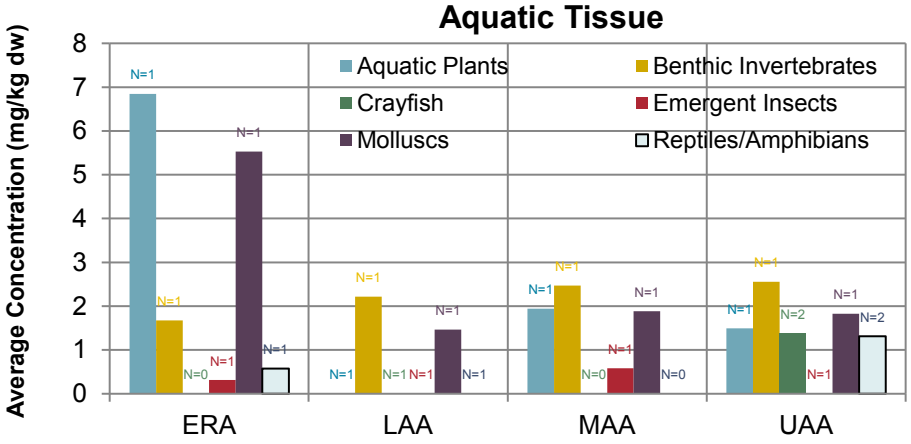
Solutia
Ingenuity Productivity Performance

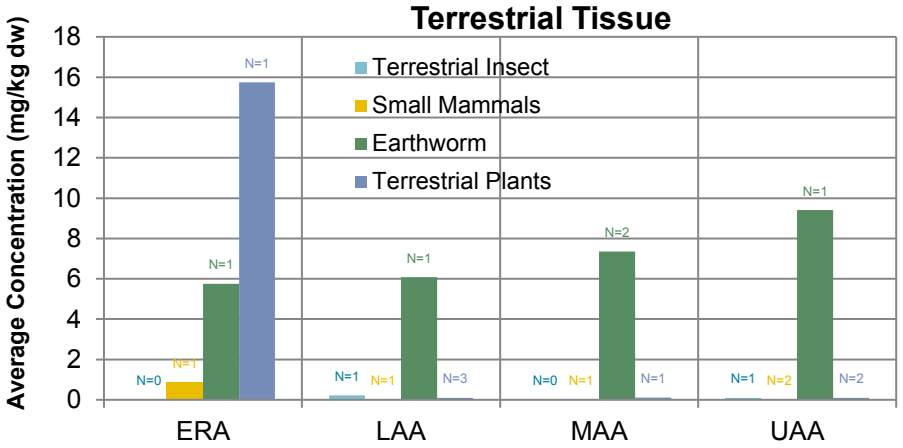
FIGURE

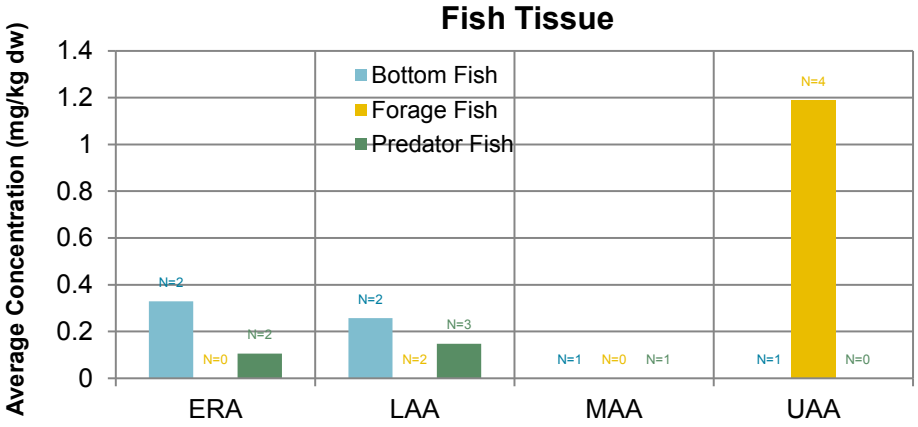
6-18











Notes:

1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
mg/kg: milligrams per kilogram
N: sample number
UAA: upper assessment area

Anniston PCB Site
Anniston, Alabama

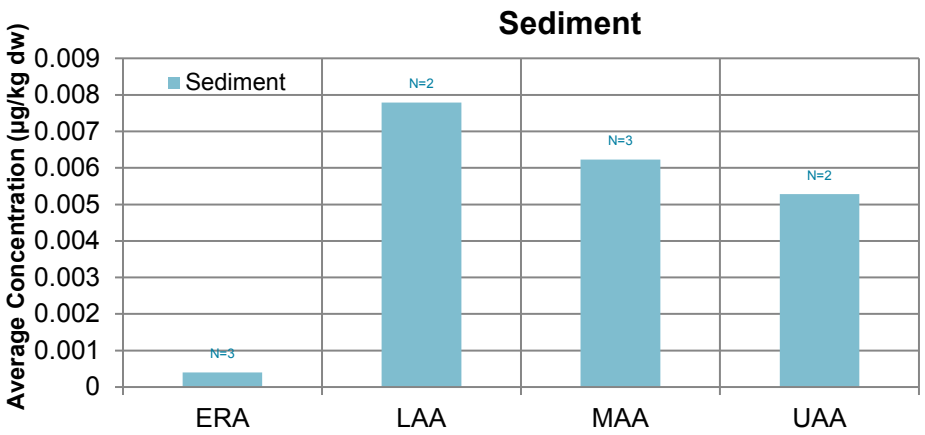
Baseline Ecological Risk Assessment for OU-4

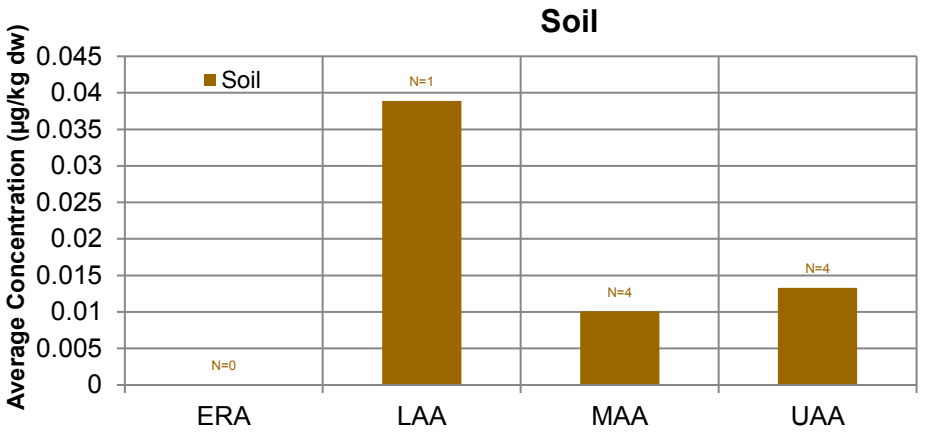
Mean Vanadium Concentrations for Tissue Data by Ecological Area

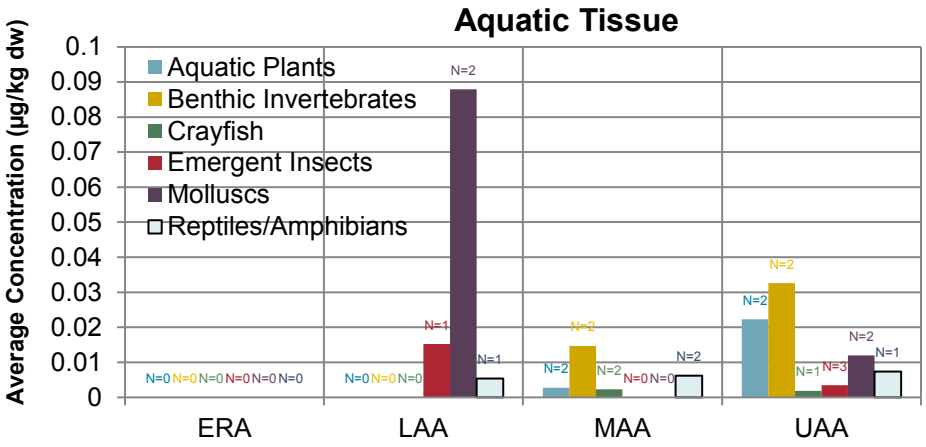
Solutia
Ingenuity Productivity Performance

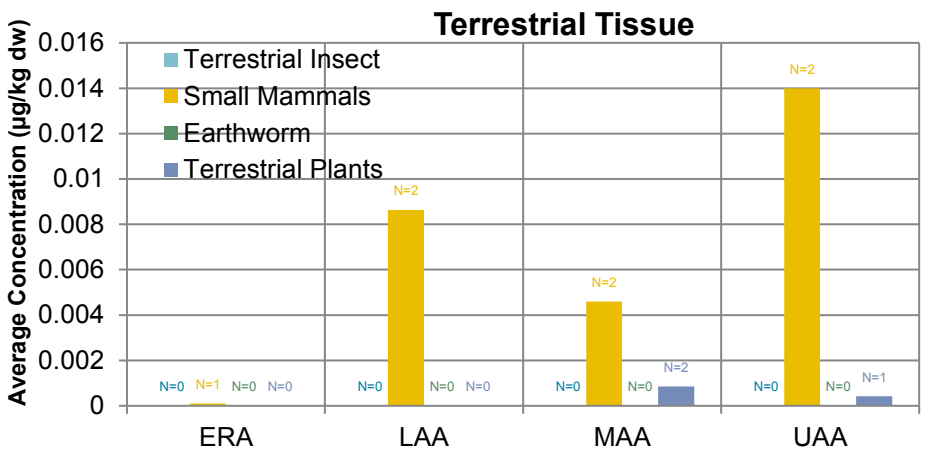
FIGURE

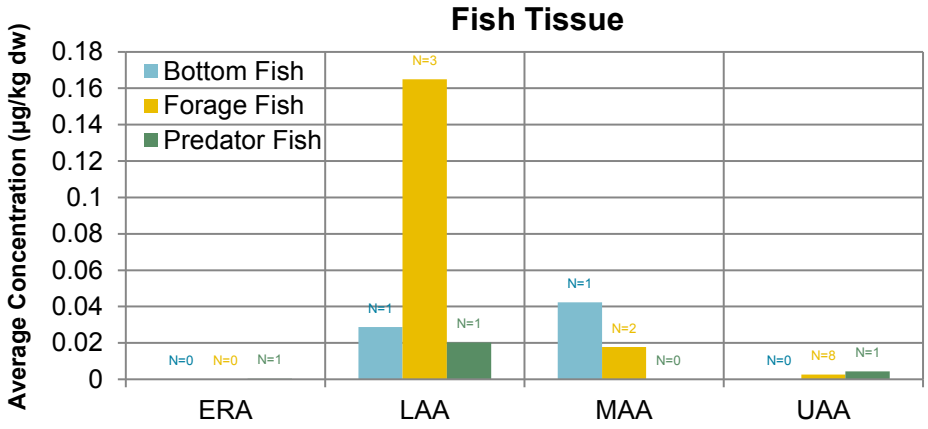
6-19











Notes:

1. Averages are Kaplan-Meier estimates of the mean.
2. If results are all non-detect in a given media/tissue for a given location, concentration is plotted as zero.

COPC: constituent of potential concern
dw: dry weight
ERA: ecological reference area
LAA: lower assessment area
MAA: middle assessment area
N: sample number
UAA: upper assessment area
µg/kg: micrograms per kilogram

Anniston PCB Site
Anniston, Alabama

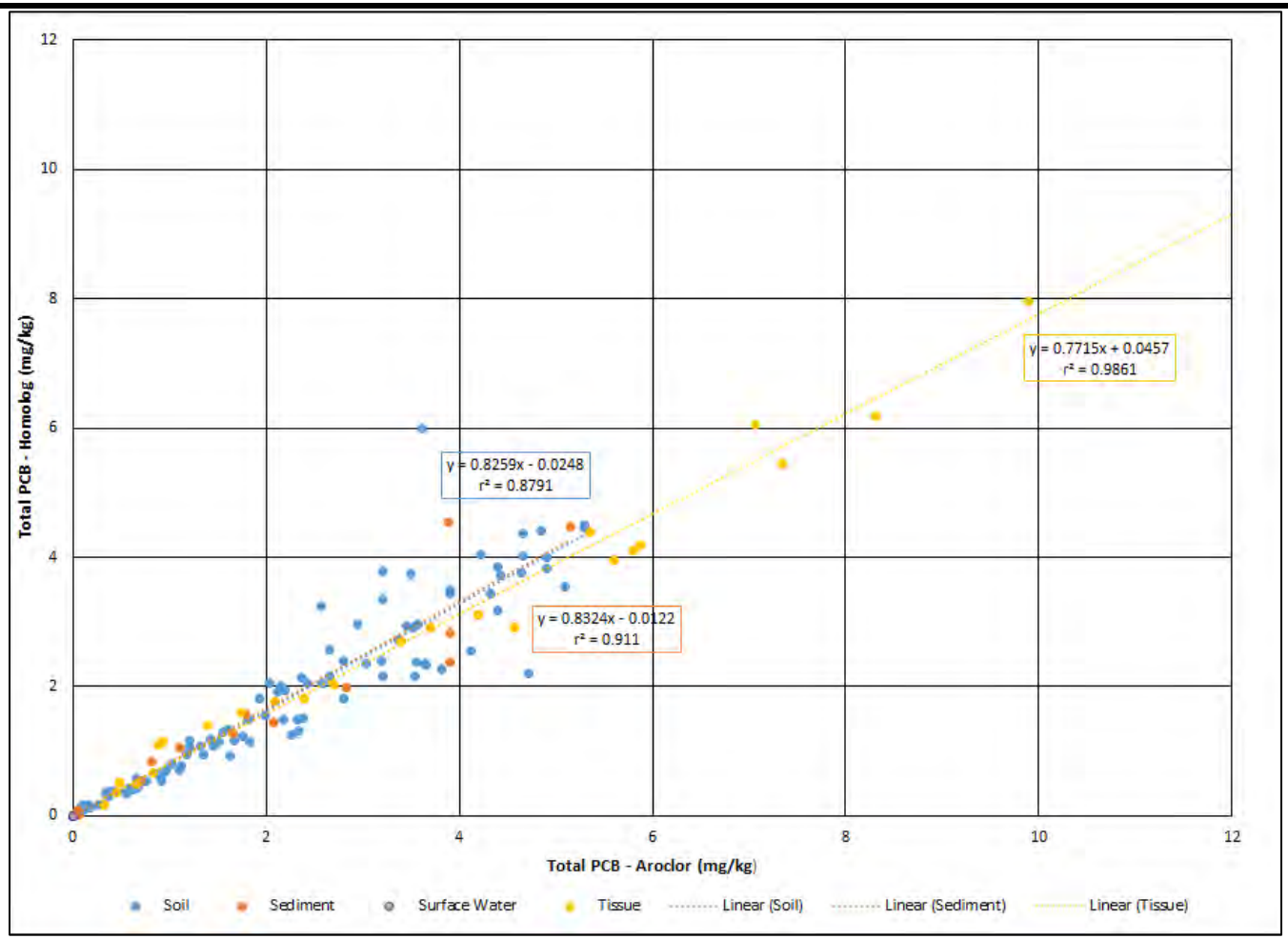
Baseline Ecological Risk Assessment for OU-4

Mean PCDD/PCDF TEQ Concentrations for Tissue Data by Ecological Area

Solutia
Ingenuity Productivity Performance

FIGURE

6-20



Notes:
mg/kg: milligrams per kilogram
PCB: polychlorinated biphenyls

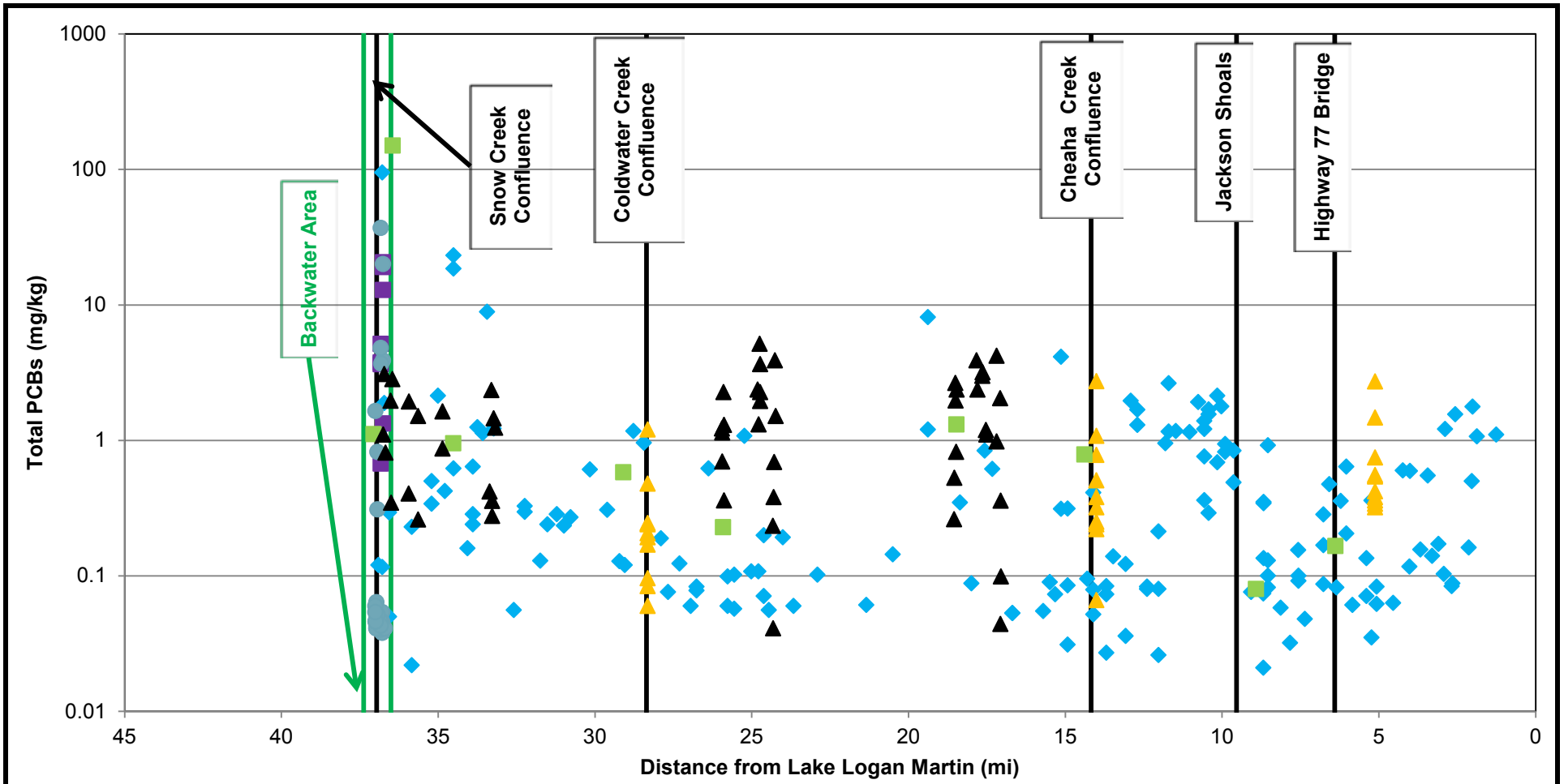
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Comparison of PCB Concentrations Measured as Aroclors and Homologs

Solutia
Ingenuity Productivity Performance

Figure
6-21



- RFI Nature and Extent
- RFI Fish Tissue Sampling Locations
- Geochronological
- RI/FS Nature and Extent
- RI/FS Fish Tissue Collection Locations
- RI/FS Ecological Program

Notes:
Green markers indicate stability areas of interest; black markers indicate landmarks/areas of interest.

mg/kg = milligrams per kilogram
mi = miles
PCB = polychlorinated biphenyl

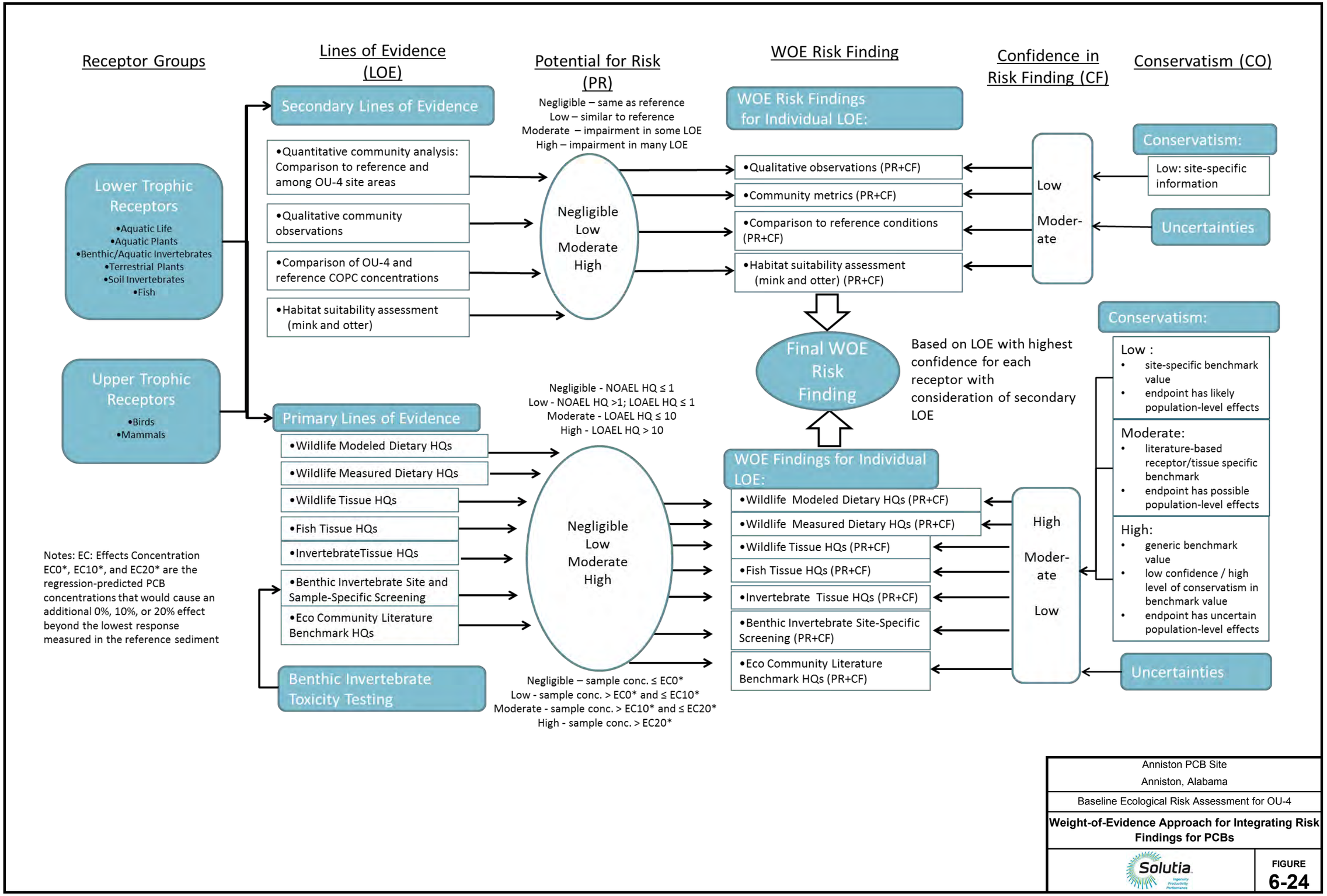
Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Total PCB Concentrations in Surface Sediment with Distance from Lake Logan Martin by Collection Program

Solutia

Figure 6-22



Anniston PCB Site
Anniston, Alabama

Baseline Ecological Risk Assessment for OU-4

Weight-of-Evidence Approach for Integrating Risk Findings for PCBs

Solutia

FIGURE
6-24