TABLE OF CONTENTS

TABLE OF CONTENTS i

LIST OF FIGURES vii

LIST OF TABLES xvii

LIST OF MAPS xxv

LIST OF ACRONYMS xxxvii

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
- 1.1 Area of Study 1-2
- 1.2 Purpose of Report 1-2
- 1.3 Site Background 1-4
- 1.4 Report Organization 1-5

2.0 SOURCES OF ENVIRONMENTAL DATA 2-1
- 2.1 Lower Willamette Group 2-1
  - 2.1.1 Pre-AOC Sampling Activities 2-1
  - 2.1.2 Round 1 Sampling Activities 2-2
  - 2.1.3 Round 2 Sampling Activities 2-6
- 2.2 Existing Historical and Concurrent Studies 2-16
  - 2.2.1 Data Quality 2-16
  - 2.2.2 Chemical Data Review Criteria 2-17
  - 2.2.3 Biological Data Review Criteria 2-17
  - 2.2.4 Site Characterization and Risk Assessment (SCRA) Database 2-18
  - 2.2.5 Existing Chemical and Biological Data 2-19
- 2.3 Data Usability 2-20
  - 2.3.1 Data Quality 2-20
  - 2.3.2 Sediment Stability 2-20
  - 2.3.3 Data Use 2-21

3.0 CONCEPTUAL SITE MODEL SUMMARY 3-1
- 3.1 In-River Physical System Environment 3-2
- 3.2 Ecological Functions 3-4
- 3.3 Potential Sources and Pathways 3-5
- 3.4 Chemical Distribution and Potential Exposure Media 3-7
  - 3.4.1 Sediment 3-7
  - 3.4.2 Transition Zone Water 3-8
  - 3.4.3 Surface Water 3-9
  - 3.4.4 Tissue Samples 3-9
- 3.5 Fate & Transport 3-10
- 3.6 Receptors 3-12

3.6.1 Human 3-12
3.6.2 Ecological 3-13

SECTION 4 EXECUTIVE SUMMARY ES4-i

4.0 PHYSICAL SETTING 4-1
4.1 Land Use 4-1
4.1.1 Portland Harbor Overview 4-2
4.1.2 Navigational Channel Authorization History 4-3
4.1.3 Dredging and Capping Activities 4-3
4.1.4 Stormwater Systems 4-5
4.1.5 General Land Use History 4-8
4.1.6 Historical Shoreline and Fill Placement 4-10
4.1.7 Historical Overwater Operations 4-12
4.2 Hydrogeology 4-13
4.3 Hydrology 4-13
4.3.1 Regional Datums 4-14
4.3.2 Willamette River Seasonal Stages and Flows 4-14
4.3.3 Hydrodynamics 4-15
4.4 Riverbed Characteristics and Sediment Dynamics 4-17
4.4.1 Bed Bathymetry and Time-series Change Data 4-17
4.4.2 Physical Characteristics of Sediments 4-18
4.5 Sediment Transport Regimes 4-22
4.5.1 Upstream of the Study Area 4-23
4.5.2 RI Study Area 4-23
4.5.3 Downstream of the Study Area 4-26
4.6 Habitat 4-26
4.6.1 Open-Water Habitat 4-27
4.6.2 Bank and Riparian Habitat 4-27
4.7 Human Access and Use 4-28

SECTION 5 EXECUTIVE SUMMARY ES5-i

5.0 IDENTIFICATION OF SOURCES 5-1
5.1 Upland Sources 5-1
5.1.1 Site Summaries 5-2
5.1.2 Groundwater 5-4
5.1.3 Direct Discharge - Stormwater and Wastewater 5-8
5.1.4 Riverbank Erosion 5-16
5.1.5 Atmospheric Deposition 5-16
5.1.6 Overwater Releases 5-16
5.2 Sources Outside the Study Area 5-17
5.2.1 Non-Study Area Sources in the Lower Willamette River 5-17
5.2.2 Sources Above Willamette Falls (Upper Willamette River) 5-18
5.3 Historical Sources 5-19

SECTION 6 EXECUTIVE SUMMARY ES6-i

6.0 IN-RIVER CHEMICAL DISTRIBUTION 6-1
6.1 Indicator Chemicals in Sediment 6-2
6.1.1 Nature and Extent of Indicator Chemicals in Study Area Sediment 6-3
6.1.2 Upstream, Downstream, and Riparian Zone Data Evaluation 6-27
6.1.3 Background Sediment Concentrations 6-34
6.1.4 Temporal Trends in Surface Sediment Chemical Data 6-39
6.2 Transition Zone Water and Groundwater Seeps 6-40
6.2.1 Groundwater Seeps 6-41
6.2.2 Transition Zone Water Analytical Results—Nature and Extent Summary 6-43
6.2.3 Spatial and Temporal Nature of the TZW Data 6-52
6.3 Indicator Chemicals in Surface Water 6-53
6.3.1 Non-LWG Data 6-53
6.3.2 Round 2A Sample Collection Conditions 6-54
6.3.3 Nature and Extent of Surface Water Indicator Chemicals 6-55
6.3.4 Particulate-Phase COPC Concentrations 6-65
6.4 Biota Chemical Distribution 6-67
6.4.1 Indicator Chemicals 6-67
6.4.2 Nature and Extent of Indicator Chemicals in Study Area Tissue 6-68
6.4.3 Nature and Extent of Selected Indicator Chemicals in Tissue Collected Upriver from the Study Area 6-84
6.4.4 Nature and Extent of Selected Indicator Chemicals in Tissue Collected Downstream from the Study Area 6-89

SECTION 7 EXECUTIVE SUMMARY ES7-i

7.0 OVERVIEW AND APPROACH TO ASSESSMENT OF LOADING, FATE, AND TRANSPORT PROCESSES 7-1
7.1 Chemical Loading to the Study Area from External Sources 7-2
7.1.1 Upstream Loading 7-3
7.1.2 Stormwater 7-9
7.1.3 Upland Groundwater Plumes 7-16
7.1.4 Atmospheric Deposition 7-20
7.1.5 Permitted Wastewater Discharge 7-23
7.1.6 Upland Soil and Riverbank Erosion 7-24
7.2 Fate and Transport Processes within the Study Area 7-28
7.2.1 Sediment and Porewater Fate and Transport Processes 7-29
7.2.2 Surface Water Fate and Transport Processes 7-41
7.2.3 Biological Fate and Transport Processes 7-43
7.3 River-Wide Fate and Transport Model 7-51
7.3.1 Modeling Objectives 7-52
7.3.2 Hybrid Model Components 7-53
7.3.3 Path Forward 7-54

SECTION 8 EXECUTIVE SUMMARY ES8-i

8.0 ROUND 2 HUMAN HEALTH RISK ASSESSMENT SUMMARY 8-1
8.1 Data Evaluation 8-1
8.2 Exposure Assessment 8-2
8.3 Toxicity Assessment 8-3
8.4 Risk Characterization and Uncertainty Analysis 8-4
8.4.1 Risk Characterization Results 8-4
8.4.2 Uncertainty Analysis 8-7
8.4.3 Data Needs Evaluation 8-8
8.5 Screening of Surface Water and Transition Zone Water Data 8-9
8.5.1 Screening of Surface Water Data 8-9
8.5.2 Screening of Transition Zone Water Data 8-10
8.5.3 Screening Evaluation Conclusions 8-11
8.6 Summary and Conclusions 8-11

SECTION 9 EXECUTIVE SUMMARY ES9-i

9.0 ROUND 2 ECOLOGICAL RISK ASSESSMENT SUMMARY 9-1
9.1 ERA Data Set 9-2
9.2 Selected Receptors and Risk Assessment Approach 9-3
9.2.1 Benthic Invertebrates 9-3
9.2.2 Fish 9-5
9.2.3 Wildlife 9-5
9.2.4 Amphibians and Reptiles 9-6
9.2.5 Aquatic Plants 9-6
9.3 Results of Round 2 COPC Screening Assessment 9-7
9.4 Results of Round 2 ERA and Identification of iCOCs 9-8
9.4.1 Benthic Invertebrates 9-8
9.4.2 Fish 9-10
9.4.3 Wildlife 9-11
9.4.4 Amphibians and Reptiles 9-12
9.4.5 Aquatic plants 9-12
9.5 ERA Data Needs and Future Analyses 9-13

SECTION 10 EXECUTIVE SUMMARY ES10-i

10.0 PRELIMINARY IDENTIFICATION OF iAOPCs 10-1
10.1 Approach and Methods 10-2
10.1.1 General Approach 10-2
10.1.2 Human-Health-Specific Methods 10-11
10.1.3 Ecological-Specific Methods 10-20
10.1.4 Compilation of iAOPCs 10-26
10.2 Background Information 10-26
10.2.1 Source and Derivation of Background Values 10-27
10.2.2 Use of Background Values in AOPC Development 10-27
10.2.3 Background and RI/FS 10-28

10.3 Summary of iPRGs 10-29
10.4 Summary of Potential Risk Areas 10-29
10.4.1 Human Health Risk 10-30
10.4.2 Ecological Risk 10-31
10.5 Overall iAOPCs 10-31
10.5.1 Overall iAOPC Methods 10-31
10.5.2 Overall iAOPC Results 10-34
10.5.3 Spatial Evaluation of TZW Screening Exceedances 10-35

SECTION 11 EXECUTIVE SUMMARY ES11-i

11.0 CONCEPTUAL SITE MODEL 11-1
11.1 Conceptual Site Model Overview for the Entire Study Area 11-2
11.1.1 iCOCs and Potential iCOCs 11-2
11.1.2 Loading, Fate, and Transport Processes 11-4
11.1.3 Loading, Fate, and Transport of iCOCs and Potential iCOCs 11-10
11.2 Site-Wide iAOPC 11-43
11.2.1 Physical Setting, Infrastructure, and Operational History 11-43
11.2.2 Chemical Distribution of PCBs in the Site-wide iAOPC 11-44
11.2.3 Potential Sources of iCOCs 11-49
11.2.4 Relationship of Upland Sources to the Distribution of iCOCs 11-54
11.3 CSM for iAOCs 11-55
11.3.1 CSM for iAOPC 1 11-56
11.3.2 CSM for iAOPC 2 11-72
11.3.3 CSM for iAOPCs 3, 4, 5 11-78
11.3.4 CSM for iAOPC T4 11-94
11.3.5 CSM for iAOPC 6 11-104
11.3.6 CSM for iAOPC 7 11-114
11.3.7 CSM for iAOPCs 8 and 9 11-124
11.3.8 CSM for iAOPC 10 11-134
11.3.9 CSM for iAOPC 11 11-147
11.3.10 CSM for iAOPCs 12 and 13 11-165
11.3.11 CSM for iAOPC 14 11-178
11.3.12 CSM for iAOPCs 15 and 16 11-205
11.3.13 CSM for iAOPC 17 11-217
11.3.14 CSM for iAOPC 18 11-230
11.3.15 CSM for iAOPC 19 11-240
11.3.16 CSM for iAOPCs 20, 21, 22, and 23 11-260
11.3.17 CSM for iAOPC 24 11-279
11.3.18 CSM for iAOPC 25 11-286
11.3.19 CSM for iAOPC 26 11-290
11.3.20 CSM for iAOPC 27 11-298

SECTION 12 EXECUTIVE SUMMARY ES12-i

12.0 DATA GAPS AND ADDITIONAL DATA NEEDS 12-1
12.1 Summary of Findings of the Round 2 Report 12-2
12.1.1 Nature & Extent 12-2
12.1.2 Human Health Risk 12-3
12.1.3 Ecological Risk 12-3
12.1.4 Initial Areas of Potential Concern 12-3
12.1.5 Key Findings from Round 2 Report 12-4
12.2 Site-wide Data Needs 12-4
12.2.1 Nature and Extent 12-4
12.2.2 Upstream Contribution and Naturally Occurring Background Concentrations 12-6
12.2.3 Human Health Risk 12-8
12.2.4 Ecological Risk 12-9
12.2.5 Fate and Transport Data Needs 12-11
12.2.6 FS Data Needs 12-12
12.2.7 Site-Wide iAOPC 12-15
12.3 Area-specific Data Needs 12-17
12.3.1 Data Needs for Areas that Are Not iAOPCs 12-17
12.3.2 TZW 12-19
12.3.3 FS Data Needs for iAOPCs 12-20

13.0 NEXT STEPS 13-1

14.0 REFERENCES 14-1

15.0 GLOSSARY OF TERMS 15-1

Appendix A. Data Sources and Site Characterization/Risk Assessment Database
Appendix B. Identification of Sources
Appendix C. Nature and Extent
Appendix D. Loading, Fate and Transport
Appendix E. Food Web Model and Biota-Sediment Accumulation Factor (BSAF) Development
Appendix F. Round 2 Human Health Risk Assessment
Appendix G. Round 2 Ecological Risk Assessment
Appendix H. Derivation of Initial Areas of Potential Concern
Appendix I. iAOPC CSM Data Tables
Appendix J. Upland CSM Site Summary Table