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NEVILLE LAND COMPANY
1900 Grant Building
Pittsburgh, Pennsylvania 15219

November 22, 1994

VIA FACSIMILE AND FIRST CLASS MAIL

Mr. Abraham Ferdas
Superfund Office
Associate Division Director
U.S. EPA/Region III 3HW02
841 Chestnut Building
Philadelphia, PA 19107-4431

Re: Ohio River Park Site

Dear Mr. Ferdas:

This will confirm that your letter to Mr. Blaxter dated November 18, 1994 accurately reflects the agreement reached with respect to Neville Land Company's recent dispute relating to EPA's action on the DERA. Accordingly, NLC withdraws its current Request for Dispute Resolution.

Please note, however, that as of this date NLC has still not received the final Human Risk Assessment from Region III. Our records reflect that Region III is preparing a "supplement" to the HRA. To facilitate completion of the tasks remaining to be done under AOC it is important that a final HRA (with a central risk tendency analysis) be completed.

Very truly yours,

Marian F. Dietrich
Vice President, Neville Land Company

cc: H. Vaughan Blaxter, III
Thomas C. Reed
Robert Davis
Eric Johnson
Romuald A. Roman
Jeffrey A. Pike
Gwen E. Pospisil

V:\VAL\FERDAS.LTR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107-4431

November 18, 1994

VIA TELEFAX AND FIRST CLASS MAIL

H. Vaughan Blaxter, III
President
Neville Land Company
19th Floor, Grant Building
Pittsburgh, Pennsylvania 15219

Re: Ohio River Park Site -- Neville Land Company ("NLC") Dispute Concerning the Draft Ecological Risk Assessment ("DERA") Submitted by NLC Under the Administrative Order by Consent for Remedial Investigation/Feasibility Study as Amended by the First Amendment ("AOC"), Docket No. III-74-DC

Dear Mr. Blaxter:

This will confirm that NLC and the United States Environmental Protection Agency, Region III ("EPA") have agreed to resolve the above dispute as follows:

1. EPA acknowledges that it remains NLC's position that: (a) the DERA submitted to EPA by NLC in July of 1994 was "in accordance" with the terms of the AOC in this matter and should therefore have been approved; and (b) it is inappropriate to quantify ecological risk in the manner set forth in EPA's Data Interpretation and Ecological Risk Assessment ("Data Interpretation"), a copy of which is attached hereto.

2. NLC acknowledges that it remains EPA's position that: (a) the DERA was not fully prepared in accordance with the terms of the AOC in this matter and that only Sections 1.0 - 3.0 thereof have been formally approved by EPA; (b) it is appropriate to quantify ecological risk in the manner set forth in EPA's Data Interpretation; and (c) EPA's Data Interpretation and Sections 1.0 - 3.0 of the DERA together constitute the EPA-approved Ecological Risk Assessment for the Ohio River Park Site.

3. With respect to these issues EPA and NLC "agree to disagree," with the understanding that the rights of each party to have the merits of these disputes resolved in another forum, at the appropriate time, are fully reserved.

4. Although EPA has approved only Sections 1.0 - 3.0 of the DERA, it is also agreed that the entire DERA as submitted shall become a part of the Administrative Record ("AR") and, as appropriate, can be considered in this matter.

5. EPA's Data Interpretation to be included in the AR is attached hereto.

If the foregoing accurately sets forth our agreement, please forward to my attention a letter withdrawing NLC's current Request for Dispute Resolution.

Sincerely,

Abraham Ferdas
Superfund Office
Associate Division Director

Attachment
cc: Thomas C. Reed, Esquire
Robert Davis (3HW13)
Eric Johnson (3HW13)
Romuald Roman (3HW23)
Jeffrey Pike (3HW23)
Gwen E. Pospisil (3RC23)

Ohio River Park Site

U.S. Environmental Protection Agency
Region III

Data Interpretation And Ecological Risk Assessment

Introduction

The objective of this project was to prepare a screening level ecological risk assessment for the Ohio River Park Site, Neville Township, Pennsylvania. The following discussion summarizes EPA's interpretation of the site data and of the ecological risk posed by contaminants at the Ohio River Park site. The ecological risk assessment for the project will be the first three chapters of the July 1994 Ecological Risk Assessment report ("July 1994 ERA") prepared by ENSR, on behalf of Neville Land Company, and the following discussion prepared by EPA.

The data in the Remedial Investigation (RI) and in the first three chapters of the July 1994 ERA indicate that all media (except air) at the site show some level of risk due to site contaminants.

EPA Region III determines quantitative estimates of cumulative risk by adding the Ecological Effects Quotients (EEQ) of all contaminants with an EEQ greater than one. The values are added according to the formula shown here:

$$R = r^1 + r^2 + r^3 + \ldots$$

Where R = Total Risk
r = risk of individual contaminants

For example, the calculations for cumulative risk in the surface water, main channel involves the following:

$$R = EEQ^{Hg} + EEQ^{Cu(+2)} + EEQ^{Cr(as\ VI)}$$

$$R = 55.83 + 8.38 + 1.10$$

$$R = 65.31$$

Those calculations that show a result higher than one (1) are considered to demonstrate a potential risk. Values higher than ten (10) are considered to represent moderately high potential risk, and those above one hundred (100) are considered to represent extreme potential risk. Risk to the guild and community level of a habitat is estimated by adding the EEQs. The concept here views the habitat as a whole with the potential for risks from contaminants impacting all organisms. It differs fundamentally from the way additive effects are calculated in human health risk assessment. In ecological risk assessment, it is assumed that impacts are either evenly severe to all members of the community or devastating impacts to a few species and fatally destructive to the community, ultimately.

Ecological Risk Assessment

The following discussions are arranged according to the media as presented in Chapter 3 of the July 1994 ERA.

A. Surface Water (Main Channel)

Mercury has been identified at high levels in the surface water of the main channel of the Ohio River. It is possible that some of this contaminant comes from the site, as Table B-1, Appendix B, of the July 1994 ERA fails to indicate any mercury reported from the background samples. Two other contaminants also show EEQ levels above one and are considered to be of possible concern. These are copper and chromium (VI), neither of which is included in Table B-1, and are likely to arise from the site as well.

All three of these contaminants carry ecological implications and should be viewed as potentially harmful to the ecosystem of the Ohio River. Their effects on the river are expected to be chronic and long-term.

Mercury has an EEQ of over 55; copper(+2) has an EEQ of 8.38 and total chromium (as VI) has an EEQ of 1.10.

The cumulative risk for surface water in the main channel equals 6.531E+1. This level of potential ecological risk is considered to be serious.

B. Surface Water (Back Channel)

Two contaminants appear to have many implications for ecological impacts: chromium (VI) and copper (2). The EEQ values are 1.51 and 1.43, respectively, and the additive value is 2.94. It is likely that the site is a source of these contaminants, as the levels reported are significantly above background (see Table 3.2 of the July 1994 ERA). These levels of potential ecological risk are considered to be of possible long-term risk to ecological receptors.

C. Sediment (Main Channel)

Many contaminants listed in Table 3.3 not only show concentrations above criteria levels, but several are elevated above background. The contaminants above background with EEQs above 1 are: arsenic, chromium, copper, mercury, lead, nickel, zinc, 4,4'-DDD, alpha chlordane, PCBs, dieldrin, endrin, gamma chlordane, benzo(a)anthracene, 2-methylnaphthalene, and fluorene. In addition, several others are considered to be of ecological significance, but had no EEQ calculations could be performed due to a lack of information. These are: barium, cobalt, cyanide, manganese, selenium, vanadium, 2,4,5-T, 2,4,5-TP, 2,4-D, several arochlor congenors, endrin aldehyde, and endrin ketone.

Summing the calculations shows an EEQ of 781. This level of potential ecological risk is considered to be serious. From a conservative perspective, this number is actually very low due to the presence of several contaminants which have not been included in the cumulative risk calculations. The biological implications of these contaminants cannot be ignored in judging risk potential. These are cyanide, selenium, 2,4,5-T, 2,4,5-TP, 2,4-D, many PCB congenors, and breakdown products of endrin. The site may be a likely source of contamination of the sediments in the main channel.

D. Sediment (Back Channel)

All of the discussions above on the sediments in the main channel also apply to sediments in the back channel. The additive EEQ calculation is 1305 and every contaminant identified and appearing in Table 3.4 of the July 1994 ERA is above levels identified at the background stations, indicating a potential level of ecological risk which is considered serious. Again, the site is a likely source of contamination of the sediments in the back channel.

E. Soil

As with the sediments in the back channel, most of the contaminants in the soils are found at levels above background concentrations. Although only six of these contaminants have EEQ's over 1, the result was a total EEQ of 42.7. This shows a high potential for risk.

Many other contaminants were not included in the calculation of soil EEQs, but many have serious biological implications. Examples are cyanide, thallium, vanadium, 2,4,6-trichlorophenol, 2,4-dichlorophenol, naphthalene, phenol, 2,4,5-T, 2,4,5-TP, 2,4-D, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha BHC, alpha chlordane, several as well as total PCBs, beta & delta BHCs, dioxin, dieldrin, 3 endosulfan formulations and endrin.

F. Groundwater

Statements made above regarding soils and sediments apply to the groundwater situation as well. The cumulative potential risk value is 549, which places it in the serious category of risk. Groundwater is crucial in the risk assessment because it is a pathway by which contamination reaches the river.

Here, too, several contaminants of ecological concern were left out of the EEQ calculations in the July 1994 ERA. These were 2,4-dimethylphenol, 2-methylphenol, 4-methylphenol, di-n-butylphthalate, di-n-octylphthalate, 2,4,5-T, 2,4,5-TP, 2,4-D, 4,4'-DDE, alpha BCH, 1,1,1-trichlorothane, 1,1,2-trichloroethane, 2-butanone, acetone, benzene, bromoform, carbon disulfide, chloroethane, methylene chloride, and toluene. This is due mainly to a lack of AWQC chronic toxicity values. Some of these are economic poisons (pesticides) for which chronic toxicity values have been developed for other media; therefore, they are known toxicants for which chronic numbers could be developed from literature sources. Still others (e.g., phthalate esters) have generic toxicity numbers which were not used in any calculations, because of the fact that the numbers are generally applied to all members of the chemical group in question. The levels above background, however, are indications that the groundwater is a likely secondary source and pathway of contamination to the river.

Summary and Conclusions

Risk calculations for all media (except air) have been carried out in ENSR's July 1994 ERA and they show potential for risk from many site related contaminants. Cumulative risk assessment calculations were carried out on those contaminants for the media where the EEQ exceeds one. The calculations were based upon those contaminants for which ENSR developed EEQs, but did not include all contaminants where levels exceeded background.

Even with this limited data base, it is clear that a potential for ecological risk exists in all media sampled. It can also be concluded that the potential risk is associated with contaminants that come from the site, as the background ratios show (see Tables 3.1 through 3.6 of the July 1994 ERA). In many cases, the ratios are elevated above background by many orders of magnitude, indicating that the site is a source of contamination to the Ohio River in the vicinity of Neville Island (see Table 3.6 of the July 1994 ERA). Contaminants from the site likely have contributed and likely can be expected to continue to contribute to the degraded condition of the river, and the levels reported by ENSR indicate a potential for risk.

Neville Land Company

Pittsburgh, Pennsylvania

Ecological Risk Assessment for the Ohio River Site, Neville Township, PA

ENSR Consulting and Engineering

July 1994

Document Number 4920-003-906

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1.0 INTRODUCTION

The Ohio River Site (ORS) in Neville Township, Pennsylvania is included on the National Priority List and, pursuant to the Administrative Order on Consent between the United States Environmental Protection Agency (U.S. EPA) Region 3 and Neville Land Company (owner of the ORS) dated October 16, 1991, a Remedial Investigation/Feasibility Study (RI/FS) has been undertaken. As part of the RI/FS process and under agreement with U.S. EPA Region 3, ENSR has conducted an ecological risk assessment for the Ohio River Site for the Neville Land Company. The remainder of this introduction describes some of the components of the ecological risk assessment and presents an overview of the approach to ecological risk assessment followed for the ORS. The introduction concludes with a description of the organization of the report.

1.1 Objectives

The purpose of an ecological risk assessment is to evaluate the likelihood of potential adverse ecological and biological effects of site-related environmental stressors on receptors and areas of potential concern at the site. The probability and magnitude of potential effects are dependent upon the site-specific stressors (i.e., compounds of concern), the extent of elevated compound concentrations, the existence of complete exposure pathways, and the biological receptors present at the site. As for a human health risk assessment, the object is to determine any incremental effects resulting from conditions of the site, not necessarily the total effects due to the site in combination with any naturally elevated stressors in the area (the "background").

Ecological risk assessments necessarily involve multiple receptor species, rather than a single species as is the case for human health risk assessments. In addition, the effects of environmental exposure to contaminants is much less understood for most non-human species. The combination of these two factors makes the application of the established procedures for human health risk assessment (the so-called "human health paradigm") difficult in the ecological context and alternative procedures must be followed.

Although formal guidance for evaluating potential ecological impacts from a site has not been presented in the Risk Assessment Guidance for Superfund Sites Volume II. Environmental Evaluation Manual (RAGS) (U.S. EPA, 1989c), the U.S. EPA RAGS document provided an overall framework for evaluating environmental effects. More recent efforts by the U.S. EPA have resulted in the Framework for Ecological Risk Assessment (U.S. EPA, 1992) and related documents. These documents, while not regulations nor U.S. EPA guidance, provided an interim procedure for the continuing effort to develop guidelines for ecological risk assessment. Specific environmental evaluation methods were provided in other documents including: Review of Ecological Risk Assessment Methods (U.S. EPA, 1988); Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (U.S. EPA, 1989a); and User's Manual for Ecological Risk Assessment (ORNL, 1986). Using the interim guidance and the methods presented in the evaluation documents, a logical, consistent, and technically sound approach can be followed when performing ecological risk assessments.

For the ORS, the primary objective of the risk assessment was to determine the relative risk of the site by comparing site concentrations to appropriate criteria and literature-derived values. The results of the risk characterization were interpreted to provide statements of the level of potential risk associated with site-related stressors. Also in Appendix F, a quantitative evaluation of potential effects to specific ecological receptors is presented.

1.2 Site Location and Usage

The ORS consists of approximately 32 acres in Neville Township, Pennsylvania, located on the western tip of Neville Island in the Ohio River approximately 10 miles downstream of Pittsburgh. The site is surrounded by the Ohio River (main and back channel) to the north, south, and west and by Neville Township (Neville Island) to the east.

Historically, the ORS was used primarily for agricultural purposes from the last century until the 1940s. From the mid-1930s through the mid-1950s, a portion of the site was used to landfill municipal wastes including domestic refuse and construction debris from Neville Island residences. From 1952 through the mid-1960s, the ORS was used for the disposal of industrial wastes, much of which originated from the industrial interests located at the eastern end of Neville Island.

Construction of the Ohio River Park was initiated in August 1977 and grading, construction, and landscaping was completed in early 1979. The park was never opened to the public and most structural components were dismantled during 1980. Currently, the ORS is not in use, and the landscaping and infrastructure are not being maintained.

1.3 Conceptual Site Model

A discussion of the characteristics of the site and surrounding area is provided as a conceptual site model (CSM) in Section 2.0 of this report. The CSM identifies the various ecological habitats found on the site and identifies potential exposure pathways relevant to the areas of potential ecological concern at the ORS.

1.4 Areas of Potential Ecological Concern

Areas of potential ecological concern are defined as areas in which potential effects of the ORS are expected to be greatest through direct or indirect exposures. The areas are also homogeneous subunits of the site and surrounding area which have similar ecological characteristics and are believed to receive similar exposures from the site. In the case of the ORS, the areas of potential ecological concern include both aquatic and terrestrial resources. The aquatic resources in the vicinity of the ORS consist of the Ohio River main channel and the smaller channel (or back channel) located to the south of Neville Island. The important potential aquatic habitats in these areas include the deep water sections and shallower littoral areas of the main and back channels of the Ohio River adjacent to the ORS. The terrestrial resources include habitats located on the ORS. The important terrestrial habitats include the upland area in the southern half of the site, the terrestrial woodland, and the riparian/flood plain habitats which exist at the shoreline around the periphery of the ORS.

1.5 Technical Approach

The approach followed to conduct the ecological risk assessment for the ORS is outlined in the form of a flow chart in Figure 1-1. The flow chart depicts three successive evaluations, or screenings: a screening level evaluation to identify compounds of potential concern, a secondary level risk evaluation, and a site-specific risk evaluation. The first of these evaluations, the screening level, strictly follows the procedures requested by U.S. EPA Region 3 and relies upon conservative assumptions for site concentrations and the extremely protective benchmarks for comparison. For these reasons, the results of this level do not reduce significantly the very large list of constituents identified at the site to a more focused list that can be used to direct management decisions.

Accordingly, the secondary level evaluation considers other methods of characterizing site concentrations, other benchmarks, additional consideration of the chemical-specific potential for adverse ecological effects, and best professional judgement. Taken together, these additional steps reduce the number of compounds under consideration to those constituents that have the most potential for ecological risks due to the site. The site-specific risk evaluation continues this process, incorporating consideration of site-specific criteria, specific exposure pathways, and relative magnitude of site concentrations to focus on only those compounds at the site that are more likely to create such risks as may be present. This stepwise process allows users of this risk assessment to consider the level of evaluation that is most useful for specific management decisions.

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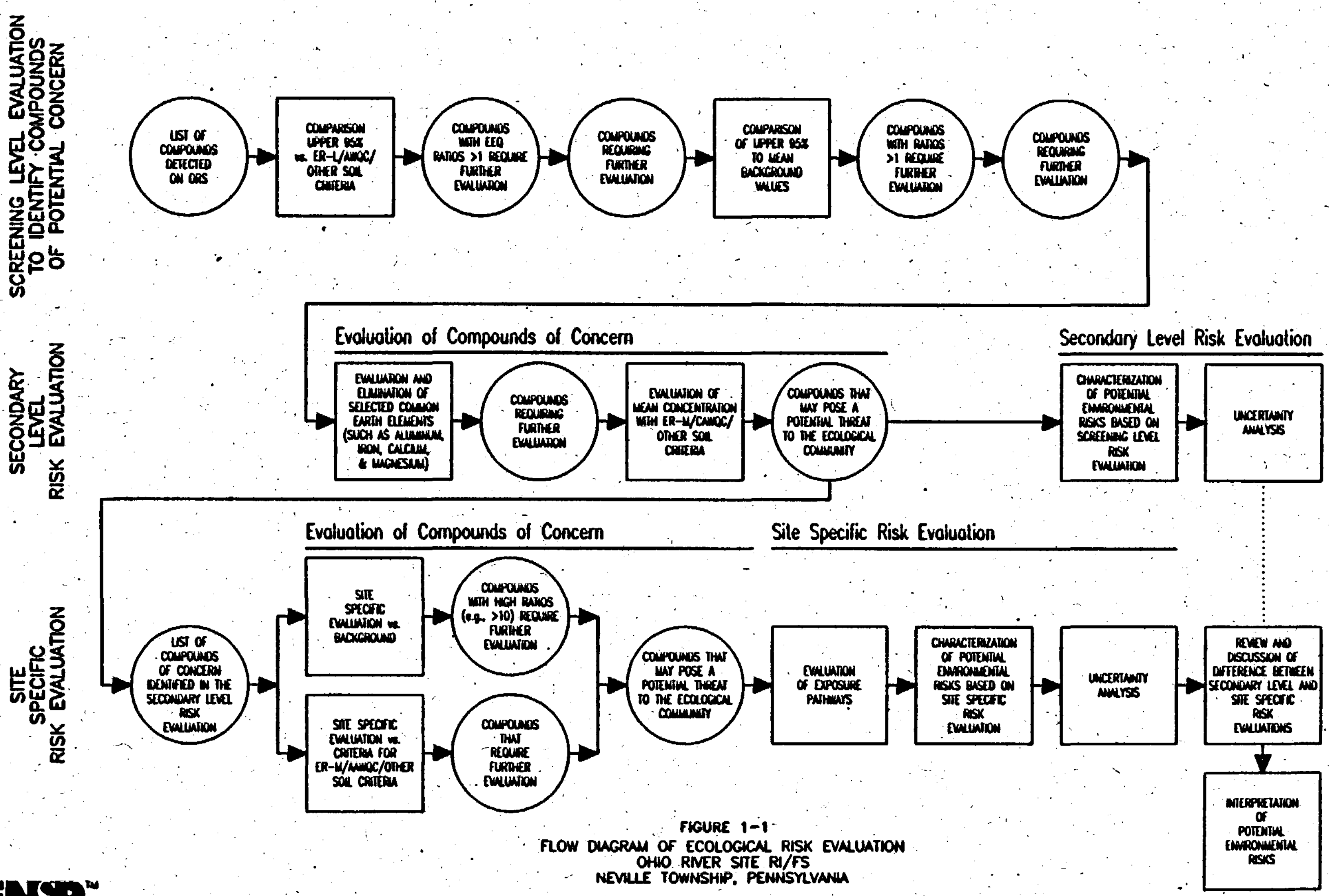

FIGURE 1-1
FLOW DIAGRAM OF ECOLOGICAL RISK EVALUATION
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

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The specific activities associated with each of these levels of evaluation are shown in Table 1-1 and discussed in more detail in the following sections.

1.5.1 Screening Level Evaluation to Identify Compounds of Potential Concern

Compounds of potential concern (CPCs) were conceptually identified based on historical knowledge about their possible presence at the ORS, the results of the RI, their potential to pose an environmental risk, and the availability of sufficient toxicological and biological data to perform a quantitative evaluation of potential ecological risk.

Based on site usage and previous investigations (ENSR, 1993; 1994), CPCs were determined to likely include metals, polycyclic aromatic hydrocarbons (PAHs), and other organic compounds such as volatile organic compounds (VOCs) and pesticides/herbicides. Identification of preliminary CPCs followed the steps outlined below and incorporate U.S. EPA Region 3 staff suggestions for an initial, conservative evaluation. .The screening level evaluation is based upon a minimum of information and uses conservative criteria. The purpose of this screening level evaluation is to identify the suite of compounds which are to be evaluated further for their potential ecological effects. A complete discussion of the compound evaluation process is also provided in Section 3.0.

To generate a list of screening level CPCs for the site, all concentrations of compounds detected in surface water, sediments, surface soil, and groundwater were compared with conservative environmental criteria. Examples of the environmental benchmarks and the applicable medium included Federal Ambient Water Quality Criteria (AWQC) for surface and groundwater, NOAA Effects Range-Low guidance values (ER-Ls) for sediments, and suggested criteria provided by U.S. EPA Region 3 staff for soils. The upper 95% confidence limit for the levels of each compound detected in a medium investigated at the site was compared to the appropriate benchmark, and compounds present in concentrations exceeding the benchmark were retained for further investigation. The next step in this preliminary analysis was a comparison of the magnitude of site concentrations relative to reference background concentrations. Again, only compounds for which site concentrations exceeded background concentrations were retained for further analysis.

The screening level risk evaluation provided a strictly conservative assessment of the potential risk associated with site-related CPCs. This conservatism includes the use of the upper 95% confidence limit as the comparison value, use of criteria such as the chronic AWQCs which assume constant exposure for aquatic organisms, and the use of AWQCs for evaluating groundwater quality without application of a mixing model. Because of the conservative approach adopted for this evaluation, few compounds identified at the site were excluded and the results of the screening level evaluation may be viewed as an extremely conservative assessment of

Table 1-1
Overview of Evaluation and Selection of Site-Related Chemicals of Potential Concern

Medium	Screening Level Evaluation (Section 3.0)	Secondary Level Evaluation (Section 4.0)	Site-Specific Evaluation (Section 5.0)
Surface Water (Main and Back Channels)	● 95th UCL vs. chronic AWQC ● 95th UCL vs. background	● Mean vs. chronic AWQC ● Mean vs. background ● Evaluate common elements	● No additional evaluation
Sediments (Main and Back Channels)	● 95th UCL vs. ER-L values ● 95th UCL vs. background	● Mean vs. ER-M ● Mean vs. background ● Evaluate common elements	● Mean vs. EP-derived SQC ● Relative enrichment ● Best professional judgement
Soil	● 95th UCL vs. EPA (3) values ● 95th UCL vs. background	● Mean vs. EPA (3) values ● Mean vs. background ● Evaluate common elements	● Relative enrichment ● Frequency of detection ● Best professional judgement
Groundwater	● 95th UCL vs. chronic AWQC ● 95th UCL vs. background	● Mean vs. chronic AWQC ● Mean vs. background ● Evaluate common elements	● Back channel groundwater wells vs. chronic AWQC ● Best professional judgement
Results of Evaluation	● Conservative criteria identify universe of potential CPCs ● Allows consideration of worst-case scenario	● Application of additional, less-stringent criteria to identify more likely CPCs ● Allows removal of unlikely CPCs (e.g., earth elements)	● Fine-tunes selection of CPCs by utilizing site characteristics ● Best professional judgement is invoked

ecological risks at the site. The screening level CPCs identified by the primary evaluation were evaluated in terms of their potential to result in adverse ecological effects, but the large number of compounds retained at this stage of the assessment made further interpretation impossible.

1.5.2 Secondary Level Risk Evaluation

The screening level CPCs identified by the screening level risk evaluation were further considered in the secondary level risk evaluation. In this stage of the risk assessment process, ubiquitous earth and essential nutrients were eliminated from further consideration in the risk assessment, as were CPCs at or below national average levels for particular media. Remaining CPCs were compared to other available criteria. In addition, the magnitude of site concentrations relative to reference background concentrations was re-examined. The secondary level compounds of concern (COCs) identified by the secondary level were evaluated in a manner analogous to that used for the screening evaluation; however, because the assessment was targeted toward more clearly defined COCs, it was possible to conduct the evaluation in more detail.

The secondary level risk evaluation continued with the identification and evaluation of relevant exposure pathways, placed into the context of the conceptual site model. The ratio of estimated receptor dose to acceptable dose determined the chemical-specific potential risk. If the ratio was less than or equal to one, it was concluded that no adverse effects were likely to occur. If the ratio was greater than one, further evaluation was necessary. The evaluation was concluded with a discussion of the uncertainty associated with the secondary level analysis.

1.5.3 Site-Specific Risk Evaluation

The final stage of the procedure followed for the ORS ecological risk assessment involved a site-specific risk evaluation. Because the number of secondary COCs that were considered in the secondary level risk evaluation was still quite high, it was difficult in that portion of the assessment to focus on the subset of identified contaminants most responsible for risk. Accordingly, the site-specific evaluation used a more rigorous procedure to narrow and focus the list of COCs.

In this evaluation, compounds were compared to applicable site-specific criteria (e.g., site-specific sediment quality criteria) or exposure pathways (e.g., potentially contaminated groundwater entering the back channel). Best professional judgement was used to evaluate compounds lacking applicable criteria for comparison.

Compounds identified in the site-specific evaluation were selected as the site-specific COCs. In this type of semi-quantitative assessment, knowledge of acceptable levels of exposure was necessary in order to estimate potential adverse risks for the semi-quantitative assessment.

Chemical-specific levels or doses (i.e., daily intakes) were derived from literature sources and are described in Appendix E.

The results of the exposure assessment were combined with the results of the ecological effects characterization to characterize potential environmental risk. This evaluation presents a more central tendency risk evaluation and is more realistic. The results of the site-specific risk assessment (semi-quantitative approach) are presented in Section 5.0. Because of the limitations associated with the risk assessment process, an uncertainty assessment section was also provided.

1.6 Interpretation

The results of the risk characterization were evaluated to provide an overall risk assessment. The evaluation considered the initial set of CPCs identified by the screening level risk evaluation. The results of the secondary level risk evaluation and site-specific risk assessment were compared and differences discussed. Both the magnitude and potential severity of potential ecological risk were considered. The results and interpretation are presented in Sections 6.0 and 7.0.

1.7 Report Organization

This ecological risk assessment report is organized as follows. Section 1.0 presents a brief overview of the site and provides a summary of the approach followed to conduct the risk assessment. Section 2.0 presents the site background for the ORS and surrounding area. Section 3.0 describes in more detail the processes used to identify CPCs. Section 3.0 also contains the results of the screening level risk evaluation and discussion of extremely conservative potential risks. Section 4.0 describes the secondary level risk evaluation and Section 5.0 details the site-specific risk assessment. Comparison of the results of the secondary and site-specific risk evaluation is provided in Section 6.0. Finally, Section 7.0 contains the summary and interpretations. The details and supporting documentation for the site-specific risk assessment using representative (surrogate) species are included in Appendix F.

2.0 CONCEPTUAL SITE MODEL FOR THE OHIO RIVER SITE

To evaluate the potential ecological impacts of the Ohio River Site, it is necessary to consider the physical features of the site, the physical and chemical properties of the CPCs and the biological components of the ecosystem. This process is formalized in the development of a conceptual site model (CSM). The CSM contains a set of working assumptions based on habitats and species present within potentially affected ecosystems and is used to identify potential exposure pathways and compounds of potential concern. The CSM may also be used to provide the rationale behind the selection of species having the highest potential exposures to CPCs and, thus, are assumed to have the highest potential risk. At the same time, the CSM facilitates rapid elimination of compounds that pose little potential risk due to their physicochemical properties or relatively small potential exposures.

The elements of the CSM for the ORS provided in this section are as follows: a brief overview of the physical and geologic setting of the site (Sections 2.1.1-2.1.3); a description of site land use (Section 2.1.4); the important potentially affected habitats (Sections 2.1.5-2.1.7); identification of important exposure pathways (Section 2.2); and a summary of the CSM (Section 2.3).

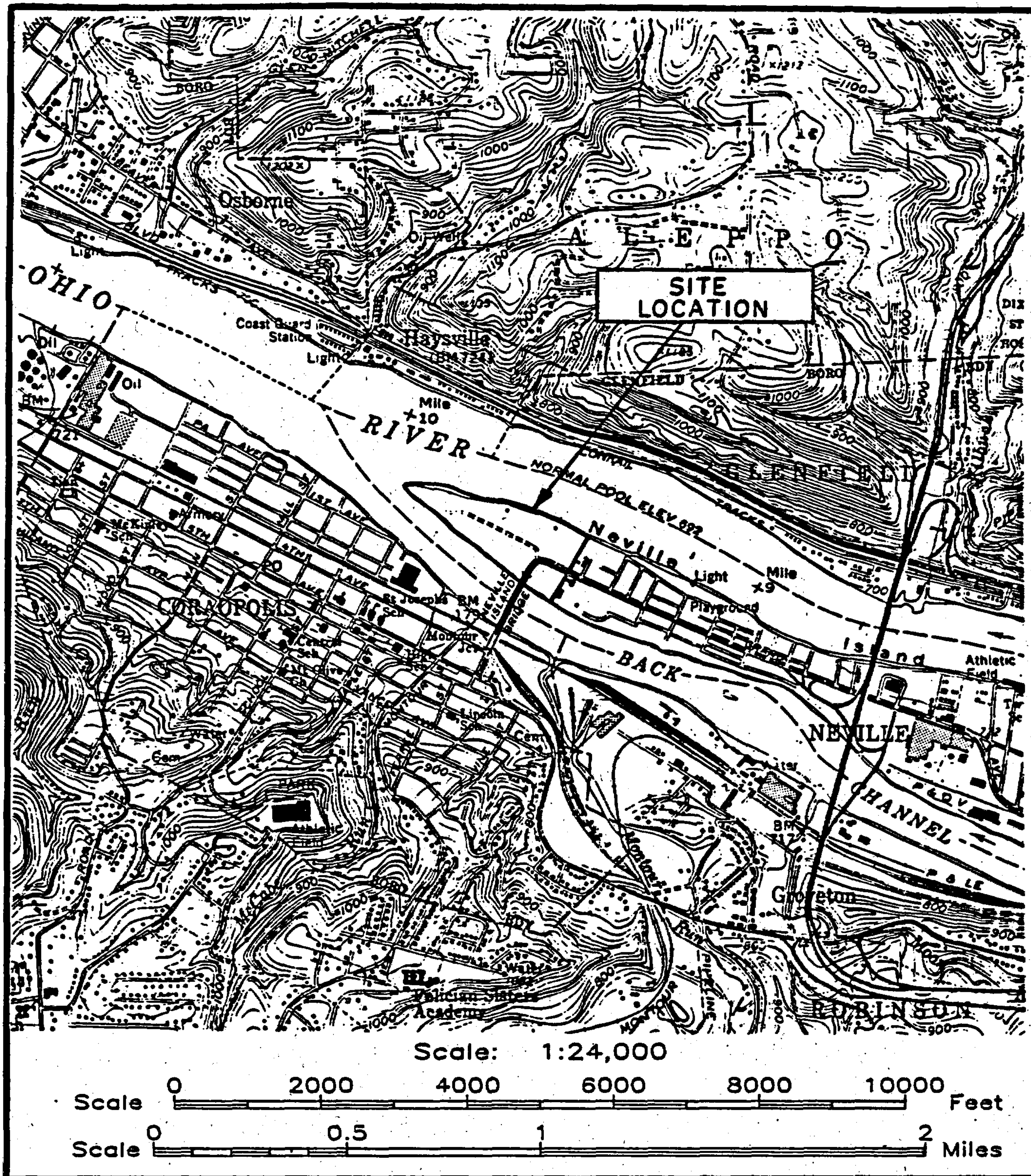
2.1 Ecosystem Characterization

This section will provide the necessary background information about the physical (Section 2.1.1) and biological (Section 2.1.2) characteristics of the ORS which will be used to identify habitats and receptors for further evaluation.

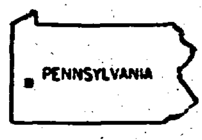
2.1.1 Physical Setting

The ORS is located in Neville Township, Allegheny County, Pennsylvania, at a latitude of 40° 31' N. and a longitude of 80° 09' W (U.S.G.S, Ambridge, PA 7.5 Minute Quadrangle). It consists of approximately 32 acres on the western tip of Neville Island in the Ohio River, and is situated approximately 10 miles downstream of downtown Pittsburgh. It is surrounded by the Ohio River (main and back channel) to the north, south, and west, and by Neville Township to the east (Figure 2-1).

Topographically, the ORS is relatively flat with the exception of a slight mound on the western tip of the island and steep slopes along the Ohio River (Figure 2-2). In addition, the slope along the river is interrupted by a terrace, typically 20 feet wide, on the western end of the island. At the northwestern tip of the island, a gentle slope exists extending from the Ohio River to the mound.



REFERENCE:
Ambridge, Pennsylvania, USGS 7.5 Minute Quadrangle



QUADRANGLE LOCATION

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FIGURE 2-1
SITE LOCATION MAP
OHIO RIVER SITE
NEVILLE TOWNSHIP, PENNSYLVANIA

Drawn: MSH	Date: 8/9/93	Project Number:	Rev:
Appr'd: KB	Revised: 8/10/93	4920-003	0

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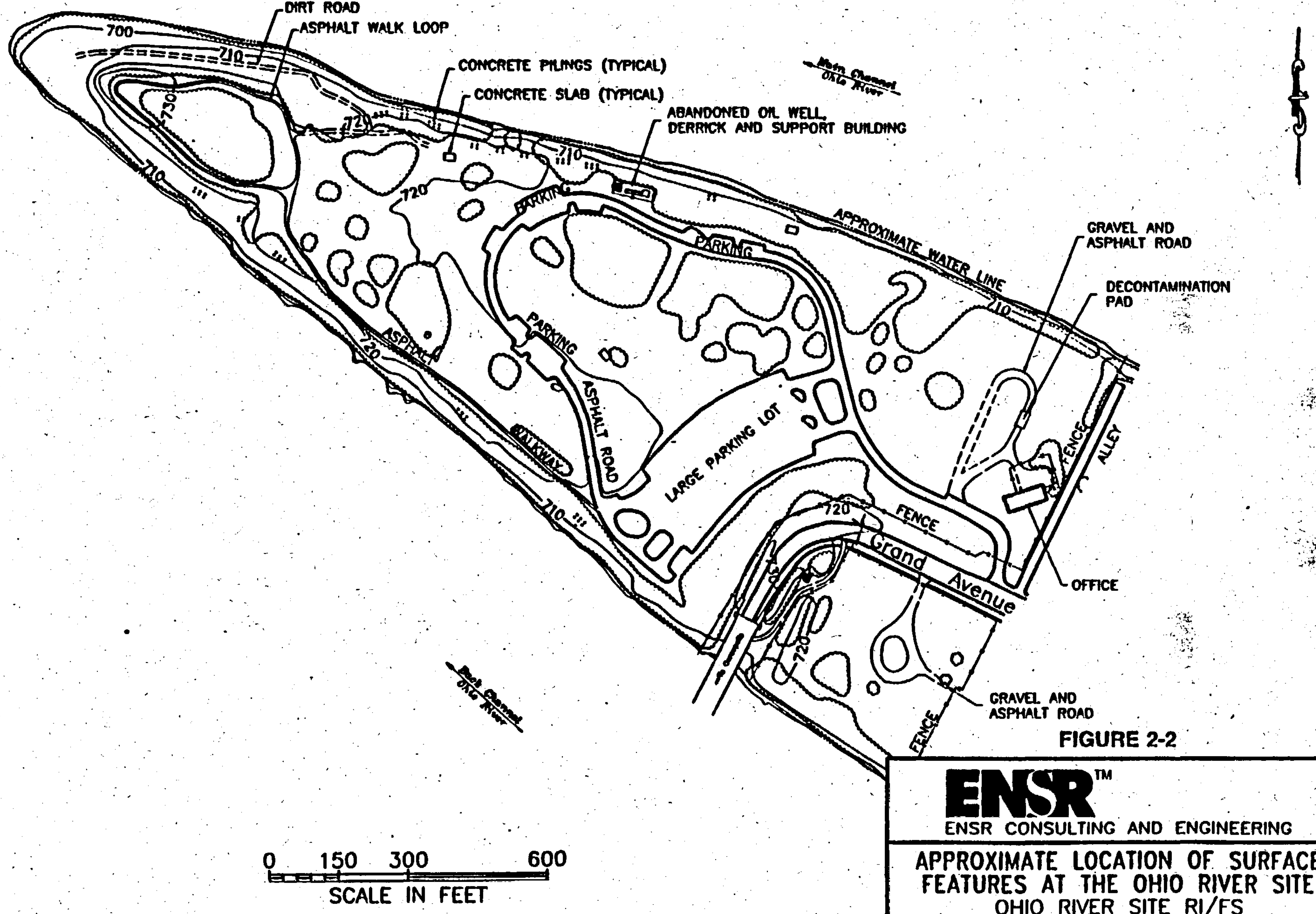

FIGURE 2-2

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APPROXIMATE LOCATION OF SURFACE FEATURES AT THE OHIO RIVER SITE
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

Drawn	MSH	Date:	11/10/92	Project Number		Rev.	
Appr'd	KB	Revised	8/31/93	4920-003		0	

The ORS is approximately 27 feet higher in elevation than the Ohio River normal pool elevation in the Dashields Pool (located between the downstream Dashields Dam and the upstream Emsworth Dam).

2.1.2 Bedrock Geology

The ORS is located within the Allegheny Plateau section of the Appalachian Plateaus Physiographical Province. The geological structure of the region is characterized by gentle, parallel, northeast-southwest trending folds. The bedrock in the region is Pennsylvania Age, Connemaugh Group. The Connemaugh Group is composed of the Glenshaw and Casselman Formations. These two formations consist primarily of shale and sandstone. The Glenshaw Formation (lower) and the Casselman Formation (upper) are separated by the Ames Limestone in Western Pennsylvania. Thin limestone and coal beds are also present in the Connemaugh Group.

2.1.3 Soil Geology

Neville Island is a detached portion of a dissected river terrace that was deposited by the ancestral Ohio River. The terrace is partially submerged by impoundments on the Ohio River. Remnants of the terrace flank both sides of the Ohio River at approximately the same elevation as Neville Island (Adamoan et al., 1949).

Unconsolidated sediments overlie the bedrock in the stream valleys. These unconsolidated sediments are generally 60 feet thick along the Ohio River in the vicinity of the ORS and only a few feet thick along the ridges. The upper portion of the unconsolidated sediments consists of Quaternary fluvial clay, silt and sand that was recently deposited. The lower portion of the unconsolidated sediments consists of sand and gravel with some silt and clay that was deposited by glacial meltwaters during the Pleistocene interglacial stages. The alluvial deposits are approximately 25 feet thick and the glacio-fluvial deposits are generally 35 feet thick.

The top soil at the ORS, as characterized by the U.S. Department of Agriculture, Soil Conservation Service, is urban land. Urban land typically consists of nearly level land on flood plains. It occurs where the land has been altered by construction and filling or is obscured by structures such that the original soils cannot be identified (U.S.D.A., 1981). The apparent causes of this disturbance at the ORS include both historical land use (agricultural and industrial operations) and the more recent grading of surface material for potential park operation.

2.1.4 Land Use at ORS and in the Vicinity

The ORS is located on the western tip of Neville Island. The land immediately adjacent to the site to the east consists of urban residential and commercial properties. The eastern half of Neville Island (approximately 2 miles east of the ORS) is occupied by petrochemical facilities, coal coking facilities and abandoned steel facilities. The area immediately surrounding the ORS to the north, west, and south is dominated by the main and back channels of the Ohio River. Upstream of the site, areas along the Ohio River consist of urban, industrial and commercial development.

Residential, commercial, and industrial properties exist in the vicinity of the ORS. South of the Ohio River is the community of Coraopolis. Downtown Coraopolis is primarily composed of commercial businesses with interspersed residential areas. The areas to the south, west, and east of downtown Coraopolis are primarily mixed residential and commercial areas with undeveloped areas interspersed due to steep topography.

The communities of Sewickley, Osborne, and Haysville are located north of the Ohio River and the ORS. The land in those communities adjacent to the Ohio River contains residences, industry, and transportation corridors (i.e., rail lines and State Route 65). The area directly north of State Route 65 is sparsely populated, primarily due to steep topography.

Historically, the ORS was used primarily for agricultural purposes from the last century until the 1940s. From the mid-1930s through the mid-1950s, a portion of the site was used to landfill municipal wastes including domestic trash and construction debris from Neville Island residences. U.S. Navy barracks were constructed on the eastern portion of the ORS. These barracks were located to the north and east of the Coraopolis Bridge, but were demolished and removed from the site during the 1960s. The area of the site containing the U.S. Navy barracks was not used as part of the municipal landfill and does not contain waste disposal areas. From 1952 through the 1960s, the ORS was used for the disposal of industrial wastes, much of which originated from the industrial interests located at the eastern end of Neville Island.

Construction of the Ohio River Park was initiated in August 1977 and grading, construction, and landscaping were completed in early 1979. The park never opened to the public and most structural components were dismantled during 1980. Currently, the ORS is not in use, and the landscaping and infrastructure are not being maintained.

The ORS has been used for industrial purposes since the 1940s except for the U.S. Navy barracks that were located on the eastern most portion of the site. The ORS is currently zoned "special". This zoning classification indicates that there are conditions placed on uses of the ORS. Typically, special zoning classifications are used for public parks, public parking, etc. Any future development of the ORS must be approved by the Neville Township Zoning Hearing Board. The Neville Land Company (NLC) has no intentions to transfer ownership and control for residential purposes.

2.1.5 Important Aquatic and Terrestrial Habitats

Important habitats were identified at the Ohio River Site and within the vicinity of Neville Island. Important habitats are areas in which potential effects of the ORS are expected be greatest through direct or indirect exposures. For example, an important habitat could either be directly affected by compounds of potential concern in groundwater discharge from the ORS or alternatively provide food or shelter for species exposed to compounds from the ORS. Important habitats were selected for evaluating the potential impacts of the ORS through consideration of proximity to the ORS, potential exposure pathways of compounds from the ORS, and the potential sensitivity of that habitat's biological community to disturbance. Identification of habitats and vegetation species in the vicinity of the ORS was based on aerial photographs, resource maps and other environmental information, supplemented by observations and sampling results from a field reconnaissance.

The aquatic resources in the vicinity of the ORS consist of the Ohio River main channel ("Ohio River") and the smaller channel (or "back channel") located to the south of Neville Island. The terrestrial resources include habitats located on the ORS. The important potential aquatic habitats include the deep water sections and shallower littoral areas of the back and main channels of the Ohio River adjacent to the ORS. The important potential terrestrial habitats include the upland area in the southern half of the site and the riparian/flood plain habitat which exists at the shoreline around the periphery of the ORS. These habitats and the associated plant and animal communities are described in detail below.

2.1.6 Aquatic Habitats

The ORS is located on the western tip of Neville Island, bordered by the Ohio River. South of the ORS is the back channel of the Ohio River and north of the ORS is the main channel of the Ohio River. The Ohio River was selected as an important habitat due to the proximity of the ORS, the potential discharge of compounds to the river via groundwater, the potential migration of sediments from the ORS via stormwater runoff, and the potential sensitivity of the aquatic organisms found in the Ohio River.

The main channel of the Ohio River at the ORS between River Mile 9 and 10 is a fairly straight stretch which ranges from 1,000 to 1,200 feet wide. Depth in the main navigational channel is approximately 15-20 feet with a normal pool elevation of 692 feet above mean sea level (MSL).

The back channel in the vicinity of the ORS is approximately 600-700 feet wide and has an estimated maximum depth of about 20 feet at the center of the navigational channel. An approximate cross-section of the back channel is given in Figure 2-3. The cross-section identifies areas of fine-grained river bottom sediments located in the back channel adjacent to the ORS.

The Emsworth back channel dam is located approximately 2.8 miles upstream of the ORS and the Emsworth main channel dam and locks are approximately 3.3 miles upstream of the ORS. The Emsworth dams maintain a normal pool elevation of 710 feet above mean sea level (MSL) upstream of the dam. The Dashields lock and dam is located approximately 3.2 miles downstream of the ORS. The Dashields dam maintains a normal pool elevation of 692 feet (MSL) between it and the Emsworth dam.

Flow in the Ohio River, as measured at the nearby Sewickley U.S.G.S. gaging station, varies significantly depending primarily on precipitation. The maximum flow rate of 465,000 cubic feet per second (cfs) was recorded in 1936 and the minimum flow rate of 2,100 cfs in 1957. The mean discharge for the Ohio River in 1991 was 27,880 cfs at Dashields Dam (U.S.G.S., 1992). Generally, approximately 90 percent of the flow occurs in the main channel of the Ohio River; however, the relative percentage of flow is dependent upon the overall flow in the Ohio River. During periods of high water, much more flow occurs in the Ohio River back channel, while during periods of low water, most flow occurs in the Ohio River main channel (U.S. COE, 1993).

The Ohio River drains a large portion of the Allegheny Plateau in Pennsylvania. Erosion and sedimentation rates are relatively high and the majority of this soil loss has been ascribed to mining activities throughout the basin (U.S.G.S., 1985). Due to the urbanization and the location of communities along the river, the basin experiences a significant amount of flood damage (U.S.G.S., 1985).

The Ohio River is navigable and commodities such as chemicals, coal, coke, sand, gravel and other materials are routinely transported on the river by barges. Because of commercial traffic, the Ohio River is periodically dredged to maintain navigable waterways for barge traffic and to recover sand and gravel. Major water users are self-supplied industries (42%) and thermoelectric power generation (50%) [U.S.G.S., 1985]. Upstream of the site, areas along the Ohio River have been developed for a wide variety of industry (such as steel, chemical, power, manufacturing, etc.). The river has received industrial, municipal, mining and commercial waste discharges for over 100 years. The Ohio River is also used for boating and swimming during the warm months and fishing year round.

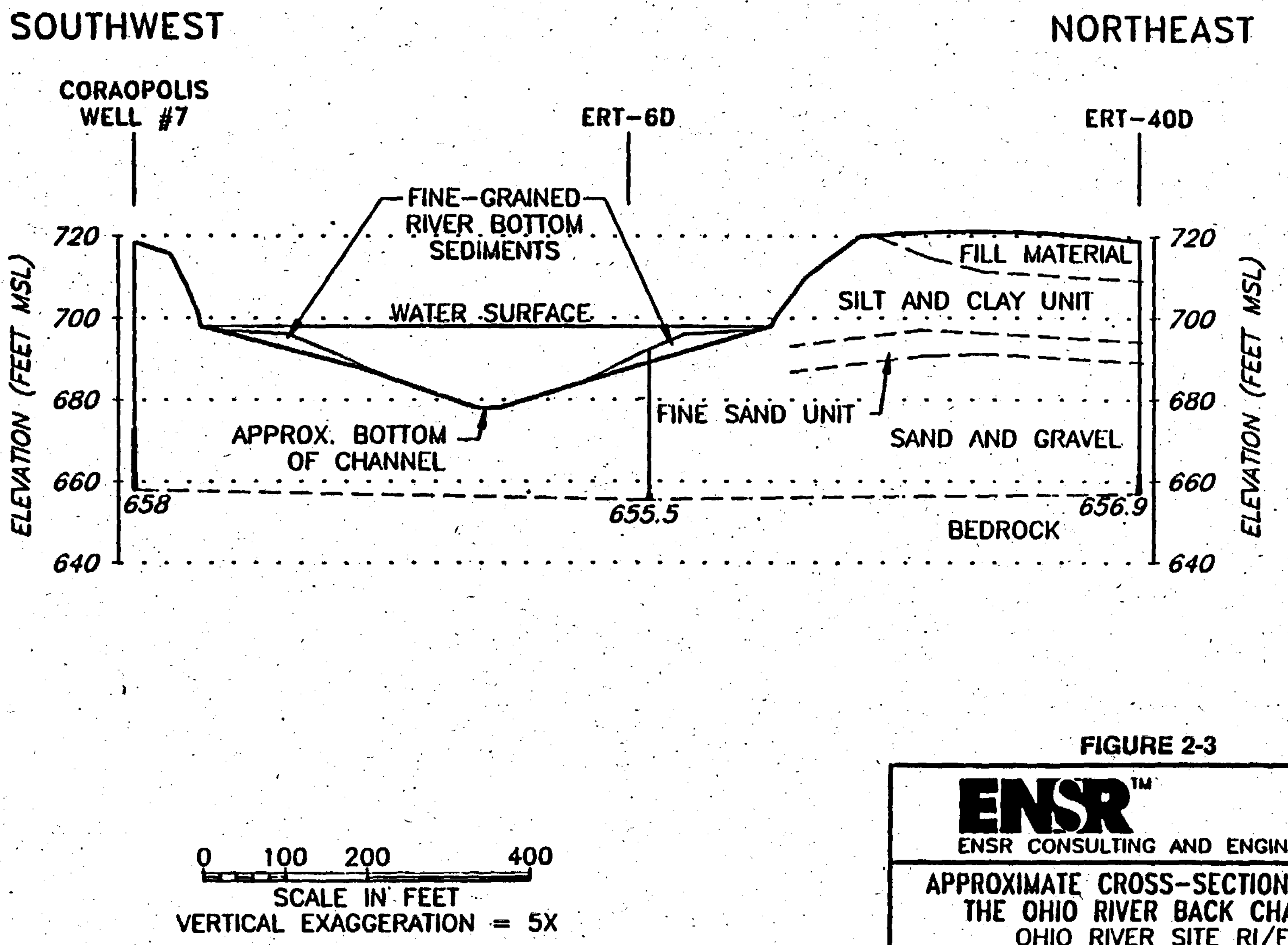

FIGURE 2-3

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APPROXIMATE CROSS-SECTION ACROSS
THE OHIO RIVER BACK CHANNEL
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

Drawn	MSH	Date:	12/1/93	Project Number:		Rev.
Appr'd	KB	Revised	X		0--003	0

2.1.7 Terrestrial Habitats

Terrestrial habitats at ORS selected for further evaluation were identified. Habitat classification was based primarily on the existing vegetation. It was assumed that vegetation present at ORS would be the basis for species presence/absence due to the availability of suitable shelter and food. During October 1992, a terrestrial habitat analysis was conducted on Operational Unit 1 (OU-1) at the ORS. The purpose of the analysis was to characterize existing habitats by vegetation and to identify site fauna.

Three types of terrestrial habitats were identified at the ORS: (1) riparian zone woodlands - consisting of a narrow forested riparian strip adjacent to the shoreline, (2) terrestrial woodlands - consisting of upland forest areas dominated by deciduous hardwood tree species, and (3) maintained grassland - consisting of various grass and shrub species. The habitats are identified in Figure 2-4 and descriptions of the terrestrial habitats are given below.

2.2 Potential Exposure Pathways

Exposure pathways describe the process by which compounds are released to various environmental media and to what extent these compounds may contact with species present on the ORS. Exposure pathways are identified based upon fate and transport models, from concentration data, and the magnitude, duration, and frequency of potential exposures.

The initial screening of potentially important exposure pathways considered the physical characteristics of the ORS. Potential exposure pathways were identified for the aquatic and terrestrial habitats of interest. Groundwater discharge to the Ohio River was identified as a potential exposure pathway. Location of monitoring wells in the back channel of the Ohio River are shown in Figure 2-5 .

The aquatic ecosystem provides habitat for many species that spend their entire life cycle in the Ohio River, although only a portion of their life cycle may be spent near the ORS. The exposure pathways for the aquatic risk assessment are exposures to CPCs in the surface water and the sediments. Biota may contact compounds via uptake from water in the water column, through sediment or porewater, or transfer through the food chain. The potential effects, if any, of the CPCs can be evaluated by comparing the observed or predicted concentrations of compounds of concern to established Ambient Water Quality Criteria (AWQCs) which are assumed to be protective for potential exposure through all pathways.

The initial set of exposure pathways identified for the terrestrial risk assessment include consumption of surface water, consumption of flesh (fish, amphibians, worms), consumption of

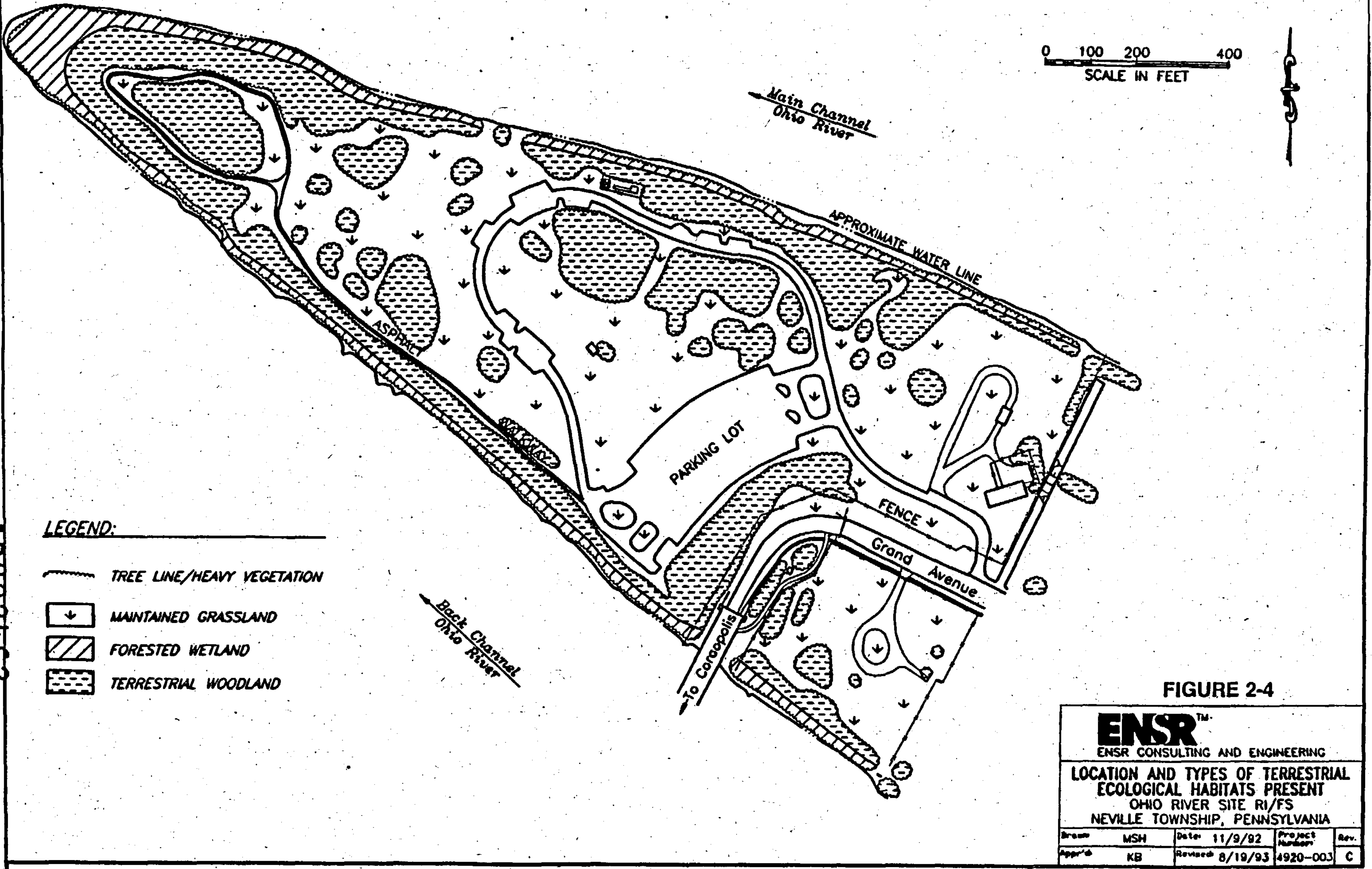

FIGURE 2-4

ENSR™
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LOCATION AND TYPES OF TERRESTRIAL ECOLOGICAL HABITATS PRESENT
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

Drawn	MSH	Date: 11/9/92	Project Number	Rev.
Appr'd	KB	Revised 8/19/93	4920-003	C

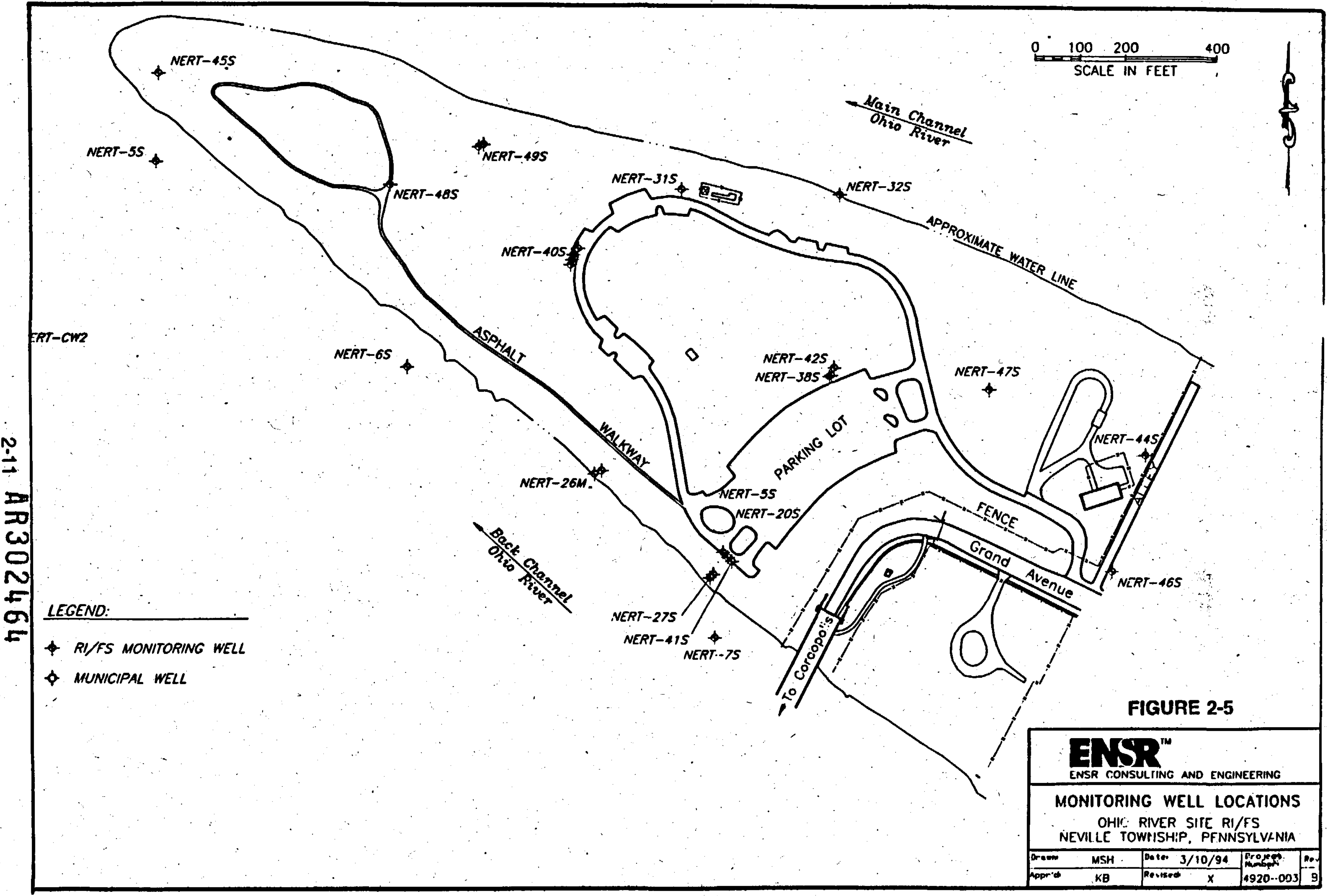

FIGURE 2-5

ENSR™
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MONITORING WELL LOCATIONS
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

Drawn	MSH	Date: 3/10/94	Project Number		Rev
Appr'd	KB	Revised X	4920-003		9

plant material, inadvertent ingestion (soil, sediments), and dermal exposure (soil, sediments, surface water). The inhalation pathway was neither directly quantifiable nor likely to be an important pathway. This conclusion was based on (1) no volatile organic compounds (VOCs) were compounds of concern in this medium, (2) only two SVOCs (naphthalene, 2-methylnaphthalene) were detected in air quality samples during an air monitoring program (ENSR, 1993), and (3) lack of appropriate air quality ecological benchmarks. Inhalation was, therefore, not considered in the terrestrial risk assessment pathways.

In the case of the terrestrial ecosystem, the potential exposures of mammals and birds are usually evaluated because of their body size, preferred food types, and/or position in the trophic food chain. Smaller animals are evaluated because their large daily food intake relative to body weight makes them more sensitive to the potential effects of compounds of concern than large animals which have a lower food intake relative to body weight. Because of the potential bioaccumulation of some of the potential CPCs, consumption of fish and amphibians may be an important pathway of exposure, as would consumption of small mammals exposed to elevated site soil concentrations.

The critical exposure pathways can be further clarified following identification of the COCs and the species present. An example evaluation of the dermal exposure pathway is presented below. The nature of the compounds of potential concern affects the degree of potential exposure. For example, a compound which does not easily pass through biological membranes, (e.g., a heavy metal or a large molecular weight organic compound) is unlikely to be important in the dermal exposure pathway. Even for compounds which are absorbed through biomembranes, the level of exposure is mediated by the relative amount of exposed skin. For example, a muskrat is covered by a bilayer pelt, of which the inner layer remains dry, and effectively prevents transfer of the compound. It is only through the area of exposed skin, conservatively estimated for muskrats at 10% (Hayssen; personal communication, 1992) by which transfer can occur. Thus, consideration of the dermal exposure pathway is affected by the compound and species of concern. Similar considerations may also be appropriate for other exposure pathways.

2.3 Conceptual Site Model Summary

The conceptual site model provides an overview of the geographic setting, geology and physical factors which influence local ecological resources. The ecosystems surrounding the ORS contain important aquatic, riparian, and terrestrial habitats. Species that are likely to be found there were identified based on site visits and/or available published information (see Appendix F for details). Following the habitat characterization and identification of associated flora and fauna, the potential exposure pathways were identified. These pathways range from simple (aquatic) to complex (terrestrial). This information provides the environmental context for subsequent risk evaluation.

3.0 SCREENING LEVEL RISK EVALUATION

As part of the approach suggested by U.S. EPA Region 3, an initial, conservative evaluation was performed to identify all compounds of potential concern. This evaluation allows the risk assessor to consider the extremely conservative scenario and largest possible pool of stressors. Further evaluation is necessary to assess the reasonableness of concern associated with compounds identified in the initial, conservative evaluation. This further evaluation is required to refine the CPCs to a point where sufficiently realistic risk information can be communicated to the site risk manager to allow the weighing of feasibility options and to support risk management decisions.

In the screening level risk evaluation, all compounds detected in the various site media were compared to conservative criteria to develop a preliminary list of CPCs. CPCs can be identified based on historical knowledge about their possible presence at the ORS, their documented presence (based on RI study), their potential to pose an environmental risk, and the availability of relevant ecotoxicological benchmarks. An outline of the activities undertaken at this evaluation stage is shown in Figure 3-1.

The screening level CPCs for the aquatic and terrestrial risk assessments were selected from a list of all compounds detected at the site during the RI. The screening level CPC list contains a number of organic and inorganic compounds associated with wastes present on the ORS and is based on the results of the Remedial Investigation (ENSR, 1993), as well as earlier information.

Analyses of compounds were made in four media: surface water, sediments, surface soil, and groundwater. As part of the approach suggested by U.S. EPA Region 3, surface water and sediment samples from the main channel and the back channel were evaluated separately. For many compounds, no values exceeded the detection limits at any sampling station for all sampling rounds in a particular medium. The compounds that were not detected were excluded from further consideration in that particular medium. Conversely, any compound which exceeded the detection limit for a single sample was further evaluated. The resulting lists of compounds by environmental medium are presented in Appendix A. These tables also contain the minimum detected value, the maximum detected value, the arithmetic and geometric mean concentrations, the upper 95% confidence limit, and the frequency of detection for each compound. Data reported as below the detection limit were entered as ½ the detection limit for the purpose of calculating these statistics. Following a protocol suggested by U.S. EPA Region 3 staff (with which NLC and ENSR disagree), the higher value of two duplicate samples was used as the

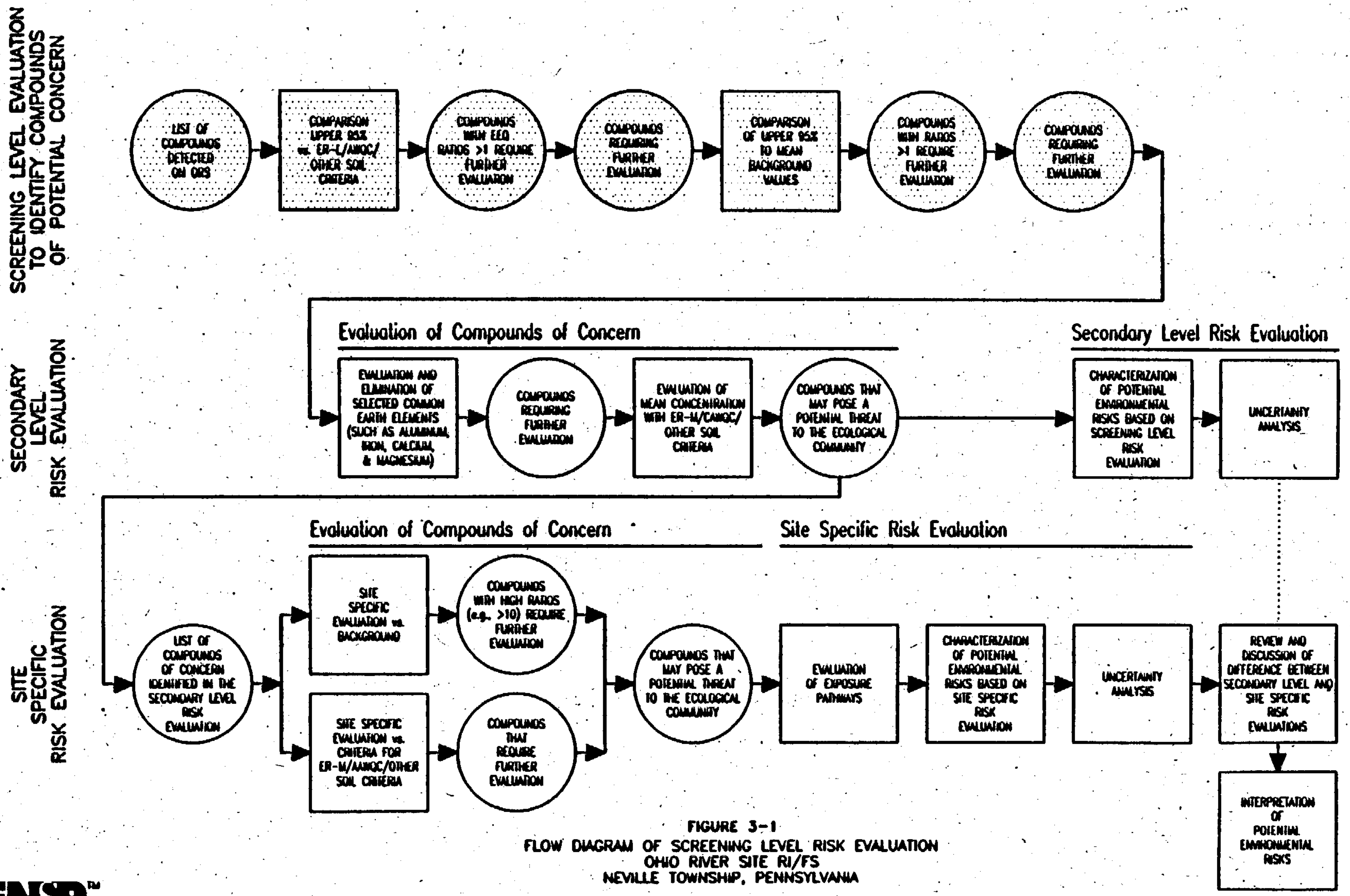

FIGURE 3-1
FLOW DIAGRAM OF SCREENING LEVEL RISK EVALUATION
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

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representative value and proxy values for non-detects (i.e., ½ detection limits) were included regardless of whether they exceeded the maximum detected value.

For the screening level evaluation, the detected screening level CPCs were compared to national criteria or U.S. EPA Region 3 regionally-endorsed environmental benchmarks, where available. Examples of the environmental benchmarks and the applicable medium included the federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life for surface waters and benthic organism, and the guidance Effects Range-Low (ER-L) values for sediments, developed as part of National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends Program (Long and Morgan, 1990; Long and MacDonald, 1992). An environmental effects quotient (EEQ) was calculated as the ratio of the comparison value concentration divided by the conservative environmental benchmark. All compounds that exceeded the conservative environmental benchmarks (i.e., EEQs greater than 1.0) were retained in the risk assessment for further evaluation.

Compounds that do not have an appropriate environmental benchmark (i.e., AWQC or ER-L) were compared to background concentrations. Compounds that were present at concentrations greater than background levels were retained in the risk assessment for further evaluation. Compounds that were below the environmental benchmark were eliminated from further consideration regardless of the results of the background comparison.

The following sections discuss the selection of screening level CPCs for each of the media evaluated. Section 3.1 presents the evaluation of screening level CPCs for surface water, and Section 3.2 presents the evaluation of screening level CPCs in sediments. Section 3.3 identifies the screening level CPCs in surface soils, and Section 3.4 identifies the screening level CPCs in groundwater at the ORS. Compounds identified during this preliminary screening process will be evaluated further in later sections of the ecological risk assessment. An overview of the entire evaluation process is given in Figure 3-1.

3.1 Screening Level Risk Evaluation of CPCs in Surface Water

To identify CPCs in both the main and back channel surface water, detected compounds were compared to relevant criteria. The list of screening level CPCs that were detected in the main channel and in the back channel surface water is presented in Tables 3-1 and 3-2, respectively. The lower value of the 95% upper confidence limit on the arithmetic mean (95% UCL) or the maximum detected concentration, if the calculated 95% UCL exceeded the maximum, was used as the comparison value in this preliminary evaluation.

Table 3.1 Screening Level Evaluation
Surface Water Screening, Main Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	BKGD Value (ug/L) (1)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Result of Screen (*=include in next screen)
Aluminum	321.7	95th UCL	87	270	3.70	1.19	*
Barium	41.2	95th UCL		41		1.00	
Calcium	25200	Maximum		20900		1.21	*
Total Chromium (as III) (2)	12.1	95th UCL	145	[4]	0.08	3.03	
Total Chromium (as VI)	12.1	95th UCL	11	[4]	1.10	3.03	*
Copper (2)	67	95th UCL	8	[3]	8.38	22.33	*
Iron	878.3	95th UCL	1000	697	0.88	1.26	
Magnesium	6570	Maximum		5310		1.24	*
Manganese	242.7	95th UCL		221		1.10	*
Mercury	0.67	95th UCL	0.012	[0.1]	55.83	6.70	*
Potassium	1793.9	95th UCL		1490		1.20	*
Sodium	14300	Maximum		10000		1.43	*
Zinc (2)	29.8	95th UCL	74	39	0.40	0.76	
Bis(2-ethylhexyl)phthalate	ND			[5]			
Di-N-butylphthalate	ND			[5]			
Gamma-Chlordane	ND			[0.025]			
2,4,5-T	0.05	Maximum		[0.05]		1.00	
2,4,5-TP	0.05	Maximum		[0.05]		1.00	
2,4-D	0.5	95th UCL		[0.5]		1.00	
Acetone	ND			[5]			

NOTES:
(1) Values in brackets represent one half the SQL where no detects were reported.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.

Table 3-1
13-Jul-94

Table 3.2 Screening Level Evaluation
Surface Water Screening, Back Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	BKGD Value (ug/L) (1)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Result of Screen (*=include in next screen)
Aluminum	314	Maximum	87	199	3.61	1.58	*
Barium	40	Maximum		39		1.03	
Calcium	25862	95th UCL		25800		1.00	
Total Chromium (as III) (2)	16.6	95th UCL	145	[4]	0.11	4.15	
Total Chromium (as VI)	16.6	95th UCL	11	[4]	1.51	4.15	*
Copper (2)	11.4	95th UCL	8	[3]	1.43	3.80	*
Iron	788.4	95th UCL	1000	628	0.79	1.26	
Magnesium	6615.4	95th UCL		6610		1.00	
Manganese	203.4	95th UCL		194		1.05	*
Mercury	ND		0.012	[0.1]	0.00	0.00	
Potassium	1580	Maximum		1700		0.93	
Sodium	13800	Maximum		13800		1.00	
Zinc (2)	24	Maximum	73.5	15	0.33	1.60	
Bis(2-ethylhexyl)phthalate	ND			2			
Di-N-butylphthalate	5	Maximum		[5]		1.00	
Gamma-Chlordane	0.025	Maximum		[0.025]		1.00	
2,4,5-T	0.05	Maximum		[0.05]		1.00	
2,4,5-TP	0.05	Maximum		[0.05]		1.00	
2,4-D	0.5	95th UCL		[0.5]		1.00	
Acetone	ND			[5]			

NOTES:
(1) Values in brackets represent one half the SQL where no detects were reported.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.

Table 3-2
13-Jul-94

The initial screening of these CPCs was performed against chronic ambient water quality criteria (AWQCs) developed by the U.S. EPA (U.S. EPA, 1991). The ratio of compound concentration to the chronic AWQC was calculated for compounds detected in the main and back channels. When the EEQ is less than or equal to 1.0, the comparison value concentration observed in the surface water is less than the chronic AWQC for that compound, and the compound was not evaluated further. Compounds with an EEQ greater than 1.0 were retained for further evaluation. EEQs were rounded off to the nearest tenth (i.e., 0.1) to simplify interpretation.

In addition, a background surface water sample was collected in both the main channel and the back channel. Concentrations of potential site-related compounds in surface water were compared to the concentrations of compounds detected in an upstream background sample. If the resulting ratio was less than or equal to 1.0, the compound was not selected as a screening level CPC. If the ratio was greater than 1.0, the compound was retained for further evaluation.

3.1.1 Main Channel Surface Water

As shown in Table 3-1, the EEQ was greater than 1.0 for aluminum, chromium (VI), copper, and mercury in the main channel surface water samples. Because concentrations of these compounds in main channel surface water were greater than chronic AWQCs, these compounds were retained in the risk assessment for further evaluation. Chromium (III), iron, and zinc were present at concentrations below the AWQC and were eliminated from further consideration.

Screening level CPCs were then screened against background concentrations to determine whether the concentrations observed were comparable to levels found in the Ohio River upstream of the ORS. Calcium, magnesium, manganese, potassium, and sodium were present in the main channel surface water at concentrations greater than the background concentrations. These compounds were retained in the risk assessment for further analysis. Barium, iron, zinc, 2,4,5-T, 2,4,5-TP, and 2,4-D were detected at essentially the same concentrations in surface water samples collected in the main channel adjacent to the ORS as in the background surface water sample. These compounds were eliminated from further consideration. All screening level CPCs in the main channel surface water retained in the risk assessment for further evaluation are identified in Table 3-1 with an asterisk.

3.1.2 Back Channel Surface Water

As shown in Table 3-2, the comparison value concentrations of aluminum, chromium (VI), and copper detected in back channel surface water were greater than the chronic AWQC. These compounds were thus retained for further evaluation. Chromium (III), iron, and zinc were present at concentrations below the AWQC and were thus eliminated from further consideration.

Manganese and gamma-chlordane were present in back channel surface water at concentrations greater than background levels. These compounds were thus retained in the risk assessment for further evaluation. Barium, calcium, magnesium, potassium, sodium, di-n-butylphthalate, 2,4,5-T, 2,4,5-TP, and 2,4-D were present in back channel surface water at concentrations similar to background concentrations and were thus eliminated from further consideration in the risk assessment. All screening level CPCs in the back channel surface water retained in the risk assessment for further evaluation are identified in Table 3-2 with an asterisk.

3.2 Screening Level Risk Evaluation of CPCs in Sediments

Sediment samples were evaluated separately in the main and back channels. The screening level evaluation of CPCs in sediment was performed against the guidance concentrations (ER-L values) for sediments developed as part of NOAA's National Status and Trends Program (Long and Morgan, 1990; Long and MacDonald, 1992). The ER-L values represent the lower tenth percentile of the data where effects were observed and provide an estimate of where effects are first likely to be detected.

Two points regarding the source of the ER-Ls need to be considered in using these values. First, these values were derived primarily from marine locations (especially values provided by Long and MacDonald (1992)). Some freshwater data are included and these data suggest that the threshold at which biological effects were first observed is higher in freshwater than the ER-L indicates, depending on the compound. The second point is that these values were derived somewhat arbitrarily to assess data collected as part of the National Status and Trends Program. They are applicable as screening tools; however, they do not carry the regulatory authority of AWQCs.

The ratio of sediment compound concentration to the ER-L is provided for the main channel and the back channel. When the EEQ was less than or equal to 1.0, the sediment comparison value concentration was less than the ER-L, and the compound was not evaluated further. Compounds with an EEQ greater than 1.0 were retained for further analysis.

In addition, a background sediment sample was collected in both the main channel and the back channel. Concentrations of potential site-related compounds in sediment were compared to the concentration detected in an upstream background sample. If the resulting ratio of sediment compound concentration to background sample compound concentration was less than or equal to 1.0, the compound was eliminated as a screening level CPC. If the ratio was greater than 1.0, the compound was retained for further evaluation.

3.2.1 Main Channel Sediments

As shown in Table 3-3, the EEQ was greater than 1.0 for the following compounds: arsenic, chromium, copper, lead, mercury, nickel, zinc, 4,4'-DDD, alpha-chlordane, PCBs, dieldrin, endrin, gamma-chlordane, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and total PAH. These results indicate that concentrations of these compounds in sediments were higher than ER-Ls. Therefore, these compounds were retained in the risk assessment for further evaluation.

Comparison of compound concentrations in main channel sediment to background levels is also provided in Table 3-3. As shown, sediment concentrations for the following compounds exceed background levels: aluminum, barium, calcium, cobalt, cyanide, iron, magnesium, manganese, potassium, selenium, vanadium, 2,4,5-T, 2,4,5-TP, 2,4-D, endrin aldehyde, and endrin ketone. Because these concentrations exceeded background concentrations, they were retained in the risk assessment for further analysis. Benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzofuran, and indeno(1,2,3-cd)pyrene were detected at concentrations below background levels and were thus eliminated from further consideration. All screening level CPCs in the main channel sediment retained in the risk assessment for further evaluation are identified in Table 3-3 with an asterisk.

3.2.2 Back Channel Sediments

As shown in Table 3-4, the EEQ was greater than 1.0 for the following compounds: arsenic, chromium, copper, lead, mercury, nickel, zinc, 4,4'-DDD, alpha-chlordane, PCBs, dieldrin, endrin, gamma-chlordane, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and total PAH. These results indicate that concentrations of these compounds in sediments were higher than ER-Ls. Therefore, these compounds were retained in the risk assessment for further evaluation.

Based on comparison to the background values, aluminum, barium, beryllium, calcium, cobalt, cyanide, iron, magnesium, manganese, potassium, selenium, vanadium, 2,4,5-T, 2,4,5-TP, 2,4-D, endrin ketone, lindane, bis(2-ethylhexyl)phthalate, carbazole, di-n-octylphthalate, and dibenzofuran were retained for further evaluation. The following compounds were eliminated based on background ratios: 2-butanone, acetone, and carbon disulfide. All CPCs in the back channel sediment retained in the risk assessment for further evaluation are identified in Table 3-4 with an asterisk.

Table 3.3 Screening Level Evaluation
Sediment Screening, Main Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	ER-L (1) (ug/kg)	BKGD Value (2) (ug/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (* = include in next screen)
Aluminum	2.21E+07	95th UCL		1.23E+07		1.79	•
Arsenic	1.94E+04	95th UCL	8.20E+03	1.80E+04	2.36	1.08	•
Barium	3.01E+05	95th UCL		1.89E+05		1.59	•
Beryllium	3.32E+03	95th UCL		R			
Calcium	6.95E+07	95th UCL		3.45E+07		2.01	•
Total Chromium	9.60E+04	95th UCL	8.10E+04	2.50E+04	1.19	3.84	•
Cobalt	3.91E+04	95th UCL		2.40E+04		1.63	•
Copper	1.48E+05	95th UCL	3.40E+04	4.40E+04	4.35	3.36	•
Cyanide	2.23E+04	95th UCL		5.30E+03		4.22	•
Iron	1.06E+08	95th UCL		6.13E+07		1.72	•
Lead	2.00E+05	95th UCL	4.67E+04	5.70E+04	4.27	3.50	•
Magnesium	5.24E+06	95th UCL		4.71E+06		1.11	•
Manganese	3.82E+06	95th UCL		2.25E+06		1.70	•
Mercury	6.54E+02	95th UCL	1.50E+02	[60]	4.36	10.91	•
Nickel	8.78E+04	95th UCL	2.09E+04	4.40E+04	4.20	2.00	•
Potassium	2.06E+06	95th UCL		7.98E+05		2.58	•
Selenium	1.56E+03	95th UCL		[250]		6.22	•
Sodium	7.19E+05	Maximum		R			
Vanadium	2.80E+04	Maximum		1.40E+04		2.00	•
Zinc	3.44E+06	95th UCL	1.50E+05	2.48E+05	22.94	13.89	•
2,4,5-T	2.10E+02	95th UCL		1.10E+01		19.09	•
2,4,5-TP	2.10E+01	95th UCL		1.20E+00		17.50	•
2,4-D	2.10E+02	95th UCL		1.25E+01		16.83	•
4,4'-DDD	5.89E+00	95th UCL	2.00E+00	[1.65]	2.95	3.57	•
Alpha-chlordane	9.44E+00	95th UCL	5.00E-01	8.50E-01	18.88	11.11	•
Aroclor-1242	5.88E+01	95th UCL		[16.5]		3.56	•
Aroclor-1248	5.84E+01	95th UCL		1.40E+01		4.17	•
Aroclor-1254	2.91E+02	95th UCL		2.60E+01		11.20	•
Aroclor-1260	7.10E+01	95th UCL		[16.5]		4.30	•
Total PCBs	3.08E+02	95th UCL	2.27E+01	4.00E+01	13.59	7.71	•
Dieldrin	5.89E+00	95th UCL	2.00E-02	[1.65]	294.50	3.57	•
Endrin	5.89E+00	95th UCL	2.00E-02	[1.65]	294.50	3.57	•
Endrin Aldehyde	5.89E+00	95th UCL		1.65E+00		3.57	•
Endrin Ketone	5.69E+00	95th UCL		[1.65]		3.45	•
Gamma-BHC (Lindane)	ND			[0.85]			
Gamma-chlordane	9.06E+00	95th UCL	5.00E-01	[0.85]	18.12	10.66	•
2-Butanone	ND			[6]			
Acetone	ND			[6]			
Carbon Disulfide	ND			[6]			
2-Methylnaphthalene	1.49E+03	95th UCL	7.00E+01	[2100]	21.24	0.71	•
Acenaphthene	1.23E+03	95th UCL	1.60E+01	[2100]	77.09	0.59	•
Anthracene	7.36E+02	95th UCL	8.53E+01	2.10E+03	8.62	0.35	•
Benzo(a)anthracene	2.82E+03	95th UCL	2.61E+02	6.40E+03	10.82	0.44	•
Benzo(a)pyrene	2.35E+03	95th UCL	4.30E+02	5.50E+03	5.48	0.43	•
Benzo(b)fluoranthene	2.70E+03	95th UCL		6.50E+03		0.42	
Benzo(g,h,i)perylene	1.39E+03	95th UCL		2.30E+03		0.61	
Benzo(k)fluoranthene	8.53E+02	95th UCL		3.00E+03		0.28	
Bis(2-ethylhexyl)phthalate	ND			[2100]			
Carbazole	ND			[2100]			
Chrysene	1.49E+03	95th UCL	3.84E+02	5.70E+03	3.89	0.26	•
Di-n-butylphthalate	ND			[2100]			
Di-n-octylphthalate	ND			[2100]			
Dibenz(a,h)anthracene	1.22E+03	95th UCL	6.34E+01	[2100]	19.24	0.58	•
Dibenzofuran	1.51E+03	95th UCL		[2100]		0.72	
Fluoranthene	4.20E+03	Maximum	6.00E+02	1.20E+04	7.00	0.35	•
Fluorene	1.20E+03	Maximum	1.90E+01	6.00E+02	63.17	2.00	•
Indeno(1,2,3-cd)pyrene	1.49E+03	95th UCL		2.30E+03		0.65	
Naphthalene	1.27E+03	95th UCL	1.60E+02	[2100]	7.94	0.61	•
Phenanthrene	2.94E+03	95th UCL	2.40E+02	5.80E+03	12.24	0.51	•
Pyrene	3.66E+03	95th UCL	6.65E+02	9.20E+03	5.51	0.40	•
Total PAH	2.63E+04	95th UCL	4.02E+03	6.14E+04	6.55	0.43	•

Notes:
(1) ER-L values are from Long and MacDonald (1992) except for 4,4'DDD, chlordanes, dieldrin, and endrin which are from Long and Morgan (1990).
(2) Values in brackets represent one half the SQL where no detects were reported.
R" indicates that the data are unusable based on quality control measures.

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Table 3.4 Screening Level Evaluation
Sediment Screening, Back Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	ER-L (1) (ug/kg)	BKGD Value (2) (ug/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (•=included in next screen)
Aluminum	1.55E+07	95th UCL		1.08E+07		1.44	•
Arsenic	1.52E+04	95th UCL	8.20E+03	7.60E+03	1.85	2.00	•
Barium	1.74E+05	95th UCL		1.56E+05		1.11	•
Beryllium	2.00E+03	Maximum		1.10E+03		1.82	•
Calcium	1.36E+07	Maximum		4.13E+06		3.29	•
Total Chromium	1.03E+05	Maximum	8.10E+04	1.70E+04	1.27	6.06	•
Cobalt	5.07E+04	95th UCL		1.70E+04		2.98	•
Copper	1.57E+05	95th UCL	3.40E+04	3.30E+04	4.62	4.76	•
Cyanide	9.16E+03	95th UCL		[360]		25.44	•
Iron	1.81E+08	Maximum		3.73E+07		4.85	•
Lead	1.21E+05	Maximum	4.67E+04	4.00E+04	2.59	3.03	•
Magnesium	2.70E+06	Maximum		2.09E+06		1.29	•
Manganese	2.38E+06	95th UCL		7.60E+05		3.13	•
Mercury	2.90E+02	Maximum	1.50E+02	[70]	1.93	4.14	•
Nickel	8.30E+04	Maximum	2.09E+04	2.70E+04	3.97	3.07	•
Potassium	1.52E+06	95th UCL		1.16E+06		1.31	•
Selenium	3.64E+03	95th UCL		[290]		12.56	•
Sodium	ND			R			
Vanadium	2.30E+04	Maximum		1.90E+04		1.21	•
Zinc	4.02E+05	95th UCL	1.50E+05	1.01E+05	2.68	3.98	•
2,4,5-T	2.88E+02	95th UCL		1.45E+01		19.86	•
2,4,5-TP	2.50E+01	Maximum	9.59E+03	1.45E+01		1.72	•
2,4-D	2.00E+02	Maximum		1.45E+01		1.38	•
4,4'-DDD	2.45E+00	Maximum	2.00E+00	[2.3]	1.23	1.07	•
Alpha-chlordane	1.77E+00	95th UCL	5.00E-01	3.20E-01	3.54	5.53	•
Aroclor-1242	3.92E+01	95th UCL		[23]		1.70	•
Aroclor-1248	ND			[23]			
Aroclor-1254	ND			[23]			
Aroclor-1260	6.92E+01	95th UCL		4.10E+01		1.69	•
Total PCBs	1.02E+02	Maximum	2.27E+01	4.10E+01	4.47	2.48	•
Dieldrin	2.70E+00	Maximum	2.00E-02	2.80E+00	135.00	0.96	•
Endrin	3.25E+00	Maximum	2.00E-02	[2.3]	162.50	1.41	•
Endrin Aldehyde	ND			[2.3]			
Endrin Ketone	3.30E+00	Maximum		[2.3]		1.43	•
Gamma-BHC (Lindane)	1.70E+00	Maximum		[1.2]		1.42	•
Gamma-chlordane	3.20E+00	95th UCL	5.00E-01	1.30E+00	6.40	2.46	•
2-Butanone	8.05E+02	95th UCL		[900]		0.89	
Acetone	8.52E+02	95th UCL		[900]		0.95	
Carbon Disulfide	7.98E+02	95th UCL		[900]		0.89	
2-Methylnaphthalene	5.08E+03	95th UCL	7.00E+01	[240]	72.51	21.15	•
Acenaphthene	4.75E+03	95th UCL	1.60E+01	[240]	296.99	19.80	•
Anthracene	5.29E+03	95th UCL	8.53E+01	[240]	62.02	22.04	•
Benzo(a)anthracene	1.05E+04	95th UCL	2.61E+03	2.50E+02	4.04	42.19	•
Benzo(a)pyrene	6.47E+03	95th UCL	4.30E+03	1.70E+02	1.51	38.06	•
Benzo(b)fluoranthene	9.68E+03	95th UCL		2.40E+02		40.32	•
Benzo(g,h,i)perylene	4.33E+03	95th UCL		1.20E+02		36.07	•
Benzo(k)fluoranthene	5.50E+03	Maximum		6.90E+01		79.71	•
Bis(2-ethylhexyl)phthalate	4.26E+04	95th UCL		1.10E+02		387.17	•
Carbazole	4.77E+03	95th UCL		[240]		19.88	•
Chrysene	7.64E+03	95th UCL	3.84E+02	1.30E+02	19.91	58.80	•
Di-n-butylphthalate	ND			8.80E+01			
Di-n-octylphthalate	2.60E+03	Maximum		[240]		10.83	•
Dibenz(a,h)anthracene	5.06E+03	95th UCL	6.34E+01	[240]	79.89	21.10	•
Dibenzofuran	4.90E+03	95th UCL		[240]		20.41	•
Fluoranthene	1.91E+04	95th UCL	6.00E+02	2.70E+02	31.79	70.63	•
Fluorene	5.08E+03	95th UCL	1.90E+01	[240]	267.25	21.16	•
Indeno(1,2,3-cd)pyrene	4.78E+03	95th UCL		1.00E+02		47.79	•
Naphthalene	4.86E+03	95th UCL	1.60E+02	[240]	30.38	20.25	•
Phenanthrene	1.37E+04	95th UCL	2.40E+02	1.70E+02	57.25	80.62	•
Pyrene	1.58E+04	95th UCL	6.65E+02	2.60E+02	23.72	60.67	•
Total PAH	1.04E+05	95th UCL	4.02E+03	1.78E+03	25.95	58.65	•

Notes:
(1) ER-L values are from Long and MacDonald (1992) except for 4,4'DDD, chlordanes, dieldrin, and endrin which are from Long and Morgan (1990).
(2) Values in brackets represent one half the SQL where no detects were reported.
"R" indicates that the data are unusable based on quality control measures.

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3.3 Screening Level Risk Evaluation of CPCs in Surface Soil

Compounds in surface soils at the ORS are presented in Table 3-5. No surface soil screening criteria analogous to the AWQCs for surface water or the ER-Ls for sediments are currently available. U.S. EPA Region 3 provided a suggested set of soil criteria for selected compounds, mostly inorganic. Use of these soil criteria by ENSR for this evaluation does not constitute an agreement as to the correctness of such an application. As in the case of the surface water and sediment screening, the ratio of the compound concentration detected on-site to the estimated criteria value is the EEQ. If the EEQ was greater than 1.0, the compound was retained for further evaluation.

As shown in Table 3-5, the EEQ was greater than 1.0 for the following compounds: arsenic, copper, lead, manganese, mercury, and zinc. Therefore, these compounds were retained in the risk assessment for further evaluation. The EEQ for barium, chromium, cobalt, nickel, and aldrin were below 1.0. These compounds were thus eliminated from further consideration in the risk assessment.

The screening level evaluation for CPCs in surface soils was also performed against background concentrations. Data from one background sampling location were obtained and used in this initial screening effort. Based on the background comparison concentrations, all compounds were retained for further evaluation in the risk assessment, with the exception of the following compounds: sodium, 1,1,1-trichloroethane, 1,1-dichloroethene, 4-methyl-2-pentanone, carbon disulfide, chloro-benzene, ethylbenzene, and tetrachloroethene. These compounds were not considered further in the ecological risk assessment. Due to a lack of a background reference sample, 2,3,7,8-TCDD was included for further evaluation. All screening level CPCs in surface soil retained in the risk assessment for further evaluation are identified in Table 3-5 with an asterisk.

3.4 Screening Level Risk Evaluation of CPCs in Groundwater

The list of compounds detected in groundwater is presented in Table 3-6. As a conservative measure, this primary evaluation assumes that aquatic organisms will have direct contact with groundwater. The initial screening of these CPCs was performed against chronic AWQCs developed by the U.S. EPA. When the maximum or 95% UCL concentration detected in the groundwater was less than the chronic AWQC for that compound, the compound was excluded from this assessment. A comparison to background concentrations was also performed for the compounds that do not have chronic AWQC information available.

Table 3.5 Screening Level Evaluation
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (* = include in next screen)
Aluminum	15133.241	95th UCL		13100		1.16	*
Arsenic	12.596	95th UCL	10	8.3	1.26	1.52	*
Barium	213.270	95th UCL	300	130	0.71	1.64	
Beryllium	1.696	95th UCL		[0.125]		13.57	*
Calcium	46739.316	95th UCL		2160		21.64	*
Chromium (total)	25.137	95th UCL	30	16	0.84	1.57	
Cobalt	13.176	95th UCL	25	15	0.53	0.88	
Copper	76.208	95th UCL	70	20	1.09	3.81	*
Cyanide	20.949	95th UCL		[0.315]		66.50	*
Iron	37672.221	95th UCL		30900		1.22	*
Lead	84.202	95th UCL	50	36	1.68	2.34	*
Magnesium	3798.345	95th UCL		1920		1.98	*
Manganese	1918.640	95th UCL	600	1080	3.20	1.78	*
Mercury	0.942	95th UCL	0.03	[0.065]	31.41	14.50	*
Nickel	26.912	95th UCL	80	21	0.34	1.28	
Potassium	1476.382	95th UCL		1260		1.17	*
Selenium	0.661	95th UCL		[0.255]		2.59	*
Silver	0.770	95th UCL		[0.65]		1.18	*
Sodium	356.447	95th UCL					
Thallium	0.828	95th UCL		[0.5]		1.66	*
Vanadium	42.904	95th UCL		21		2.04	*
Zinc	217.379	95th UCL	54	83	4.03	2.62	*
2,4,6-Trichlorophenol	0.570	95th UCL		[0.210]		2.71	*
2,4-Dichlorophenol	1.035	95th UCL		[0.210]		4.93	*
Naphthalene	28.125	95th UCL		[0.210]		133.93	*
Phenol	0.704	95th UCL		[0.210]		3.35	*
2,4,5-T	0.336	95th UCL		0.0125		26.88	*
2,4,5-TP	0.352	95th UCL		0.0125		28.18	*
2,4-D	1.177	95th UCL		0.125		9.42	*
4,4'-DDD	0.022	95th UCL		[0.00205]		10.83	*
4,4'-DDE	0.007	95th UCL		[0.00205]		3.41	*
4,4'DDT	0.062	95th UCL		[0.00205]		30.05	*
Alpha-BHC	0.092	95th UCL		[0.00105]		87.24	*
Aldrin	0.038	95th UCL	0.3	[0.00105]	0.13	36.10	
Alpha-chlordane	0.048	95th UCL		[0.00105]		45.43	*
Arochlor-1242	0.066	95th UCL		[0.0205]		3.22	*
Arochlor-1254	0.075	95th UCL		[0.0205]		3.64	*
Arochlor-1260	0.145	95th UCL		0.027		5.39	*
Total PCB's	0.266	95th UCL		0.027		9.85	*
Beta-BHC	0.153	95th UCL		[0.00105]		145.43	*
Delta-BHC	0.038	95th UCL		[0.00105]		36.48	*
2,3,7,8-TCDD	1.52E-07	95th UCL					
Dieldrin	0.030	95th UCL		[0.00205]		14.54	*
Endosulfan I	0.005	95th UCL		[0.00105]		4.38	*
Endosulfan II	0.011	95th UCL		[0.00205]		5.46	*
Endosulfan Sulfate	0.011	95th UCL		[0.00205]		5.17	*
Endrin	0.007	95th UCL		[0.00205]		3.27	*
Endrin Aldehyde	0.003	95th UCL		[0.00205]		1.56	*
Endrin Ketone	0.013	95th UCL		[0.00205]		6.15	*
Gamma-BHC (Lindane)	0.269	95th UCL		[0.00105]		256.00	*
Gamma-chlordane	0.089	95th UCL		0.00036		246.39	*
Heptachlor	0.027	95th UCL		[0.00105]		25.33	*
Heptachlor Epoxide	0.008	95th UCL		[0.00105]		7.90	*
Methoxychlor	0.076	95th UCL		[0.0105]		7.26	*

(continued)

Table 3.5 Screening Level Evaluation
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (* = include in next screen)
Toxaphene	0.293	95th UCL		[0.105]		2.79	*
1,1,1-Trichloroethane	0.006	95th UCL		[0.0065]		0.98	
1,1-Dichloroethene	0.005	Maximum		[0.0065]		0.77	
1,2-Dichloroethene (T)	0.007	95th UCL		0.004		1.63	*
4-Methyl-2-Pentanone	0.007	95th UCL		[0.0065]		1.00	
Acetone	0.007	95th UCL		[0.0065]		1.08	*
Benzene	0.008	95th UCL		[0.0065]		1.26	*
Carbon Disulfide	0.004	Maximum		[0.0065]		0.62	
Chlorobenzene	0.004	Maximum		[0.0065]		0.62	
Chloroform	0.007	95th UCL		[0.0065]		1.05	*
Ethylbenzene	0.007	95th UCL		[0.0065]		1.02	
Methylene Chloride	0.008	95th UCL		[0.0065]		1.18	*
Tetrachloroethene	0.006	95th UCL		[0.0065]		0.92	
Toluene	0.009	95th UCL		0.004		2.28	*
Trichloroethene	0.009	95th UCL		[0.0065]		1.45	*
2-Methylnaphthalene	2.419	95th UCL		[0.210]		11.52	*
Acenaphthene	1.384	95th UCL		[0.210]		6.59	*
Acenaphthylene	0.410	95th UCL		[0.210]		1.95	*
Anthracene	3.281	95th UCL		[0.210]		15.62	*
Benzo(a)anthracene	7.363	95th UCL		0.17		43.31	*
Benzo(a)pyrene	5.912	95th UCL		0.066		89.57	*
Benzo(b)fluoranthene	9.637	95th UCL		0.15		64.25	*
Benzo(g,h,i)perylene	4.060	95th UCL		0.076		53.41	*
Benzo(k)fluoranthene	3.434	95th UCL		[0.210]		16.35	*
Bis(2-ethylhexyl)phthalate	8.007	95th UCL		[0.210]		38.13	*
Carbazole	1.158	95th UCL		[0.210]		5.51	*
Chrysene	6.384	95th UCL		0.075		85.12	*
Di-n-butylphthalate	0.180	95th UCL		0.063		2.86	*
Di-n-octylphthalate	ND			[0.210]		0.00	
Dibenz(a,h)anthracene	1.250	95th UCL		[0.210]		5.95	*
Diethylphthalate	0.681	95th UCL		[0.210]		3.24	*
Dibenzofuran	1.998	95th UCL		[0.210]		9.51	*
Fluoranthene	15.317	95th UCL		0.2		76.59	*
Fluorene	1.460	95th UCL		[0.210]		6.95	*
Hexachlorobutadiene	1.661	95th UCL		[0.210]		7.91	*
Indeno(1,2,3-cd)pyrene	4.399	95th UCL		0.06		73.32	*
Phenanthrene	12.494	95th UCL		0.08		156.18	*
Pyrene	11.143	95th UCL		0.17		65.55	*
Total PAH	101.027	95th UCL		1.047		96.49	*

NOTES:
(1) Soil criteria suggested by U.S. EPA Region III staff.
(2) Values in brackets represent one half the SQL where no detects were reported.

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Table 3.8 Screening Level Evaluation
Groundwater Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	Mean BKGD Value (3) (ug/L)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (*=include in next screen)
Aluminum	36921.1	95th UCL	87	96900	424.380	0.38	*
Antimony (1)	21.6	95th UCL	30	28.65	0.720	0.75	
Arsenic (4)	9.21	95th UCL	190	7.55	0.048	1.22	
Barium	822.7	95th UCL		1278.5		0.64	
Beryllium (1)	3.41	95th UCL	5.3	6.5	0.643	0.52	
Cadmium (2)	11.3	95th UCL	0.8	[1.5] (a)	14.125	7.53	*
Calcium	264022.3	95th UCL		56900		4.64	*
Total Chromium (as III) (2)	52	95th UCL	145	165.5	0.359	0.31	
Total Chromium (as VI)	52	95th UCL	11	165.5	4.727	0.31	*
Cobalt	81.8	95th UCL		97.3		0.84	
Copper (2)	132	95th UCL	8	169	16.500	0.78	*
Cyanide	33.2	95th UCL	5.2	[2.5] (a)	6.385	13.28	*
Iron	128641.4	95th UCL	1000	218500	128.641	0.59	*
Lead (2)	41.3	95th UCL	1.8	56.9	22.944	0.73	*
Magnesium	63811	95th UCL		33000		1.93	*
Manganese	35588	95th UCL		8350		4.26	*
Mercury	0.24	95th UCL	0.012	0.65	20.000	0.37	*
Nickel (2)	138	95th UCL	110	200.5	1.238	0.68	*
Potassium	7304.9	95th UCL		12735		0.57	
Selenium	3.5	95th UCL	5		0.700		
Silver (2)	5.7	95th UCL	1.9		3.000		*
Sodium	126598.6	95th UCL		21900		5.78	*
Thallium (1)	1.9	95th UCL	40		0.048		
Vanadium	58	95th UCL		168.2		0.34	
Zinc (2)	7623.4	95th UCL	74	519	103.019	14.69	*
2,4,6-Trichlorophenol (1)	13127.4	95th UCL	970	[5.0]	13.533	2625.48	*
2,4-Dichlorophenol (1)	2616.5	95th UCL	365	[5.0]	7.168	523.30	*
2,4-Dimethylphenol	1775.8	95th UCL		[5.0]		355.16	*
2-Chlorophenol (1) (3)	656.8	95th UCL	2000	[5.0]	0.328	131.36	
2-Methylphenol	4748.4	95th UCL		[5.0]		949.68	*
2-Nitrophenol (1)	1562.4	95th UCL	150	[5.0]	10.416	312.48	*
4-Methylphenol	6350.1	95th UCL		[5.0]		1270.02	*
Bis(2-ethylhexyl)phthalate (1)	1562.4	95th UCL	360	[5.0]	4.340	312.48	*
Di-n-butylphthalate	1562.4	95th UCL		67		23.32	*
Di-n-octylphthalate	1562.2	95th UCL		[5.0]		312.44	*
Naphthalene (1)	1562.3	95th UCL	620	[5.0]	2.520	312.46	*
Phenol (1)	6158.5	95th UCL	2560	[5.0]	2.406	1231.70	*
2,4,5-T	0.12	95th UCL		[0.05]		2.40	*
2,4,5-TP	0.21	95th UCL		[0.05]		4.20	*
2,4-D	8.44	95th UCL		[0.05] (a)		168.80	*
4,4'-DDE (1)	0.18	95th UCL		[0.05]		3.60	*
Alpha-BHC (1)	0.09	95th UCL		[0.025]		3.60	*
Dieldrin	0.18	95th UCL	0.0019	[0.05]	94.737	3.60	*
Endosulfan II	0.18	95th UCL	0.056	[0.05]	3.214	3.60	*
Endrin Aldehyde (3)	0.18	95th UCL	0.0023	[0.05]	78.261	3.60	*
1,1,1-Trichloroethane	217.2	95th UCL		[5.0] (a)		43.44	*
1,1,2-Trichloroethane (1)	217.8	95th UCL		[5.0] (a)		43.56	*
1,2-Dichloroethane (1)	215.9	95th UCL	20000	[5.0] (a)	0.011	43.18	
1,2-Dichloroethene (T) (1)	217.8	95th UCL		[5.0] (a)		43.56	*
2-Butanone	223.4	95th UCL		[5.0] (a)		44.68	*
Acetone	230.5	95th UCL		[5.0] (a)		46.10	*

(continued)

Table 3.6 Screening Level Evaluation
Groundwater Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	Mean BKGD Value (3) (ug/L)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Results of Screen (*=include in next screen)
Benzene (1)	2172	95th UCL		[5.0] (a)		434.40	*
Bromoform	1820.9	95th UCL		[5.0] (a)		364.18	*
Carbon Disulfide	223.3	95th UCL		[5.0] (a)		44.66	*
Chlorobenzene (3)	217.8	95th UCL	50	[5.0] (a)	4.356	43.56	*
Chloroethane	218.1	95th UCL		[5.0] (a)		43.62	*
Methylene Chloride	217.7	95th UCL		[5.0] (a)		43.54	*
Tetrachloroethene (1)	217.7	95th UCL	840	[5.0] (a)	0.259	43.54	
Toluene (1)	217.6	95th UCL		[5.0] (a)		43.52	*
Trichloroethene (1)	217.9	95th UCL	21900	[5.0] (a)	0.0099	43.58	

NOTES:
(1) Insufficient data to develop criteria. Value presented is the LOAEL.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.
(3) Values in brackets represent one-half the SQL where no detects were reported.
(4) Criterion for Arsenic (III).
(a) Background concentration represents the minimum value.

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As shown in Table 3-6, the EEQ was greater than 1.0 for the following compounds: aluminum, cadmium, chromium VI, copper, cyanide, iron, lead, mercury, nickel, silver, zinc, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-nitrophenol, bis(2-ethylhexyl)phthalate, naphthalene, phenol, dieldrin, endosulfan II, endrin aldehyde, and chlorobenzene. Therefore, these compounds were retained for further evaluation. Antimony, arsenic, beryllium, chromium III, selenium, thallium, 2-chlorophenol, 1,2-dichloroethane, tetrachloroethene, and trichloroethene were present at concentrations below the chronic AWQC. These compounds were thus eliminated from further consideration.

The following compounds exceeded the comparison to background screen: calcium, magnesium, manganese, sodium, 2,4-dimethylphenol, 2-methylphenol, 4-methylphenol, di-n-butylphthalate, di-n-octylphthalate, 2,4,5-T, 2,4,5-TP, 2,4-D, 4,4'-DDE, alpha-BHC, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-trichloroethene, 2-butanone, acetone, benzene, bromoform, carbon disulfide, chloroethane, methylene chloride, and toluene. Therefore, these compounds are retained in the risk assessment for further analysis. Barium, cobalt, potassium, and vanadium were present at concentrations below background levels and were thus eliminated from further consideration.

3.5 Consideration of CPCs Identified in the Screening Level Risk Evaluation

The screening level risk evaluation provides a long list of CPCs. The selection of these compounds is prompted by exceedance of conservative environmental criteria or, for compounds lacking criteria, by exceedance of background concentrations. A general discussion of the potential adverse effects associated with the classes of screening level CPCs under consideration is provided below.

3.5.1 Heavy Metals

Heavy metals are widespread in occurrence; however, they usually are found only in trace amounts in non-industrialized areas. Heavy metals include those with a defined nutritional role (e.g., copper, zinc) and those with no biological requirement (e.g., cadmium, mercury). Adverse developmental effects have been observed in both aquatic and terrestrial organisms.

Heavy metals were detected in surface waters, sediments, unsaturated soils, and in the groundwater at the ORS (ENSR, 1994). The heavy metals identified as potential concern in the various media at the ORS are arsenic, barium, beryllium, chromium, copper, cyanide, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

Most heavy metals affect the reproductive success of fish and are bioconcentrated to varying degrees. The toxicity of some metals in water varies with the ambient hardness. Some of the heavy metals such as barium and lead behave in a manner similar to calcium. Accumulation has also been observed in the gills and scales of fish. The metals lead and barium have been observed to replace calcium in metabolic pathways. Thus, heavy metals have been observed to accumulate in the bones and organs of both fish and terrestrial animals. Adverse neurological effects due to metals such as lead and mercury have also been observed in terrestrial animals. Heavy metals also have been observed to adversely impact the development and growth of both aquatic and terrestrial plants.

3.5.2 Earth Metals

Earth metals constitute large proportions of solid media such as soils and sediments. They occur naturally in high concentrations due to their representation in mineral and geologic formations. Insufficient information is available on the toxicity of the earth metals to make any observations on their adverse effects. However, due to naturally occurring high levels, they are generally regarded as non-toxic.

Earth metals were detected in all media at the ORS (ENSR, 1994). Earth metals which were identified as screening level CPCs included aluminum, calcium, magnesium, potassium, sodium, cobalt, and iron.

3.5.3 Herbicides/Pesticides

Herbicides are complex organic compounds that can affect the central nervous system. Generally, they appear to be of low toxicity. They are mobile in the environment and readily migrate in soils and water.

Pesticides are complex organic compounds that are generally designed to act on the central nervous system, respiratory system, and/or circulatory system. Pesticides are generally lipophilic compounds and bioconcentration may be possible.

Herbicides and pesticides identified as screening level CPCs by the screening level risk evaluation included chlordane, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, DDT and DDT byproducts, dieldrin, endrin and endrin byproducts, endosulfan I, endosulfan II, endosulfan sulfate, heptachlor, heptachlor epoxide, and methoxychlor.

3.5.4 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are highly lipophilic compounds that are relatively immobile in the environment. Due to their lipophilic nature, they tend to bioconcentrate in fish and animal tissues. Acute toxicity tests have demonstrated that PCB exposure may lead to weight loss, ataxia and diarrhea in rats. Subacute oral toxicity tests have shown PCBs induce enlargement of the liver, atrophy of the spleen and hepatic porphyria. Mink involved in subacute oral toxicity testing have shown an unusually high sensitivity to PCBs. Rats used in chronic oral toxicity testing have shown an increase in liver weight and adverse reproductive effects. PCBs have also been demonstrated to accumulate in body fat. Severe skin lesions have also been observed in dermal toxicity studies using rabbits. In fish, the effects of PCBs have been found to be cumulative and toxicity decreases with level of chlorination. The growth and development of young fish is adversely affected by PCBs.

Total PCBs and mixtures of PCB congeners (e.g., Aroclor 1242, 1248, 1254, 1260) were identified as potential (candidate) compounds of concern.

3.5.5 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbons (PAHs) are a diverse group of organic compounds that are widespread in urban environments. High molecular weight PAHs (i.e., molecular weight greater than 300) are a group of compounds that bind strongly to soils and sediment. Low molecular weight PAHs may be mobile in the environment. PAHs are metabolized rapidly in the body and therefore do not tend to bioconcentrate. Under laboratory conditions, adverse biological effects associated with PAH exposure include decreased survival, growth, and metabolism, and tumor formation.

At the ORS, a large number of PAHs were identified as potential (candidate) compounds of concern. They included: 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene, acenaphthylene, hexachlorobutadiene, phenanthrene, pyrene.

3.5.6 Chlorinated Compounds

Pathological changes in the liver have been observed in rats exposed, via the inhalation route, to chlorinated compounds. Avian embryos exposed to chlorinated compounds have demonstrated embryotoxicity, growth defects and morphological anomalies. No evidence of tetragenicity has been demonstrated in mammals.

The chlorinated compounds trichloroethene, 1,2-dichloroethene, 1,1,2-trichloroethane, 1,1,1-trichloroethane, and chloroethane were identified as potential (candidate) compounds of concern.

3.5.7 Semi-Volatile and Volatile Organic Compounds (SVOCs/VOCs)

Semi-volatile and volatile organic compounds (SVOCs and VOCs) are compounds which are widely used in industrial processes. SVOCs and VOCs cause a reduction in hatching and fry and tadpole survival, in fish and tadpoles, respectively. Also, in plants, a reduction in the number of seeds germinating has been observed. At very high levels, SVOCs and VOCs have been observed in birds to produce abnormalities in body weight and egg production.

At the ORS, the SVOCs and VOCs which were identified as potential (candidate) compounds of concern are: bis(2-ethylhexyl)phthalate, carbazole, di-n-butylphthalate, di-n-octylphthalate, dibenzofuran, toxaphene, acetone, benzene, chloroform, methylene chloride, toluene, diethylphthalate, 2-butanone, bromoform, carbon disulfide, chlorobenzene, and toluene.

3.5.8 Phenols

Members of the phenol family of compounds appear to be widespread environmental contaminants. Aquatic organisms are most vulnerable to phenols in the reproductive and juvenile stages. In terrestrial organisms adverse effects on growth rates, liver and renal function, immune function and fetal development have been observed.

The following compounds of the phenol family were identified as potential (candidate) compounds of concern: phenol, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2-nitrophenol, and 4-methylphenol.

3.6 Summary of Screening Level Risk Assessment

A preliminary risk assessment was made based on the results of the screening level risk evaluation (Tables 3-1 through 3-6). Risk assessments were made for surface waters (Section 3.6.1), sediments (Section 3.6.2), soil (Section 3.6.3), and groundwater (Section 3.6.4). Environmental risk was established by calculation of an EEQ, based on comparison of compound concentrations to nationally-recognized criteria such as the AWQCs or ER-L sediment guidance values. These criteria were supplemented with a few soil criteria suggested by U.S. EPA Region 3. CPCs were also selected due to compound concentrations greater than background levels, but no ecological risk estimate was possible from this comparison.

To interpret the significance of these EEQ values, it is useful to classify the values into those associated with low and high potential environmental risks. Guidance from U.S. EPA (U.S. EPA, 1988) indicates the hazard quotient values less than 10 are considered indicative of possible environmental risk, while quotients greater than 10 are considered indicative of probable environmental risk. This is consistent with U.S. EPA Region 3 environmental risk assessment guidance (U.S. EPA Region 3, undated).

Due to the stringent nature of the screening level risk evaluation (i.e., conservative criteria site application and inclusion of all compounds above background value), most media had a large number of CPCs. Quantitative risk assessment of these CPCs, including earth elements and many compounds for which no ecotoxicological criteria were available, would be unlikely to effectively characterize the potential ecological risk. At this stage, it is helpful to identify CPCs of probable and possible concern, however, to start focusing on those compounds which are more likely to contribute to potential ecological risks as may be present. Therefore, no further risk assessment was made beyond this identification.

3.6.1 Surface Water

A preliminary risk assessment was made for surface water based on the results of the screening level risk evaluation (Tables 3-1, 3-2). Section 3.6.1.1 considers potential risks identified in the surface water of the main channel of the Ohio River, and Section 3.6.1.2 assesses potential risks identified in the back channel.

3.6.1.1 Main Channel Surface Water

The results of the screening level evaluation of the surface water in the main channel indicated that mercury was of probable concern; aluminum, chromium (VI), and copper were of possible concern; and calcium, magnesium, manganese, potassium, and sodium were unassessed. No further risk assessment was made.

3.6.1.2 Back Channel Surface Water

The results of the screening level evaluation of the surface water in the back channel indicated no CPCs of probable concern; aluminum, chromium (VI), and copper were of possible concern. No further risk assessment was made.

3.6.2 Sediments

A preliminary risk assessment was made for sediments based on the results of the screening level risk evaluation (Tables 3-3, 3-4). Section 3.6.2.1 describes potential risks identified in the sediments of the main channel of the Ohio River, and Section 3.6.2.2 assesses potential risks identified in the sediments of the back channel.

3.6.2.1 Main Channel Sediments

The results of the screening level risk evaluation indicated that 12 CPCs were of probable concern, 14 CPCs were of possible concern, and 21 CPCs were unassessed (i.e., neither AWQC nor ER-L values were available). The CPCs of probable concern included zinc, alpha-chlordane, total PCBs, dieldrin, endrin, gamma-chlordane, 2-methylnaphthalene, acenaphthene, benzo(a)anthracene, dibenz(a,h)anthracene, fluorene, and phenanthrene. The CPCs of possible concern included arsenic, total chromium, copper, lead, mercury, nickel, 4.4'-DDD, anthracene, benzo(a)pyrene, chrysene, fluoranthene, naphthalene, pyrene, and total PAHs. No further risk assessment was made.

3.6.2.2 Back Channel Sediments

The results of the screening level risk evaluation indicated that 13 CPCs were of probable concern, 13 CPCs were of possible concern, and 28 CPCs were unassessed (i.e., no available criteria). The CPCs of probable concern included dieldrin, endrin, 2-methylnaphthalene, acenaphthene, anthracene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and total PAHs. The CPCs of possible concern included arsenic, total chromium, copper, lead, mercury, nickel, zinc, 4,4-DDD, alpha-chlordane, total PCBs, gamma-chlordane, benzo(a)anthracene, and benzo(a)pyrene. No further risk assessment was made.

3.6.3 Surface Soil

A preliminary risk assessment was made for the surface soil based on the results of the screening level risk evaluation (Table 3-5). The results indicate that mercury was of probable concern; arsenic, copper, lead, manganese, and zinc were of possible concern; and there were 72 CPCs for which applicable soil criteria were not available. No further risk assessment was made.

3.6.4 Groundwater

A preliminary risk assessment was made for groundwater based on the results of the screening level risk evaluation (Table 3-6). The results indicate that 11 CPCs were of probable concern, 10 CPCs were of possible concern, and there were 24 CPCs for which no AWQC were available for comparison. The CPCs of probable concern included aluminum, cadmium, copper, iron, lead, mercury, zinc, 2,4-trichlorophenol, 2-nitrophenol, dieldrin, and endrin aldehyde. The CPCs of possible concern included chromium (VI), cyanide, nickel, silver, 2,4-dichlorophenol, bis(2-ethylhexyl)phthalate, naphthalene, phenol, and endosulfan II. No further risk assessment was made.

4.0 SECONDARY LEVEL RISK EVALUATION

In this section of the risk assessment, all CPCs which were identified in the screening level risk evaluation (Section 3.0) are further evaluated. This evaluation further considers the nature and concentrations of the screening level CPCs as a means to evaluate the reasonableness of their inclusion as COCs. Secondary level COCs which are identified in this evaluation are further considered in the Site-Specific Risk Evaluation (Section 5.0). An outline of the activities undertaken at this evaluation stage are shown in Figure 4-1.

As part of the secondary level risk evaluation, common, ubiquitous constituents were removed from further consideration as secondary level COCs in all media (i.e., water, sediments, soil, groundwater). In addition, lesser earth constituents were compared to the average background soil concentrations for eastern United States (ATSDR, 1992). If average values for the site were comparable to average values for the eastern U.S., those elements were removed from further evaluation. This comparison was reserved for elements for which no appropriate criteria (e.g., AWQC, ER-L) were available. This application assumes that when the site average value is comparable to the national average the probability of ecological risk is low. This approach allows evaluation of elements which have been identified as screening level CPCs solely on their enrichment relative to background levels. It should be noted that a high background ratio (i.e., site value/background value) is not, in itself, an index of potential ecotoxicological risk.

As part of the secondary level evaluation, the arithmetic mean of the screening level CPCs was compared to available environmental benchmarks. The arithmetic mean was selected as a comparative value for the secondary level evaluation based on the assumption that biota integrate the effects of site concentrations through movements with and between habitats associated with feeding, shelter, mating activities, migration, etc. The environmental benchmarks and the applicable medium included the federal AWQC for surface and groundwater, the Effects Range-Medium values (ER-M) for sediments, and the suggested U.S. EPA Region 3 soil criteria.

All compounds that exceeded the appropriate environmental benchmarks were retained in the risk assessment for further evaluation. Compounds that were below the environmental benchmark were evaluated further as to the quantitative level of the EEQ. Compounds that did not have an appropriate environmental benchmark were compared to background concentrations. Compounds that were present at concentrations greater than background levels were retained in the risk assessment for further evaluation.

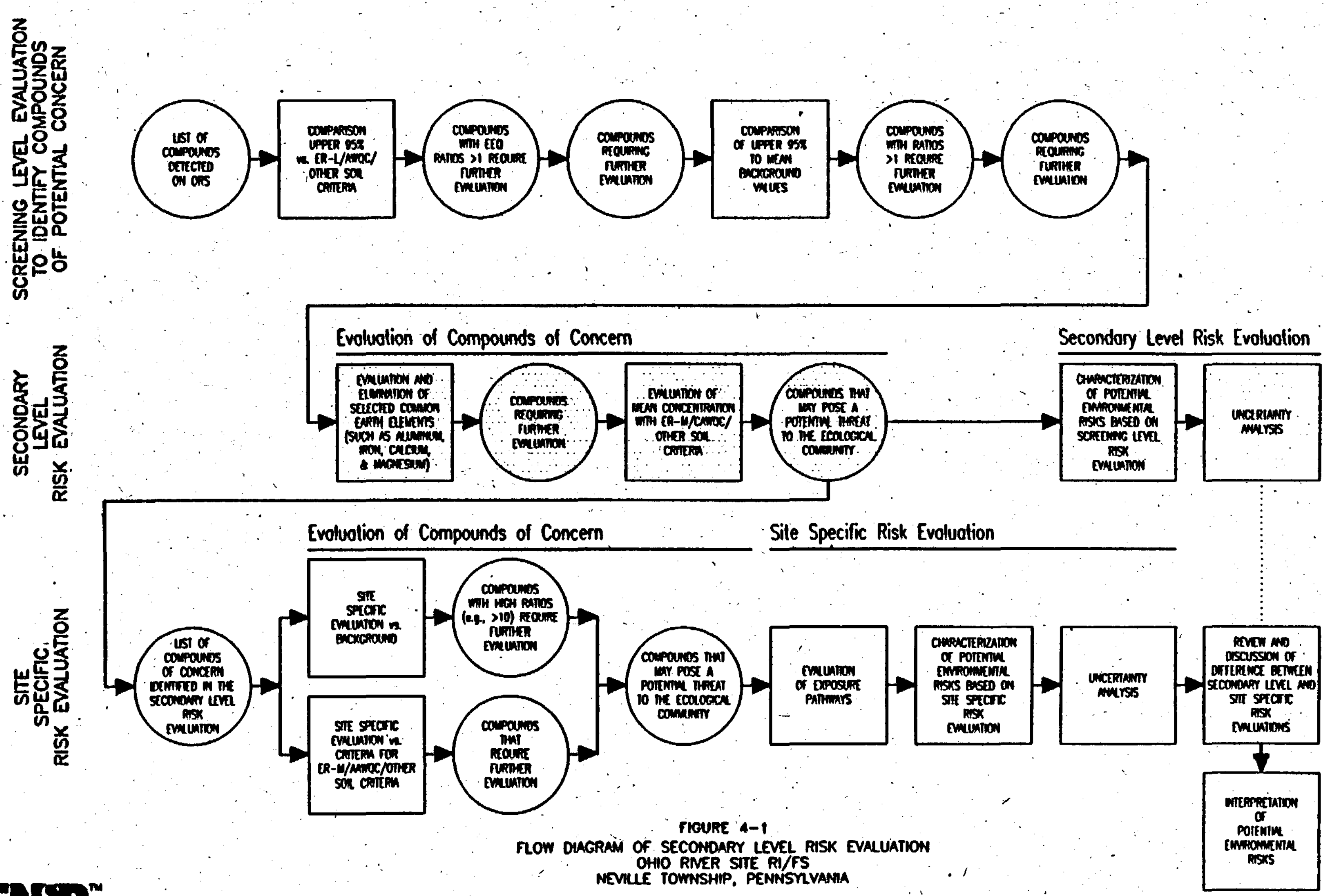

FIGURE 4-1
FLOW DIAGRAM OF SECONDARY LEVEL RISK EVALUATION
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

From the results of the secondary level risk assessment, a preliminary qualitative estimate of potential ecological concerns was made. This assessment includes consideration of potential exposure pathway, risk characterization, and uncertainty analysis. The results of this assessment will identify areas of potential ecological risk with approximation of the level of potential concern. The results of this assessment will be compared to the results of the site-specific risk assessment. This comparison and accompanying discussion are in Section 6.0.

The following sections discuss the selection of secondary level COCs for each of the media evaluated. Section 4.1 presents the selection of secondary level COCs for surface water, and Section 4.2 presents the selection of secondary level COCs in sediments. Section 4.3 identifies the secondary level COCs in surface soils, and Section 4.4 identifies the secondary level COCs in groundwater at the ORS. A preliminary qualitative risk assessment is performed in Section 4.5. The limitations and uncertainties encountered with this assessment are discussed in Section 4.6, and a summary of the results are presented in Section 4.7. Compounds identified during the secondary level evaluation as COCs were evaluated further in the site-specific risk evaluation (Section 5.0).

4.1 Secondary Level Risk Evaluation of COCs in Surface Water

To evaluate secondary level COCs in both the main and back channel surface water, the arithmetic mean of the screening level CPCs identified by the screening level risk evaluation were compared to relevant criteria. The list of COCs in the main and back channel surface water that were evaluated are presented in Tables 4-1 and 4-2, respectively.

The mean values were compared with the chronic AWQCs developed by the U.S. EPA. As in the screening level risk evaluation, when the environmental effects quotient is less than or equal to 1.0, the mean concentration observed in the surface water is less than or equal to the chronic AWQC for that compound, and the compound is not evaluated further, while compounds with an EEQ greater than 1.0 (rounded values) are retained for further analysis.

In addition, the ratio of the background channel surface water to surface water was considered. If the resulting ratio was less than or equal to 1.0, the compound was not selected as a COC. If the ratio was greater than 1.0, the compound was retained for further evaluation.

4.1.1 Main Channel Surface Water

As shown in Table 4-1, the EEQ was greater than 1.0 for copper and mercury in the main channel surface water samples. These compounds were retained for further analysis in the risk assessment. Chromium (IV) was present at concentrations below the AQWC and was eliminated

Table 4-1 Secondary Level Risk Evaluation
Surface Water Screening, Main Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	BKGD Value (ug/L) (1)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further evaluation? (Yes/No)
Aluminum	206.2	Arith.Mean	87	270	2.37	0.76	No (3)
Calcium	23040	Arith.Mean		20900		1.10	No (4)
Total Chromium (VI)	7.4	Arith.Mean	11	[4]	0.67	1.85	No
Copper (2)	32.8	Arith.Mean	8	[3]	4.10	10.93	Yes
Magnesium	5918	Arith.Mean		5310		1.11	No (3)
Manganese	201.6	Arith.Mean		221		0.91	No
Mercury	0.35	Arith.Mean	0.012	[0.1]	29.17	3.50	Yes
Potassium	1604	Arith.Mean		1490		1.08	No (3)
Sodium	12242	Arith.Mean		10000		1.22	No (3)

NOTES:
(1) Values in brackets represent one half the standard quantitation limit where no detects were reported.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.
(3) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.
(4) Eliminated from screening process based on biological significance as a nutrient.

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Table 4-2 Secondary Level Risk Evaluation
Surface Water Screening, Back Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	BKGD Value (ug/L) (1)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further evaluation? (Yes/No)
Aluminum	225.75	Arith. Mean	87	199	2.59	1.13	No (3)
Total Chromium (as VI)	7.75	Arith. Mean	11	[4]	0.70	1.94	No
Copper (2)	5.50	Arith. Mean	8	[3]	0.69	1.83	No
Manganese	188.75	Arith. Mean		194		0.96	No

NOTES:
(1) Values in brackets represent one half the standard quantitation limit where no detects were reported.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.
(3) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.

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from further consideration. Aluminum, calcium, magnesium, potassium, and sodium are common earth elements and were eliminated on that basis. Manganese was present in the main channel surface water at concentrations less than the background concentration and thus eliminated from further consideration.

Thus, following application of the secondary level evaluation, copper and mercury were retained in the risk assessment for further analysis.

4.1.2 Back Channel Surface Water

As shown in Table 4-2, there were no EEQ values greater than 1.0 in back channel surface water samples, except for aluminum. Accordingly, chromium (VI) and copper were removed from further analysis. Aluminum was eliminated as a common earth element. Manganese was present in the back channel surface water at concentrations less than the background concentration and was eliminated from further evaluation.

Thus, following application of the screening level evaluation, no COCs were identified in the back channel surface water.

4.2 Secondary Level Risk Evaluation of COCs in Sediments

Sediment samples were evaluated separately in the main and back channels. The common earth elements were removed as part of the evaluation. The secondary level evaluation also compared mean values of secondary COCs in the sediment against the NOAA ER-M guidance values (Long and MacDonald, 1992; Long and Morgan, 1990). The ER-M values represent the median of sediment concentrations where biological effects were detected and provide an estimate of concentrations where biological effects are likely to be observed (Long and Morgan, 1990).

The ratio of mean channel sediment concentrations to the ER-M is shown as the EEQ in Tables 4-3 and 4-4, respectively, for the main and back channels. If the EEQ was less than or equal to 1.0, the secondary COC was considered further. In cases where the conservative ER-L value is exceeded but the ER-M value is not, the potential for ecological risk is difficult to quantitatively assess (Long and Morgan, 1990). No guidance is provided to assess the potential incremental risk associated with values which exceed the conservative ER-L value, but which are fractions of the ER-M value. Typically, the relative location of the concentration of the COC between the ER-L and ER-M value is considered when assessing a COC's potential for ecological effects.

Professional judgement was used to select a value between the ER-L and ER-M value which, if exceeded, indicated a more likely COC. For this evaluation, a value of 1/4 the ER-M

Table 4-3
Secondary Level Risk Evaluation
Sediment Screening, Main Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	ER-M (1) (ug/kg)	BKGD Value (2) (ug/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)	
Aluminum	1.91E+07	Arith.Mean		1.23E+07		1.55	No	(3)
Arsenic	1.49E+04	Arith.Mean	7.00E+04	1.80E+04	0.21	0.83	No	(5)
Barium	2.19E+05	Arith.Mean		1.89E+05		1.16	Yes	
Beryllium	2.98E+03	Arith.Mean		R			No	(3)
Calcium	3.06E+07	Arith.Mean		3.45E+07		0.89	No	(4)
Total Chromium	6.68E+04	Arith.Mean	3.70E+05	2.50E+04	0.18	2.67	No	(5)
Cobalt	2.86E+04	Arith.Mean		2.40E+04		1.19	Yes	
Copper	1.02E+05	Arith.Mean	2.70E+05	4.40E+04	0.38	2.31	Yes	
Cyanide	1.25E+04	Arith.Mean		5.30E+03		2.35	Yes	
Iron	8.83E+07	Arith.Mean		6.13E+07		1.44	No	(3)
Lead	1.67E+05	Arith.Mean	2.23E+05	5.70E+04	0.75	2.92	Yes	
Magnesium	3.49E+06	Arith.Mean		4.71E+06		0.74	No	(3)
Manganese	2.35E+06	Arith.Mean		2.25E+06		1.04	No	(3)
Mercury	4.40E+02	Arith.Mean	7.10E+02	[60]	0.62	7.33	Yes	
Nickel	6.14E+04	Arith.Mean	5.16E+04	4.40E+04	1.19	1.40	Yes	
Potassium	1.80E+06	Arith.Mean		7.98E+05		2.26	No	(3)
Selenium	9.00E+02	Arith.Mean		[250]		3.60	Yes	
Sodium	5.40E+05	Arith.Mean		R			No	(3)
Vanadium	2.33E+04	Arith.Mean		1.40E+04		1.66	Yes	
Zinc	1.45E+06	Arith.Mean	4.10E+05	2.46E+05	3.54	5.90	Yes	
2,4,5-T	8.40E+01	Arith.Mean		1.10E+01		7.64	Yes	
2,4,5-TP	1.72E+01	Arith.Mean		1.20E+00		14.33	Yes	
2,4-D	1.72E+02	Arith.Mean		1.25E+01		13.76	Yes	
4,4'-DDD	3.36E+00	Arith.Mean	2.00E+01	[1.65]	0.17	2.04	No	(5)
Alpha-chlordane	4.52E+00	Arith.Mean	6.00E+00	8.50E-01	0.75	5.32	Yes	
Aroclor-1242	3.34E+01	Arith.Mean		[16.5]		2.02	Yes	
Aroclor-1248	3.08E+01	Arith.Mean		1.40E+01		2.20	Yes	
Aroclor-1254	1.33E+02	Arith.Mean		2.60E+01		5.12	Yes	
Aroclor-1260	4.23E+01	Arith.Mean		[16.5]		2.56	Yes	
Total PCBs	1.66E+02	Arith.Mean	1.80E+02	4.00E+01	0.92	4.15	Yes	
Dieldrin	3.36E+00	Arith.Mean	8.00E+00	[1.65]	0.42	2.04	Yes	
Endrin	3.36E+00	Arith.Mean	4.50E+01	[1.65]	0.07	2.04	No	(5)
Endrin Aldehyde	3.36E+00	Arith.Mean		1.65E+00		2.04	Yes	
Endrin Ketone	2.87E+00	Arith.Mean		[1.65]		1.74	Yes	
Gamma-chlordane	4.17E+00	Arith.Mean	6.00E+00	[0.85]	0.70	4.91	Yes	
2-Methylnaphthalene	8.54E+02	Arith.Mean	6.70E+02	[2100]	1.27	0.41	Yes	
Acenaphthene	7.75E+02	Arith.Mean	5.00E+02	[2100]	1.55	0.37	Yes	
Anthracene	5.18E+02	Arith.Mean	1.10E+03	2.10E+03	0.47	0.25	Yes	
Benzo(a)anthracene	1.70E+03	Arith.Mean	1.60E+03	6.40E+03	1.06	0.27	Yes	
Benzo(a)pyrene	1.39E+03	Arith.Mean	1.60E+03	5.50E+03	0.87	0.25	Yes	
Chrysene	1.02E+03	Arith.Mean	2.80E+03	5.70E+03	0.37	0.18	Yes	
Dibenz(a,h)anthracene	7.51E+02	Arith.Mean	2.60E+02	[2100]	2.89	0.36	Yes	
Fluoranthene	2.87E+03	Arith.Mean	5.10E+03	1.20E+04	0.56	0.24	Yes	
Fluorene	7.61E+02	Arith.Mean	5.40E+02	6.00E+02	1.41	1.27	Yes	
Naphthalene	7.15E+02	Arith.Mean	2.10E+03	[2100]	0.34	0.34	Yes	
Phenanthrene	1.78E+03	Arith.Mean	1.50E+03	5.80E+03	1.19	0.31	Yes	
Pyrene	2.43E+03	Arith.Mean	2.60E+03	9.20E+03	0.93	0.26	Yes	
Total PAH	1.76E+04	Arith.Mean	4.48E+04	6.14E+04	0.39	0.29	Yes	

Notes:

(1) ER-M values are from Long and MacDonald (1992) except for 4,4'DDD, chlordanes, dieldrin, and endrin which are from Long and Morgan (1990). The ER-M value for chlordane was used for alpha- and gamma-chlordane.

(2) Values in brackets represent one half the standard quantitation limit where no detects were reported. "R" indicates that the data are unusable based on quality control measures.

(3) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.

(4) Eliminated from screening process based on biological significance as a nutrient.

(5) Eliminated from screening process based on EEQ <0.25.

(6) Eliminated from screening process based on BDGD ratio <1.0.

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Table 4-4
Secondary Level Risk Evaluation
Sediment Screening, Back Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	ER-M (1) (ug/kg)	BKGD Value (2) (ug/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)
Aluminum	1.16E+07	Arith. Mean		1.08E+07		1.07	No (3)
Arsenic	1.20E+04	Arith. Mean	7.00E+04	7.60E+03	0.17	1.58	No (5)
Barium	1.41E+05	Arith. Mean		1.56E+05		0.90	No (6)
Beryllium	1.08E+03	Arith. Mean		1.10E+03		0.98	No (6)
Calcium	8.87E+06	Arith. Mean		4.13E+06		2.15	No (4)
Total Chromium	6.70E+04	Arith. Mean	3.70E+05	1.70E+04	0.18	3.94	No (5)
Cobalt	3.38E+04	Arith. Mean		1.70E+04		1.99	Yes
Copper	1.02E+05	Arith. Mean	2.70E+05	3.30E+04	0.38	3.08	Yes
Cyanide	4.78E+03	Arith. Mean		[360]		13.26	Yes
Iron	1.18E+08	Arith. Mean		3.73E+07		3.18	No (3)
Lead	9.55E+04	Arith. Mean	2.23E+05	4.00E+04	0.43	2.39	Yes
Magnesium	1.95E+06	Arith. Mean		2.09E+06		0.93	No (3)
Manganese	1.93E+06	Arith. Mean		7.60E+05		2.54	Yes
Mercury	2.10E+02	Arith. Mean	7.10E+02	[70]	0.30	3.00	Yes
Nickel	7.33E+04	Arith. Mean	5.16E+04	2.70E+04	1.42	2.71	Yes
Potassium	1.07E+06	Arith. Mean		1.16E+06		0.93	No (3)
Selenium	1.46E+03	Arith. Mean		[290]		5.04	Yes
Sodium	ND			R			No (3)
Vanadium	2.30E+04	Arith. Mean		1.90E+04		1.21	Yes
Zinc	3.60E+05	Arith. Mean	4.10E+05	1.01E+05	0.88	3.56	Yes
2,4,5-T	9.66E+01	Arith. Mean		1.45E+01		6.66	Yes
2,4,5-TP	1.58E+01	Arith. Mean		1.45E+01		1.09	Yes
2,4-D	1.33E+02	Arith. Mean		1.45E+02		0.91	No (6)
4,4'-DDD	1.89E+00	Arith. Mean	2.00E+01	[2.3]	0.09	0.82	No (5)
Alpha-chlordane	1.15E+00	Arith. Mean	6.00E+00	3.20E-01	0.19	3.59	No (5)
Aroclor-1242	3.18E+01	Arith. Mean		[23]		1.38	Yes
Aroclor-1260	4.56E+01	Arith. Mean		4.10E+01		1.11	Yes
Total PCBs	7.74E+01	Arith. Mean	1.80E+02	4.10E+01	0.43	1.89	Yes
Dieldrin	2.21E+00	Arith. Mean	8.00E+00	2.80E+00	0.28	0.79	Yes
Endrin	2.54E+00	Arith. Mean	4.50E+01	[2.3]	0.06	1.10	No (5)
Endrin Ketone	2.63E+00	Arith. Mean		[2.3]		1.14	Yes
Gamma-BHC (Lindane)	1.31E+00	Arith. Mean		[1.2]		1.09	Yes
Gamma-chlordane	2.01E+00	Arith. Mean	6.00E+00	1.30E+00	0.34	1.55	Yes
2-Methylnaphthalene	2.19E+03	Arith. Mean	6.70E+02	[240]	3.27	9.13	Yes
Acenaphthene	1.84E+03	Arith. Mean	5.00E+02	[240]	3.68	7.67	Yes
Anthracene	2.53E+03	Arith. Mean	1.10E+03	[240]	2.30	10.54	Yes
Benzo(a)anthracene	5.03E+03	Arith. Mean	1.60E+03	2.50E+02	3.14	20.10	Yes
Benzo(a)pyrene	3.15E+03	Arith. Mean	1.60E+03	1.70E+02	1.97	18.53	Yes
Benzo(b)fluoranthene	4.63E+03	Arith. Mean		2.40E+02		19.27	Yes
Benzo(g,h,i)perylene	2.11E+03	Arith. Mean		1.20E+02		17.60	Yes
Benzo(k)fluoranthene	3.21E+03	Arith. Mean		6.90E+01		46.45	Yes
Bis(2-ethylhexyl)phthalate	1.48E+04	Arith. Mean		1.10E+02		134.16	Yes
Carbazole	2.04E+03	Arith. Mean		[240]		8.51	Yes
Chrysene	3.50E+03	Arith. Mean	2.80E+03	1.30E+02	1.25	26.92	Yes
Di-n-octylphthalate	1.78E+03	Arith. Mean		[240]		7.40	Yes
Dibenz(a,h)anthracene	2.27E+03	Arith. Mean	2.60E+02	[240]	8.73	9.46	Yes
Dibenzofuran	2.20E+03	Arith. Mean		[240]		9.15	Yes
Fluoranthene	8.23E+03	Arith. Mean	5.10E+03	2.70E+02	1.61	30.46	Yes
Fluorene	2.19E+03	Arith. Mean	5.40E+02	[240]	4.05	9.10	Yes
Indeno(1,2,3-cd)pyrene	2.38E+03	Arith. Mean		1.00E+02		23.75	Yes
Naphthalene	2.12E+03	Arith. Mean	2.10E+03	[240]	1.01	8.82	Yes
Phenanthrene	5.45E+03	Arith. Mean	1.50E+03	1.70E+02	3.63	32.06	Yes
Pyrene	7.20E+03	Arith. Mean	2.60E+03	2.60E+02	2.77	27.69	Yes
Total PAH	4.69E+04	Arith. Mean	4.48E+04	1.78E+03	1.05	26.37	Yes

Notes:

(1) ER-M values are from Long and MacDonald (1992) except for 4,4'DDD, chlordanes, dieldrin, and endrin which are from Long and Morgan (1990). The ER-M value for chlordane was used for alpha- and gamma-chlordane.

(2) Values in brackets represent one half the standard quantitation limit where no detects were reported. "R" indicates that the data are unusable based on quality control measures.

(3) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.

(4) Eliminated from screening process based on biological significance as a nutrient.

(5) Eliminated from screening process based on EEQ <0.25.

(6) Eliminated from screening process based on BDGD ratio <1.0.

concentration was used as the criterion for identifying likely potential risks, such that secondary level COCs with an EEQ less than or equal to 0.25 were removed from further evaluation, while secondary COCs which exceeded this value were retained for further evaluation. This value is an empirical factor which approximates 2 times the ER-L value for most COCs. A value of 2 times the ER-L value has previously been recommended as an appropriate criterion for soils by U.S. EPA Region 3 staff. The application of a similar criterion to sediments (the media from which the ER-L/ER-M guidance values were taken) is consistent with that recommendation and appropriate.

4.2.1 Main Channel Sediments

Elements in the main channel sediments identified as earth constituents and/or comparable to site background levels which were removed from further consideration (see Table 4-3) included aluminum, calcium, iron, magnesium, manganese, potassium, and sodium. Beryllium was removed because it did not have an environmental benchmark, nor could it be evaluated against background because the background sample was rejected in quality assurance (QA) review.

The EEQ was less than 0.25 for arsenic, total chromium, 4,4'-DDD, and endrin. Accordingly, these were removed from further evaluation. Comparison of mean concentrations of organic compounds in main channel sediment to background levels did not lead to the removal of other secondary level COCs.

Thus, the secondary level risk evaluation identified the following COCs: barium, copper, cyanide, lead, mercury, nickel, selenium, vanadium, zinc, 2,4,5-T, 2,4,5-TP, 2,4-D, alpha-chlordane, PCBs, dieldrin, endrin aldehyde, endrin ketone, gamma-chlordane, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and total PAHs. All secondary level COCs in the main channel sediment retained in the risk assessment for further evaluation are identified in Table 4-3.

4.2.2 Back Channel Sediments

Elements in the back channel sediments identified as earth constituents and/or comparable to site background levels which were removed from further consideration (see Table 4-4) included aluminum, barium, beryllium, calcium, iron, magnesium, potassium, and sodium.

The EEQ was less than 0.25 for arsenic, total chromium, 4,4'DDD, and endrin. These compounds were removed from further evaluation. Comparison of mean concentrations of organic compounds in main channel sediment to background levels led to the removal of 2,4-D, Thus the secondary level risk evaluation identified the following COCs for the back channel: cobalt, copper, cyanide, lead, manganese, mercury, nickel, selenium, vanadium, zinc, 2,4,5-T, 2,4,5-TP, alpha-chlordane, PCBs, dieldrin, endrin ketone, gamma-BHC, gamma-chlordane, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, carbazole, chrysene, di-n-octylphthalate, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, and total PAH. All secondary level COCs in the main channel sediment retained in the risk assessment for further evaluation are identified in Table 4-4.

4.3 Secondary Level Risk Evaluation of COCs in Surface Soil

The secondary level risk evaluation of the surface soil from the ORS considered the nature and extent of the screening level CPCs. Common earth elements were removed as part of the evaluation. Mean concentrations of compounds in surface soils at the ORS were compared to the surrogate soil criteria suggested by U.S. EPA Region 3 (Davis, 1994) and listed in Table 4-5. For certain elements for which no criteria were identified by U.S. EPA Region 3 (i.e., beryllium, selenium, thallium, vanadium) the mean soil concentration was compared to the mean and range of soil concentrations found in the eastern United States (USGS data reported in ATSDR, 1992) (see Appendix D).

As shown in Table 4-5, aluminum, iron, magnesium, potassium, and sodium were removed as earth elements or, as in the case of calcium, as a nutrient. In addition, comparison with the mean concentration and range found in the eastern United States indicated that beryllium, selenium, thallium, and vanadium were comparable to these national soil concentrations. Beryllium had a mean site concentration of 1.29 mg/kg, as compared to the national mean of 0.85 mg/kg and a range of less than 1 to 7 mg/kg (ATSDR, 1992). Selenium had a mean site concentration of 0.49 mg/kg, as compared to the national mean of 0.45 mg/kg and a range of less than 0.1 to 3.9 mg/kg (ATSDR, 1992). Thallium had a mean site concentration of 0.72 mg/kg, as compared to the national mean of 8.6 mg/kg and a range of 2.2 to 23 mg/kg (ATSDR, 1992). Vanadium had a mean site concentration of 28.91 mg/kg, as compared to the national mean of 52 mg/kg and a range of less than 5.2 to 900 mg/kg (ATSDR, 1992). Based on these comparisons, these elements were removed from further evaluation.

Application of the mean site concentration against the soil criteria suggested by U.S. EPA Region 3 indicated that only copper had an EEQ that was less than or equal to 1.0. Copper was eliminated from further consideration in the soil risk assessment.

Table 4-5
Secondary Level Risk Assessment
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)	
Aluminum	13795.76	Arith.Mean		13100		1.05	No	(3)
Arsenic	10.71	Arith.Mean	10	8.3	1.07	1.29	Yes	
Beryllium	1.29	Arith.Mean		[0.125]		10.31	No	(6)
Calcium	36205.03	Arith.Mean		2160		16.76	No	(4)
Copper	55.39	Arith.Mean	70	20	0.79	2.77	No	(5)
Cyanide	13.09	Arith.Mean		[0.315]		41.54	Yes	
Iron	34406.06	Arith.Mean		30900		1.11	No	(3)
Lead	67.70	Arith.Mean	50	36	1.35	1.88	Yes	
Magnesium	3267.61	Arith.Mean		1920		1.70	No	(3)
Manganese	1602.64	Arith.Mean	600	1080	2.67	1.48	Yes	
Mercury	0.52	Arith.Mean	0.03	[0.065]	17.38	8.02	Yes	
Potassium	1358.58	Arith.Mean		1260		1.08	No	(3)
Selenium	0.49	Arith.Mean		[0.255]		1.91	No	(6)
Silver	0.68	Arith.Mean		[0.65]		1,05	No	(5)
Sodium	290.79	Arith.Mean					No	(3)
Thallium	0.72	Arith.Mean		[0.5]		1.43	No	(6)
Vanadium	28.91	Arith.Mean		21		1.38	No	(6)
Zinc	166.64	Arith.Mean	54	83	3.09	2.01	Yes	
2,4,6-Trichlorophenol	0.479	Arith.Mean		[0.210]		2.28	Yes	
2,4-Dichlorophenol	0.815	Arith.Mean		[0.210]		3.88	Yes	
Naphthalene	12.230	Arith.Mean		[0.210]		58.24	Yes	
Phenol	0.577	Arith.Mean		[0.210]		2.75	Yes	
2,4,5-T	0.194	Arith.Mean		0.0125		15.50	Yes	
2,4,5-TP	0.146	Arith.Mean		0.0125		11.70	Yes	
2,4-D	0.693	Arith.Mean		0.125		5.54	Yes	
4,4'-DDD	0.0122	Arith.Mean		[0.00205]		5.95	Yes	
4,4'-DDE	0.0057	Arith.Mean		[0.00205]		2.78	Yes	
4,4'DDT	0.0403	Arith.Mean		[0.00205]		19.66	Yes	
Alpha-BHC	0.0509	Arith.Mean		[0.00105]		48.48	Yes	
Alpha-chlordane	0.0252	Arith.Mean		[0.00105]		24.00	Yes	
Arochlor-1242	0.0546	Arith.Mean		[0.0205]		2.66	Yes	
Arochlor-1254	0.0625	Arith.Mean		[0.0205]		3.05	Yes	
Arochlor-1260	0.1085	Arith.Mean		0.027		4.02	Yes	
Total PCB's	0.2200	Arith.Mean		0.027		8.15	Yes	
Beta-BHC	0.0656	Arith.Mean		[0.00105]		62.48	Yes	
Delta-BHC	0.0186	Arith.Mean		[0.00105]		17.71	Yes	
2,3,7,8-TCDD	6.88E-08	Arith.Mean					Yes	
Dieldrin	0.0189	Arith.Mean		[0.00205]		9.22	Yes	
Endosulfan I	0.0036	Arith.Mean		[0.00105]		3.43	Yes	
Endosulfan II	0.0083	Arith.Mean		[0.00205]		4.05	Yes	
Endosulfan Sulfate	0.0080	Arith.Mean		[0.00205]		3.90	Yes	
Endrin	0.0056	Arith.Mean		[0.00205]		2.73	Yes	
Endrin Aldehyde	0.0027	Arith.Mean		[0.00205]		1.32	Yes	
Endrin Ketone	0.0088	Arith.Mean		[0.00205]		4.29	Yes	
Gamma-BHC (Lindane)	0.1464	Arith.Mean		[0.00105]		139.43	Yes	
Gamma-chlordane	0.0440	Arith.Mean		0.00036		122.22	Yes	
Heptachlor	0.0146	Arith.Mean		[0.00105]		13.90	Yes	
Heptachlor Epoxide	0.0058	Arith.Mean		[0.00105]		5.52	Yes	
Methoxychlor	0.0483	Arith.Mean		[0.0105]		4.60	Yes	
Toxaphene	0.2356	Arith.Mean		[0.105]		2.24	Yes	
1,2-Dichloroethene (T)	0.0063	Arith.Mean		0.004		1.58	Yes	
4-Methyl-2-Pentanone	0.0063	Arith.Mean		[0.0065]		0.97	No	(5)

(continued)

Table 4-5
Secondary Level Risk Assessment
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)
Acetone	0.0065	Arith.Mean		[0.0065]		1.00	No (5)
Benzene	0.0072	Arith.Mean		[0.0065]		1.11	Yes
Chloroform	0.0063	Arith.Mean		[0.0065]		0.97	No (5)
Ethylbenzene	0.0060	Arith.Mean		[0.0065]		0.92	No (5)
Methylene Chloride	0.0070	Arith.Mean		[0.0065]		1.08	Yes
Toluene	0.0075	Arith.Mean		0.004		1.88	Yes
Trichloroethene	0.0080	Arith.Mean		[0.0065]		1.23	Yes
2-Methylnaphthalene	1.705	Arith.Mean		[0.210]		8.12	Yes
Acenaphthene	1.083	Arith.Mean		[0.210]		5.16	Yes
Acenaphthylene	0.353	Arith.Mean		[0.210]		1.68	Yes
Anthracene	2.231	Arith.Mean		[0.210]		10.62	Yes
Benzo(a)anthracene	5.256	Arith.Mean		0.17		30.92	Yes
Benzo(a)pyrene	4.270	Arith.Mean		0.066		64.70	Yes
Benzo(b)fluoranthene	6.794	Arith.Mean		0.15		45.29	Yes
Benzo(g,h,i)perylene	2.870	Arith.Mean		0.076		37.76	Yes
Benzo(k)fluoranthene	2.402	Arith.Mean		[0.210]		11.44	Yes
Bis(2-ethylhexyl)phthalate	4.423	Arith.Mean		[0.210]		21.06	Yes
Carbazole	0.916	Arith.Mean		[0.210]		4.36	Yes
Chrysene	4.480	Arith.Mean		0.075		59.73	Yes
Di-n-butylphthalate	0.180	Arith.Mean		0.063		2.86	Yes
Dibenz(a,h)anthracene	1.004	Arith.Mean		[0.210]		4.78	Yes
Diethylphthalate	0.558	Arith.Mean		[0.210]		2.66	Yes
Dibenzofuran	1.432	Arith.Mean		[0.210]		6.82	Yes
Fluoranthene	10.188	Arith.Mean		0.2		50.94	Yes
Fluorene	1.130	Arith.Mean		[0.210]		5.38	Yes
Hexachlorobutadiene	1.320	Arith.Mean		[0.210]		6.28	Yes
Indeno(1,2,3-cd)pyrene	3.132	Arith.Mean		0.06		52.20	Yes
Phenanthrene	7.518	Arith.Mean		0.08		93.98	Yes
Pyrene	7.644	Arith.Mean		0.17		44.97	Yes
Total PAH	72.27	Arith.Mean		1.047		69.03	Yes

NOTES:
(1) Soil criteria suggested by U.S. EPA Region III staff.
(2) Values in brackets represent one half the standard quantitation limit where no detects were reported.
(3) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.
(4) Eliminated from screening process based on biological significance as a nutrient.
(5) Eliminated from screening process based on BKGD ratio <1.0.
(6) Eliminated from screening process based on comparison to average U.S. soil concentrations.

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The secondary level evaluation for COCs in surface soils also considered the mean site concentrations against background concentrations. Based on the background comparison, the following compounds were removed from further evaluation: 4-methyl-2-pentatone, acetone, chloroform, and ethylbenzene. Silver had a background ratio of 1.05 which, when combined with its low frequency of detection (1/33), was sufficiently low to remove it from the list of secondary level COCs. These compounds were not considered further in the ecological risk assessment. All secondary level COCs in surface soil retained in the risk assessment for further evaluation are identified in Table 4-5.

4.4 Secondary Level Risk Evaluation of COCs in Groundwater

The results of the secondary level risk evaluation of the COCs detected in groundwater are presented in Table 4-6. Common earth elements typically found dissolved in groundwater were removed as part of the evaluation. Mean groundwater concentrations of these secondary level COCs were compared to chronic AWQCs developed by the U.S. EPA. A comparison of mean groundwater concentrations to background concentrations was also performed for the compounds which did not have chronic AWQC information available.

As shown in Table 4-6, aluminum, calcium, iron, magnesium, and sodium were removed as earth elements or as a nutrient. The EEQ was greater than 1.0 for all CPCs which had an environmental criterion. Barium, cobalt and nickel were present at concentrations below background levels and were thus eliminated from further consideration.

The secondary level risk evaluation identified the following compounds as COCs: cadmium, chromium VI, copper, cyanide, lead, manganese, mercury, silver, zinc, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2-methylphenol, 2-nitrophenol, bis(2-ethylhexyl)phthalate, 4-methylphenol, di-n-butylphthalate, di-n-octylphthalate, naphthalene, phenol, 2,4,5-T, 2,4,5-TP, 2,4-D, 4,4'-DDE, alpha-BHC, dieldrin, endosulfan II, endrin aldehyde, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethene, 2-butanone, acetone, benzene, bromoform, carbon disulfide, chlorobenzene, chloroethane, methylene chloride, and toluene. Therefore, these compounds are retained in the risk assessment for further analysis. All secondary level COCs which were retained for further evaluation are shown in Table 4-6.

4.5 Characterization of Potential Environmental Risk

The secondary level risk evaluation provides a preliminary, qualitative estimate of potential environmental risk due to the presence of COCs at the ORS. Environmental risk was established by calculation of an EEQ, based on comparison of compound concentrations to nationally-

Table 4-6
Secondary Level Risk Assessment
Groundwater Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	Mean BKGD Value (3) (ug/L)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluated? Yes/No
Aluminum	28251.2	Arith.Mean	87	96900	324.727	0.29	No (5)
Barium	641.4	Arith.Mean		1278.5		0.50	No (4)
Cadmium (2)	6.48	Arith.Mean	1.1	[1.5] (a)	5.891	4.32	Yes
Calcium	228207.2	Arith.Mean		56900		4.01	No (6)
Total Chromium (as VI)	40.5	Arith.Mean	11	165.5	3.682	0.24	Yes
Cobalt	64.1	Arith.Mean		97.3		0.66	No (4)
Copper (2)	85.7	Arith.Mean	12	169	7.142	0.51	Yes
Cyanide	22.8	Arith.Mean	5.2	[2.5] (a)	4.385	9.12	Yes
Iron	102696.7	Arith.Mean	1000	218500	102.697	0.47	No (5)
Lead (2)	27.7	Arith.Mean	3.2	56.8	8.656	0.49	Yes
Magnesium	55419.0	Arith.Mean		33000		1.68	No (5)
Manganese	27791.6	Arith.Mean		8350		3.33	Yes
Mercury	0.19	Arith.Mean	0.012	0.65	15.833	0.29	Yes
Nickel	103.47	Arith.Mean	110	200.5	0.941	0.52	No (4)
Silver (2)	4.57	Arith.Mean	0.12	-	38.083		Yes
Sodium	99235.4	Arith.Mean		21900		4.53	No (5)
Zinc (2)	3088.8	Arith.Mean	110	519	28.080	5.95	Yes
2,4,6-Trichlorophenol (1)	7092.5	Arith.Mean	970	[5.0]	7.312	1418.50	Yes
2,4-Dichlorophenol (1)	1447.2	Arith.Mean	365	[5.0]	3.965	289.44	Yes
2,4-Dimethylphenol	1019.2	Arith.Mean		[5.0]		203.84	Yes
2-Methylphenol	2613.1	Arith.Mean		[5.0]		522.62	Yes
2-Nitrophenol (1)	863.4	Arith.Mean	150	[5.0]	5.756	172.68	Yes
4-Methylphenol	3498.3	Arith.Mean		[5.0]		699.66	Yes
Bis(2-ethylhexyl)phthalate (1	863.5	Arith.Mean	360	[5.0]	2.399	172.70	Yes
Di-n-butylphthalate	863.4	Arith.Mean		67		12.89	Yes
Di-n-octylphthalate	863.3	Arith.Mean		[5.0]		172.66	Yes
Naphthalene (1)	863.4	Arith.Mean	620	[5.0]	1.393	172.68	Yes
Phenol (1)	3329.3	Arith.Mean	2560	[5.0]	1.301	665.86	Yes
2,4,5-T	0.09	Arith.Mean		[0.05]		1.80	Yes
2,4,5-TP	0.15	Arith.Mean		[0.05]		3.00	Yes
2,4-D	3.91	Arith.Mean		[0.05] (a)		78.20	Yes
4,4'-DDE (1)	0.15	Arith.Mean		[0.05]		3.00	Yes
Alpha-BHC (1)	0.07	Arith.Mean		[0.025]		2.80	Yes
Dieldrin	0.15	Arith.Mean	0.0019	[0.05]	78.947	3.00	Yes
Endosulfan II	0.14	Arith.Mean	0.056	[0.05]	2.500	2.80	Yes
Endrin Aldehyde (3)	0.14	Arith.Mean	0.0023	[0.05]	60.870	2.80	Yes
1,1,1-Trichloroethane	126.5	Arith.Mean		[5.0] (a)		25.30	Yes
1,1,2-Trichloroethane (1)	127.1	Arith.Mean		[5.0] (a)		25.42	Yes
1,2-Dichloroethene (T) (1)	127.1	Arith.Mean		[5.0] (a)		25.42	Yes
2-Butanone	130.4	Arith.Mean		[5.0] (a)		26.08	Yes
Acetone	137.7	Arith.Mean		[5.0] (a)		27.54	Yes
Benzene (1)	1074.7	Arith.Mean		[5.0] (a)		214.94	Yes
Bromoform	974.6	Arith.Mean		[5.0] (a)		194.92	Yes
Carbon Disulfide	130.3	Arith.Mean		[5.0] (a)		26.06	Yes
Chlorobenzene (3)	127.1	Arith.Mean	50	[5.0] (a)	2.542	25.42	Yes
Chloroethane	127.4	Arith.Mean		[5.0] (a)		25.48	Yes
Methylene Chloride	127.0	Arith.Mean		[5.0] (a)		25.40	Yes
Toluene (1)	126.9	Arith.Mean		[5.0] (a)		25.38	Yes

NOTES:
(1) Insufficient data to develop criteria. Value presented is the LOAEL.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.
(3) Values in brackets represent one-half the standard quantitation limit where no detects were reported.
(4) Eliminated from screening process based on BKGD ratio <1.0.
(5) Eliminated from screening process based on ubiquity and abundance in the environment as an earth element.
(6) Eliminated from screening process based on biological significance as a nutrient.
(a) Background concentration represents the minimum value.

recognized criteria such as the AWQCs or ER-L/ER-M sediment guidance values. These criteria were supplemented with a few soil criteria suggested by U.S. EPA Region 3.

To interpret the significance of these EEQ values, it is useful to classify the values into those associated with low and high potential environmental risks. Guidance from U.S. EPA (U.S. EPA, 1988) indicates the hazard quotient values less than 10 are considered indicative of possible environmental risk, while quotients greater than 10 are considered indicative of probable environmental risk. This is consistent with U.S. EPA Region 3 environmental risk assessment guidance.

For the purposes of this characterization, EEQs based on conservative criteria (e.g., chronic AWQCs, U.S. EPA Region 3 criteria) for CPCs in surface water, soil, and groundwater were considered indicative of possible environmental risks if they were less than 10 and were considered of probable environmental risk if they are greater than 10. This system had to be adjusted slightly with regard to sediments compared to ER-M. In this case EEQs were considered indicative of possible environmental risks if they were less than or equal to 1.0 and were considered probable environmental risk if they were greater than 1.0. Based on this classification system, potentially problematic compounds were identified in each of the relevant media.

For surface water in the main channel, the EEQ for mercury was indicative of probable risk, while the copper EEQ indicated possible environmental risk (Table 4-1). The high EEQ value for mercury reflects the environmental concern due to the bioaccumulative properties of this compound. Mercury was detected in 2 of 5 samples in the main channel and the mean mercury level is 3.5 times background. Copper was detected in 3 of 5 samples from the main channel and the mean copper level was approximately 11 times background.

No environmental risks were predicted for surface water in the back channel due to no identified secondary level COCs (Table 4-2).

For sediments in the main channel, there were 8 compounds with EEQs indicative of probable risk, while 14 compounds has EEQs which indicated possible environmental risk (Table 4-3). The CPCs with EEQs which indicated probable environmental concern included two metals (nickel, zinc) and six PAHs (2-methylnaphthalene, acenaphthene, benzo(a)anthracene, dibenz(a,h)-anthracene, fluorene, and phenanthrene. The secondary level COCs with EEQs which indicated possible environmental concerns included copper, lead, mercury, alpha-chlordane, gamma-chlordane, total PCBs, dieldrin, anthracene, benzo(a)pyrene, chrysene, fluoranthene, naphthalene, pyrene, and total PAHs. There were 14 compounds which had neither an AWQC nor an ER-M value available to evaluate the potential environmental risk.

For sediments in the back channel, there were 14 compounds with EEQs indicative of probable risk, while 7 compounds has EEQs which indicated possible environmental risk (Table 4-4). The secondary level COCs with EEQs which indicated higher environmental concern included a metal (nickel) and thirteen PAH (2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and total PAHs. The secondary level COCs with EEQs which indicated possible environmental concerns included copper, lead, mercury, zinc, gamma-chlordane, total PCBs, and dieldrin. There were 20 compounds which had neither an AWQC nor an ER-M value available to evaluate the potential environmental risk.

Assessment of the risk potential for secondary level COCs in the site soils indicates that only one COC was identified as being of probable risk (mercury) and four secondary level COCs were identified as being of possible risk (arsenic, lead, manganese, and zinc). This short list is indicative of the general lack of acceptable soil criteria which can be used to estimate ecological risk (Table 4-5). There were 61 compounds for which no ecotoxicological criteria were available to evaluate their potential environmental risk.

Groundwater COCs were identified by comparison of groundwater mean values to chronic AWQCs. Based on this conservative comparison, there were five compounds with EEQs indicative of probable risk, while 12 compounds had EEQs which indicated possible environmental risk (Table 4-6). The secondary level COCs with EEQs which indicated probable environmental concern included mercury, silver, zinc, dieldrin, and endrin aldehyde. The secondary level COCs with EEQs which indicated possible environmental concerns included cadmium, copper, cyanide, lead, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-nitrophenol, bis(2-ethylhexyl)phthalate, naphthalene, phenol, endosulfan II, and chlorobenzene. There were 22 compounds for which no ecological criteria were available to evaluate the potential environmental risk.

4.6 Uncertainty Analysis

The secondary level risk evaluation provides a preliminary estimate of potential environmental risk. It is necessary to consider the limitations and uncertainty which accompany this estimate. These limitations include the site sampling effort, data availability, site characteristics, and other factors. The uncertainty portion includes the applicability of many of the assumptions which underlie ecological risk assessment, the available ecotoxicological database, extrapolation of risk to populations and communities, etc. These limitations and assumptions are discussed below.

A considerable amount of effort was expended in characterizing the ORS and its environment (ENSR, 1994) including descriptions of the habitats of interest and biota. However, some limitations in data collection and sampling effort can be considered. For the purposes of the secondary level risk evaluation, these limitations include:

- the number of water and sediment samples taken in the main channel and back channel was limited;
- the number of background reference samples taken for all media was limited to those agreed to by U.S. EPA Region 3; and
- information on the sediment quality in locations upstream from the ORS are limited to those collected during the RI.

There are a number of assumptions that can lead to uncertainty in an ecological risk assessment. Due to the preliminary nature of the secondary level risk evaluation, many of these assumptions are conservative and protective. Some of the major sources of uncertainty that are associated with the secondary level risk evaluation include:

- the AWQCs used to assess water quality may be underprotective or overprotective of the actual species living in the Ohio River in the vicinity of the ORS. The AWQC also assume continuous exposure to biota which is not realistic for transitory fish species;
- the AWQCs do not take into account the bioavailability of the various compounds (e.g., no water-effects ratio is used) (U.S. EPA, 1994);
- the use of ER-Ls and ER-Ms are inherently conservative as the underlying data distribution is biased toward data from marine sediments and biota, which may be more sensitive than freshwater biota;
- the origin of the secondary level COCs in the surface water and sediments can not be determined reliably due to the common nature of the COCs and the large number of potential sources, both present and historical;
- the lack of available soil criteria prevents effective screening and assessment of potential ecological risk for many soil secondary level COCs;
- background reference samples may not be representative of the local conditions;
- secondary level COC concentrations in groundwater may not be predictive of the potential water quality of the eventual discharge; and

- no site-specific factors are taken into account such that potential mitigating factors (e.g., organic carbon content) are considered.

These limitations and uncertainties must be considered when assessing the confidence associated with statements of potential ecological risk.

4.7 Summary

Based on the results of the secondary level risk evaluation and risk characterization, a qualitative assessment of potential environmental risk was made. This assessment identified secondary level COCs whose EEQs indicated that they could represent possible risk (low level of concern) or probable risk (moderate to high level of concern). The findings of the secondary level risk evaluation are discussed below for each medium.

4.7.1 Surface Water

The surface water evaluation indicates probable concern with mercury and possible concern with copper in the main channel. Mercury is of potential greater concern due to its bioaccumulative properties and possible transfer via the food chain. There were no secondary level COCs identified in the back channel surface water.

4.7.2 Sediments

The results of the secondary level risk evaluation indicate concern (based on the number of exceedances of ER-M values) regarding potential ecological effects due to the presence of heavy metals and PAHs in the sediments in the main channel. The presence of these compounds could potentially affect aquatic organisms, particularly aquatic benthic communities which are less mobile than fish species. To further evaluate the potential environmental risks, comparison of sediments to appropriate site-specific sediment criteria and upstream background values is recommended.

Interestingly, one of the highest concerns in the main channel sediments was associated with dibenz(a,h)anthracene (2.89 times ER-M value). Careful inspection of the sediment data indicates that this high EEQ is somewhat misleading. Dibenz(a,h)anthracene was detected in two samples in the main channel (including one duplicate but not the other) which were, respectively, above and below the ER-M. In this case, the influence of inclusion of non-detects with 1/2 SQL greater than the maximum detect is evident. Similarly, there is a single zinc datum from NSD-2 (located upstream of outfall #1) of 5,170 µg/l. This value is greater by an order of magnitude than the average of the rest of the samples and has considerable influence on the EEQ calculation.

Inspection of the list of secondary level COCs for the main and back channel sediments shows that they share most of the identified COCs. Based on higher EEQs, it appears that the concentrations of PAH in the back channel pose a greater potential environmental risk. Accordingly, the secondary level risk evaluation indicated a moderate to high level of concern regarding potential ecological effects in the sediments of the back channel. As noted above, the presence of these compounds could potentially affect aquatic benthic communities. To further evaluate the potential environmental risks, comparison of sediments to appropriate site-specific sediment criteria and upstream background values is recommended.

4.7.3 Soils

The secondary level risk evaluation initially indicates a low level of concern regarding environmental risks associated with ORS soils. However, this finding is based on assessment of just a few soil components, as the great majority of soil secondary level COCs have no criteria to evaluate their potential ecological effect. Due to a lack of soil criteria it is difficult to characterize the ORS as to its potential for adverse ecological effects without considering the site-specific risk assessment of representative (surrogate) species, which is presented in Appendix F.

4.7.4 Groundwater

The secondary level risk evaluation indicated that groundwater contains a large number of COCs that could potentially be of risk to aquatic communities in the Ohio River. However, this groundwater is not immediately in contact with aquatic communities and reasonable scenarios for groundwater discharge would result in decreased COC concentrations. Therefore, it is judged that the results of the secondary level risk evaluation overestimate potential risk.

To evaluate the potential ecological risk, it is necessary to postulate an exposure pathway scenario which allows migration, discharge, and dilution of the groundwater with the Ohio River and to account for the scenario through modeled concentrations or by use of adjacent wells in the hypothetical path of groundwater discharge. Therefore, a site-specific risk assessment of groundwater by comparison of back channel water quality to appropriate criteria is recommended.

5.0 SITE-SPECIFIC RISK EVALUATION

In this section of the risk assessment, all compounds which were identified in the secondary level risk evaluation (Section 4.0) are further evaluated. This evaluation incorporates site-specific information on the secondary level COCs to select the list of site-specific COCs. Site-specific COCs which are identified in this evaluation are incorporated into a site-specific risk assessment using the semi-quantitative approach (Section 5.6). An outline of the activities undertaken at this evaluation stage are shown in Figure 5-1.

As part of the evaluation, site-specific information was used to further evaluate the COCs which emerged from the secondary level risk evaluation. Site-specific sediment benchmark criteria were developed using the equilibrium partitioning approach (U.S. EPA, 1993a) and channel-specific sediment organic carbon content. Groundwater was evaluated based on a site-specific exposure pathway assuming discharge of groundwater to the back channel.

Finally, best professional judgement was exercised in selecting constituents. Relative enrichment and frequency of detection were used to evaluate compounds. This approach allowed evaluation of candidate COCs for which there were no AWQC or ER-L/ER-M values to use as benchmarks of potential ecological risk. As noted previously, a high background ratio is not a direct indicator of potential ecotoxicological risk.

As a measure of the relative enrichment of a COC, the ratio of the comparison value to the background reference value was reconsidered. All compounds whose concentration did not exceed 10 times the background concentrations were removed from further consideration. The value of 10 times background level was chosen as a reasonable measure for selecting compound concentrations clearly above background levels. It represents a best professional judgement as to how to evaluate compounds which are moderately elevated on-site and which experience suggests will have a negligible effect on cumulative potential risk.

The following sections discuss the selection of site-specific COCs for each of the media evaluated. Section 5.1 presents the selection of the site-specific COCs for surface water, and Section 5.2 presents the selection of the site-specific COCs in sediments. Section 5.3 identifies the site-specific COCs in surface soils and Section 5.4 identifies the site-specific COCs in groundwater at the ORS. Compounds identified during the site-specific risk evaluation as site-specific COCs were evaluated further in the site-specific risk assessment (Section 5.6 and Appendix F). The site-specific risk assessment was used to quantify the potential ecological risk associated with site-specific COCs.

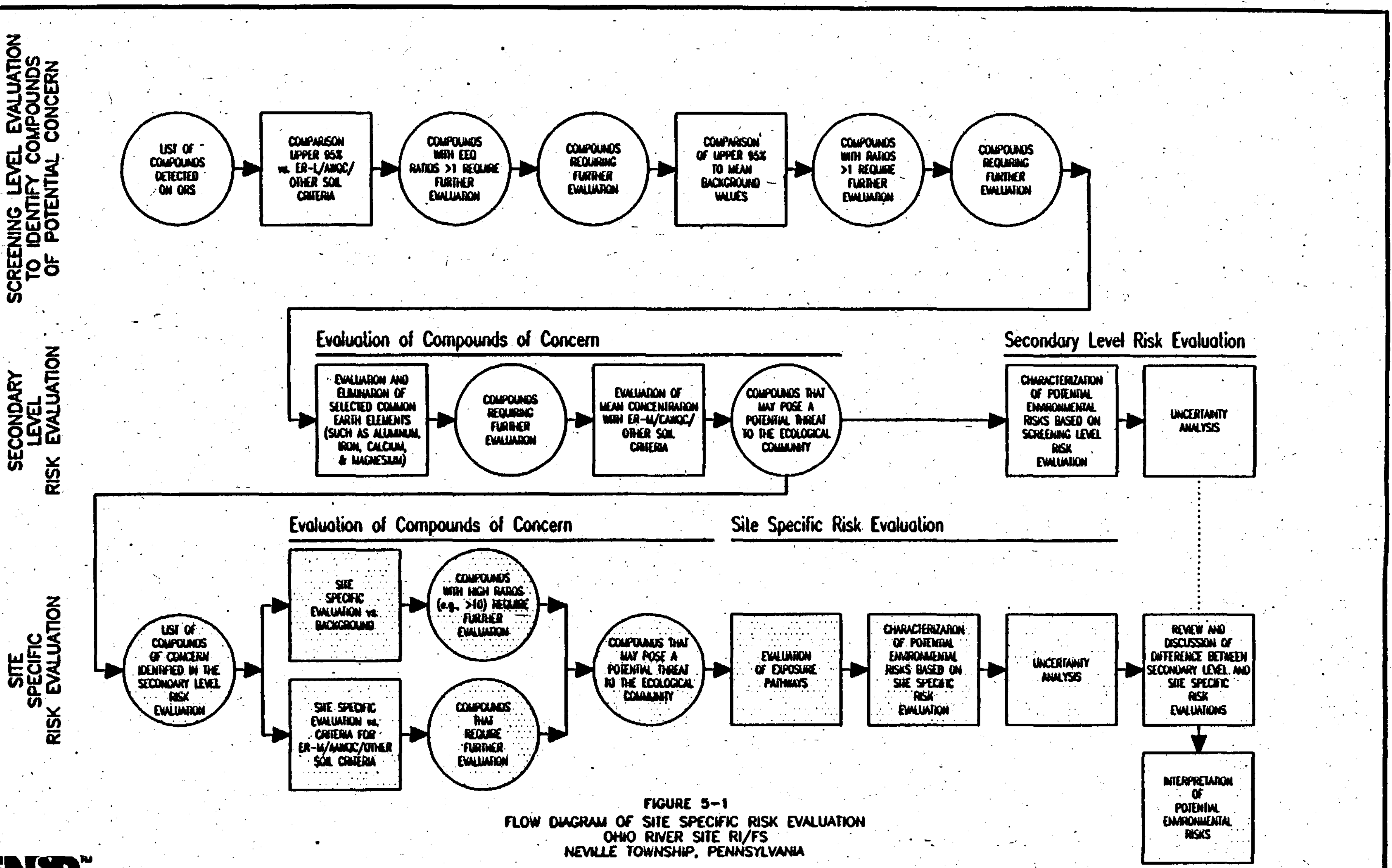

FIGURE 5-1
FLOW DIAGRAM OF SITE SPECIFIC RISK EVALUATION
OHIO RIVER SITE RI/FS
NEVILLE TOWNSHIP, PENNSYLVANIA

ENSR CONSULTING AND ENGINEERING

5.1 Site-specific Risk Evaluation of COCs in Surface Water

No additional site-specific information was available for evaluation of the surface water. The use of site-specific hardness to derive site-specific water quality criteria was previously incorporated into the screening level risk evaluation as most conservative approach (at the request of U.S. EPA Region 3). The COCs identified by the secondary level risk evaluation (Section 4.0) were selected as the site-specific COCs for surface water. Therefore copper and mercury were identified as site-specific COCs for the main channel surface water. No site-specific COCs were identified for the back channel.

5.2 Site-specific Risk Evaluation of COCs in Sediments

Sediment compounds were evaluated separately for the main and back channels, which differ in sediment characteristics. U.S. EPA Draft Sediment Quality Criteria for the Protection of Aquatic Life were used for assessing dieldrin, acenaphthene, fluoranthene and phenanthrene (U.S. EPA, 1993b; 1993c; 1993e; 1993f). For other nonionic organic compounds, sediment benchmark values were calculated using the equilibrium partitioning approach presented in "Technical Basis for Deriving Sediment Quality Criteria for Nonionic Organic Contaminants for the Protection of Benthic Organisms by Using Equilibrium Partitioning" (U.S. EPA, 1993a).

The approved use of derived sediment criteria for nonionic organic compounds in sediments at a Superfund site has been established elsewhere (WDNR, 1990; 1992). For example, sediment quality criteria were developed and approved for the Little Menomonee River/Moss-American Superfund Site (WDNR, 1990) and for the Sheboygon River and Harbor Superfund Site (WDNR, 1992).

Sediment benchmark values were based on the available aquatic toxicity literature, the organic carbon partition coefficient, and the fraction organic carbon. The fraction organic carbon was calculated from data presented in the RI (ENSR, 1994). The average organic carbon content of main channel sediments was 2.0% and that for back channel sediments was 2.5%. The sediment quality criteria and calculated benchmark values are shown in Table 5-1 and 5-2. Due to the differences in organic carbon fractions, the criteria will differ slightly between main and back channels.

Compounds whose comparison value (95% UCL or maximum value, whichever was lower) exceeded the site-specific sediment quality criteria or benchmark values were included in the list of site-specific COCs. Sediment benchmark values were not derived for the metals since the equilibrium partitioning approach is not appropriate.

Table 5.1 Site-Specific Evaluation
Sediment Screening, Main Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	Site-Specific Sed. Quality Criteria (ug/kg)	Environ. Effects Quotient (unitless)	Include in Risk Assessment?
Barium	2.19E+05	Arith. Mean	NA		No (1)
Cobalt	2.86E+04	Arith. Mean	NA		No (1)
Copper	1.02E+05	Arith. Mean	NA		Yes
Cyanide	1.25E+04	Arith. Mean	NA		No (1)
Lead	1.67E+05	Arith. Mean	NA		Yes
Mercury	4.40E+02	Arith. Mean	NA		Yes
Nickel	6.14E+04	Arith. Mean	NA		Yes
Selenium	9.00E+02	Arith. Mean	NA		No (1)
Vanadium	2.33E+04	Arith. Mean	NA		No (1)
Zinc	1.45E+06	Arith. Mean	NA		Yes
2,4,5-T	8.40E+01	Arith. Mean	2.20E+04	3.83E-03	No (2)
2,4,5-TP	1.72E+01	Arith. Mean	7.68E+03	2.24E-03	No (2)
2,4-D	1.72E+02	Arith. Mean	1.29E+04	1.33E-02	No (2)
Alpha-chlordane	4.52E+00	Arith. Mean	1.20E+01	3.75E-01	No (2)
Aroclor-1242	3.34E+01	Arith. Mean	1.48E+02	2.25E-01	No (2)
Aroclor-1248	3.08E+01	Arith. Mean	1.48E+02	2.08E-01	No (2)
Aroclor-1254	1.33E+02	Arith. Mean	1.48E+02	8.96E-01	No (2)
Aroclor-1260	4.23E+01	Arith. Mean	1.48E+02	2.85E-01	No (2)
Total PCBs	1.66E+02	Arith. Mean	1.48E+02	1.12E+00	Yes
Dieldrin	3.36E+00	Arith. Mean	2.20E+02	1.53E-02	No (2)
Endrin Aldehyde	3.36E+00	Arith. Mean	8.40E+01	4.00E-02	No (2)
Endrin Ketone	2.87E+00	Arith. Mean	8.40E+01	3.42E-02	No (2)
Gamma-chlordane	4.17E+00	Arith. Mean	1.20E+01	3.46E-01	No (2)
2-Methylnaphthalene	8.54E+02	Arith. Mean	7.69E+03	1.11E-01	No (2)
Acenaphthene	7.75E+02	Arith. Mean	2.60E+03	2.98E-01	No (2)
Anthracene	5.18E+02	Arith. Mean	3.56E+03	1.46E-01	No (2)
Benzo(a)anthracene	1.70E+03	Arith. Mean	2.76E+03	6.16E-01	No (2)
Benzo(a)pyrene	1.39E+03	Arith. Mean	1.32E+05	1.05E-02	No (2)
Chrysene	1.02E+03	Arith. Mean	4.00E+06	2.55E-04	No (2)
Dibenz(a,h)anthracene	7.51E+02	Arith. Mean	6.60E+07	1.14E-05	No (2)
Fluoranthene	2.87E+03	Arith. Mean	1.24E+04	2.31E-01	No (2)
Fluorene	7.61E+02	Arith. Mean	1.46E+05	5.21E-03	No (2)
Naphthalene	7.15E+02	Arith. Mean	1.51E+03	4.73E-01	No (2)
Phenanthrene	1.78E+03	Arith. Mean	3.60E+03	4.94E-01	No (2)
Pyrene	2.43E+03	Arith. Mean	9.88E+03	2.46E-01	No (2)
Total PAHs	1.76E+04	Arith. Mean	2.48E+03	7.10E+00	Yes

Notes:
(1) Eliminated from screening process based on BKGD ratio < 10.0
(2) Eliminated from screening process based on EEQ < 1.0.

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Table 5.2 Site-Specific Evaluation
Sediment Screening, Back Channel
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/kg)	Stat. Origin of Comp. Value	Site-Specific Sed. Quality Criteria (ug/kg)	Environ. Effects Quotient (unitless)	Include in Risk Assessment?
Cobalt	3.38E+04	Arith. Mean	NA		No (1)
Copper	1.02E+05	Arith. Mean	NA		Yes
Cyanide	4.78E+03	Arith. Mean	NA		Yes
Lead	9.55E+04	Arith. Mean	NA		Yes
Manganese	1.93E+06	Arith. Mean	NA		No (1)
Mercury	2.10E+02	Arith. Mean	NA		Yes
Nickel	7.33E+04	Arith. Mean	NA		Yes
Selenium	1.46E+03	Arith. Mean	NA		No (1)
Vanadium	2.30E+04	Arith. Mean	NA		No (1)
Zinc	3.60E+05	Arith. Mean	NA		Yes
2,4,5-T	9.66E+01	Arith. Mean	2.75E+04	3.52E-03	No (2)
2,4,5-TP	1.58E+01	Arith. Mean	9.59E+03	1.65E-03	No (2)
Aroclor-1242	3.18E+01	Arith. Mean	1.86E+02	1.71E-01	No (2)
Aroclor-1260	4.56E+01	Arith. Mean	1.86E+02	2.46E-01	No (2)
Total PCBs	7.74E+01	Arith. Mean	1.86E+02	4.17E-01	No (2)
Dieldrin	2.21E+00	Arith. Mean	2.75E+02	8.04E-03	No (2)
Endrin Ketone	2.63E+00	Arith. Mean	1.05E+02	2.50E-02	No (2)
Gamma-BHC (Lindane)	1.31E+00	Arith. Mean	2.16E+00	7.63E-01	No (2)
Gamma-chlordane	2.01E+00	Arith. Mean	1.51E+01	1.34E-01	No (2)
2-Methylnaphthalene	2.19E+03	Arith. Mean	9.61E+03	2.28E-01	No (2)
Acenaphthene	1.84E+03	Arith. Mean	3.25E+03	5.66E-01	No (2)
Anthracene	2.53E+03	Arith. Mean	4.45E+03	5.69E-01	No (2)
Benzo(a)anthracene	5.03E+03	Arith. Mean	3.45E+03	1.46E+00	Yes
Benzo(a)pyrene	3.15E+03	Arith. Mean	1.65E+05	1.91E-02	No (2)
Benzo(b)fluoranthene	4.63E+03	Arith. Mean	5.50E+05	8.42E-03	No (2)
Benzo(g,h,i)perylene	2.11E+03	Arith. Mean	1.79E+05	1.18E-02	No (2)
Benzo(k)fluoranthene	3.21E+03	Arith. Mean	1.60E+06	2.01E-03	No (2)
Bis(2-ethylhexyl)phthalate	1.48E+04	Arith. Mean	2.72E+06	5.44E-03	No (2)
Carbazole	2.04E+03	Arith. Mean	NA		No (3)
Chrysene	3.50E+03	Arith. Mean	5.00E+06	7.00E-04	No (2)
Di-n-octylphthalate	1.78E+03	Arith. Mean	NA		No (3)
Dibenz(a,h)anthracene	2.27E+03	Arith. Mean	8.25E+07	2.75E-05	No (2)
Dibenzofuran	2.20E+03	Arith. Mean	NA		Yes
Fluoranthene	8.23E+03	Arith. Mean	1.55E+04	5.31E-01	No (2)
Fluorene	2.19E+03	Arith. Mean	1.83E+05	1.20E-02	No (2)
Indeno(1,2,3-cd)pyrene	2.38E+03	Arith. Mean	5.20E+05	4.58E-03	No (2)
Naphthalene	2.12E+03	Arith. Mean	1.89E+03	1.12E+00	Yes
Phenanthrene	5.45E+03	Arith. Mean	4.50E+03	1.21E+00	Yes
Pyrene	7.20E+03	Arith. Mean	1.24E+04	5.83E-01	No (2)
Total PAHs	4.69E+04	Arith. Mean	3.10E+03	1.51E+01	Yes

Notes:
(1) Eliminated from screening process based on BKGD ratio < 10.0.
(2) Eliminated from screening process based on EEQ < 1.0.
(3) Eliminated from screening process based on single detection.

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Compounds for which no sediment criteria or values were available where examined with regard to their relative degree of enrichment and frequency of detection; a criterion of 10 times background was used to distinguish compounds which were considered relatively enriched. In addition, compounds which were only detected at low frequencies (e.g., only one detection in both main and back channel sediments) were eliminated.

5.2.1 Main Channel Sediment

Table 5-1 provides a comparison of the sediment compound concentrations to the sediment criteria or benchmark values. Compounds which had an EEQ greater than 1.0 included total PCBs and total PAHs.

Based on the consideration of relative enrichment, barium, cobalt, cyanide, selenium, and vanadium were eliminated from the list of site-specific sediment COCs.

Thus, the site-specific risk evaluation identified the following site-specific sediment COCs: copper, lead, mercury, nickel, zinc, total PCBs, and total PAHs. All site-specific COCs in the main channel sediments retained for inclusion in the site-specific risk assessment are identified in Table 5-1.

5.2.2 Back Channel Sediment

Table 5-2 provides a comparison of the sediment compound concentrations to the sediment criteria or benchmark values. Compounds which had an EEQ greater than 1.0 included benzo(a)anthracene, naphthalene, phenanthrene, pyrene, and total PAHs.

Based on consideration of relative enrichment, cobalt, manganese, selenium, and vanadium were eliminated from the list of site-specific sediment COCs. Based on a low frequency of detection (1 detected value), carbazole and di-n-octylphthalate were removed from the list of site-specific sediment COCs.

Thus, the site-specific risk evaluation identified the following site-specific sediment COCs: copper, cyanide, lead, mercury, nickel, zinc, benzo(a)anthracene, dibenzofuran, naphthalene, phenanthrene, and total PAHs. All site-specific COCs in the back channel sediments retained for inclusion in the site-specific risk assessment are identified in Table 5-2.

5.3 Site-specific Risk Evaluation of COCs in the Surface Soil

Table 5-3 provides a comparison of the mean compound concentrations in soils to the soil criteria provided by U.S. EPA Region 3 and background values. All compounds which exceeded soil criteria were included in the list of site-specific soil COCs. Best professional judgement was used to evaluate the reasonableness of inclusion as site-specific COCs of the remaining soil compounds. Relative enrichment and frequency of detection were used to eliminate compounds from the list of site-specific soil COCs.

Based on low relative enrichments, the following compounds were eliminated: 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2,4-D, 4,4-DDD, 4,4'-DDE, Aroclor -1242, -1254, -1260, total PCBs, dieldrin, endosulfan II, endrin, endrin aldehyde, endrin ketone, heptachlor epoxide 1,2-dichloroethene, benzene, methylene chloride, toluene, trichloroethene, 2-methylnaphthalene, acenaphthene, carbazole, dibenz(a,h)anthracene, dibenzofuran, and fluorene.

Compounds which were detected once or twice in the soil samples or whose frequency of detection was less than or equal to approximately 5% were removed from consideration as soil CPCs. This application is consistent with similar treatment of low frequency detected compounds for human health assessment at Superfund sites (U.S. EPA, 1989b). The compounds removed due to a low frequency of detection included phenol, endosulfan I, methoxychlor, toxaphene, acenaphthylene, di-n-butylphthalate, diethylphthalate, and hexachlorobutadiene.

Thus the site-specific risk evaluation identified the following site-specific soil COCs: arsenic, cyanide, lead, manganese, mercury, zinc, naphthalene, 2,4,5,T, 2,4,5-TP, 4'4-DDT, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, 2,3,7,8-TCDD, lindane, gamma-chlordane, heptachlor, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenzofuran, fluoranthene, indeno-(1,2,3,c,d)pyrene, phenanthrene, pyrene, and total PAHs. All site-specific COCs in surface soil retained for the site-specific risk assessment are identified in Table 5-3.

5.4 Site-specific Risk Evaluation of COCs in the Groundwater

Evaluation of the site-specific risk of COCs detected in groundwater used consideration of site-specific exposure pathways. One possible approach for evaluation of the candidate COCs would be the modeling of the groundwater discharge (assuming the maximum concentrations of compounds in groundwater) into a fraction of the flow volume typically found in the back channel of the Ohio River. This approach is sufficient to address the potential effects to free-swimming aquatic organisms; however, it would not identify potential effects to benthic organisms.

Table 5-3
Site-specific Risk Assessment
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)	
Arsenic	10.71	Arith.Mean	10	8.3	1.07	1.29	Yes	
Cyanide	13.09	Arith.Mean		[0.315]		41.54	Yes	
Lead	67.70	Arith.Mean	50	36	1.35	1.88	Yes	
Manganese	1602.64	Arith.Mean	600	1080	2.67	1.48	Yes	
Mercury	0.52	Arith.Mean	0.03	[0.065]	17.38	8.02	Yes	
Zinc	166.64	Arith.Mean	54	83	3.09	2.01	Yes	
2,4,6-Trichlorophenol	0.4793	Arith.Mean		[0.210]		2.28	No	(4)
2,4-Dichlorophenol	0.8154	Arith.Mean		[0.210]		3.88	No	(4)
Naphthalene	12.2299	Arith.Mean		[0.210]		58.24	Yes	
Phenol	0.5774	Arith.Mean		[0.210]		2.75	No	(3)
2,4,5-T	0.1938	Arith.Mean		0.0125		15.50	Yes	
2,4,5-TP	0.1462	Arith.Mean		0.0125		11.70	Yes	
2,4-D	0.6927	Arith.Mean		0.125		5.54	No	(4)
4,4'-DDD	0.0122	Arith.Mean		[0.00205]		5.95	No	(4)
4,4'-DDE	0.0057	Arith.Mean		[0.00205]		2.78	No	(4)
4,4'DDT	0.0403	Arith.Mean		[0.00205]		19.66	Yes	
Alpha-BHC	0.0509	Arith.Mean		[0.00105]		48.48	Yes	
Alpha-chlordane	0.0252	Arith.Mean		[0.00105]		24.00	Yes	
Arochlor-1242	0.0546	Arith.Mean		[0.0205]		2.66	No	(4)
Arochlor-1254	0.0625	Arith.Mean		[0.0205]		3.05	No	(4)
Arochlor-1260	0.1085	Arith.Mean		0.027		4.02	No	(4)
Total PCB's	0.2200	Arith.Mean		0.027		8.15	No	(4)
Beta-BHC	0.0656	Arith.Mean		[0.00105]		62.48	Yes	
Delta-BHC	0.0186	Arith.Mean		[0.00105]		17.71	Yes	
2,3,7,8-TCDD	6.88E-08	Arith.Mean					Yes	
Dieldrin	0.0189	Arith.Mean		[0.00205]		9.22	No	(4)
Endosulfan I	0.0036	Arith.Mean		[0.00105]		3.43	No	(3)
Endosulfan II	0.0083	Arith.Mean		[0.00205]		4.05	No	(4)
Endosulfan Sulfate	0.0080	Arith.Mean		[0.00205]		3.90	No	(4)
Endrin	0.0056	Arith.Mean		[0.00205]		2.73	No	(4)
Endrin Aldehyde	0.0027	Arith.Mean		[0.00205]		1.32	No	(4)
Endrin Ketone	0.0088	Arith.Mean		[0.00205]		4.29	No	(4)
Gamma-BHC (Lindane)	0.1464	Arith.Mean		[0.00105]		139.43	Yes	
Gamma-chlordane	0.0440	Arith.Mean		0.00036		122.22	Yes	
Heptachlor	0.0146	Arith.Mean		[0.00105]		13.90	Yes	
Heptachlor Epoxide	0.0058	Arith.Mean		[0.00105]		5.52	No	(4)
Methoxychlor	0.0483	Arith.Mean		[0.0105]		4.60	No	(3)
Toxaphene	0.2356	Arith.Mean		[0.105]		2.24	No	(3)
1,2-Dichloroethene (T)	0.0063	Arith.Mean		0.004		1.58	No	(4)
Benzene	0.0072	Arith.Mean		[0.0065]		1.11	No	(4)
Methylene Chloride	0.0070	Arith.Mean		[0.0065]		1.08	No	(4)
Toluene	0.0075	Arith.Mean		0.004		1.88	No	(4)
Trichloroethene	0.0080	Arith.Mean		[0.0065]		1.23	No	(4)
2-Methylnaphthalene	1.7053	Arith.Mean		[0.210]		8.12	No	(4)
Acenaphthene	1.0826	Arith.Mean		[0.210]		5.16	No	(4)
Acenaphthylene	0.3532	Arith.Mean		[0.210]		1.68	No	(3)
Anthracene	2.2312	Arith.Mean		[0.210]		10.62	Yes	
Benzo(a)anthracene	5.2557	Arith.Mean		0.17		30.92	Yes	
Benzo(a)pyrene	4.2703	Arith.Mean		0.066		64.70	Yes	
Benzo(b)fluoranthene	6.7937	Arith.Mean		0.15		45.29	Yes	
Benzo(g,h,i)perylene	2.8697	Arith.Mean		0.076		37.76	Yes	
Benzo(k)fluoranthene	2.4016	Arith.Mean		[0.210]		11.44	Yes	
Bis(2-ethylhexyl)phthalate	4.4231	Arith.Mean		[0.210]		21.06	Yes	
Carbazole	0.9155	Arith.Mean		[0.210]		4.36	No	(4)

Table 5-3
Site-specific Risk Assessment
Surface Soil Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (mg/kg)	Stat. Origin of Comp. Value	Criteria Value (1) (mg/kg)	BKGD Value (2) (mg/kg)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluation? (Yes/No)
Chrysene	4.4798	Arith.Mean		0.075		59.73	Yes
Di-n-butylphthalate	0.1800	Arith.Mean		0.063		2.86	No (3)
Dibenz(a,h)anthracene	1.0036	Arith.Mean		[0.210]		4.78	No (4)
Diethylphthalate	0.5584	Arith.Mean		[0.210]		2.66	No (3)
Dibenzofuran	1.4324	Arith.Mean		[0.210]		6.82	No (4)
Fluoranthene	10.1877	Arith.Mean		0.2		50.94	Yes
Fluorene	1.1299	Arith.Mean		[0.210]		5.38	No (4)
Hexachlorobutadiene	1.3195	Arith.Mean		[0.210]		6.28	No (3)
Indeno(1,2,3-cd)pyrene	3.1321	Arith.Mean		0.06		52.20	Yes
Phenanthrene	7.5184	Arith.Mean		0.08		93.98	Yes
Pyrene	7.6443	Arith.Mean		0.17		44.97	Yes
Total PAH	72.2744	Arith.Mean		1.047		69.03	Yes

NOTES:
(1) Soil criteria suggested by U.S. EPA Region 3 staff.
(2) Values in brackets represent 1/2 the standard quantitation limit where no detects were reported.
(3) Eliminated from screening process based on frequency of detection (approx. <5%).
(4) Eliminated from final list of CPCs based on BKGD ratio <10.0.

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Alternatively, the concentrations of the candidate COCs detected in wells located within the back channel of the Ohio River can be used to estimate the maximum concentrations to which benthic organisms might be potentially be exposed. This method of evaluating the groundwater has been indicated to be more acceptable to U.S. EPA Region 3. The latter method is discussed further in the following section.

5.4.1 Evaluation of Relevant Monitoring Wells

Site-specific evaluation of potential ecological risk due to groundwater exposure used the concentrations found within wells located in the back channel to characterize potential risks that aquatic biota might incur from groundwater discharge. Wells NERT-5 (M,D), NERT-6 (M,D), and NERT-7 (D) are located in the back channel of the Ohio River (Figure 2-5). Data from these wells are presented in Appendix Table A-5 and are used in this comparison. Compounds not detected in any sample from any of the wells are excluded from this assessment. The 95% UCL or the maximum observed compound concentration, whichever was lower, was compared with the chronic AWQC. Compounds present at concentrations that do not exceed the chronic AWQC were eliminated from further evaluation. Compounds eliminated from further evaluation include chromium and copper.

5.4.2 Groundwater Site-Specific COC Selection

As the final step in the site-specific COC selection process, a compound-specific evaluation of each of the remaining candidate COCs was performed. Groundwater quality from back channel wells is discussed below. The selection process results are shown in Table 5-4.

Acetone was detected at low levels in two samples and 2-butanone was detected in one sample from the wells located in the back channel of the Ohio River. During the data validation process, it was revealed that the continuing calibration for acetone and 2-butanone was outside acceptable QA/QC limits (greater than 50% difference from the initial calibration). Acetone and 2-butanone (two common laboratory contaminants) were therefore eliminated from further consideration in the risk assessment.

Chloroethane was detected in one sample from a back channel well. Because this compound was detected only once at a very low concentration, it was not considered to be a significant site-related compound and was eliminated from further consideration in the risk assessment.

2,4-Dimethylphenol was also detected in one of the groundwater samples. The maximum concentration (15 µg/L) was much lower than the acute LOEL (2120 µg/L); therefore, 2,4-dimethylphenol was excluded from this assessment.

Table 5-4
Site-specific Risk Assessment
Groundwater Screening
Ohio River Site, Neville Island
Ecological Risk Assessment

Compound	Comparison Value (ug/L)	Stat. Origin of Comp. Value	Chronic Freshwater AWQC (ug/L)	Mean BKGD Value (3) (ug/L)	Environ. Effects Quotient (unitless)	Ratio of Comp. to BKGD Value (unitless)	Further Evaluated? Yes/No
Cadmium (2)	ND		1.1	[1.5] (a)			No
Total Chromium (as VI)	6.1	Upper 95%	11	165.5	0.550	0.04	No
Copper (2)	4.0	Upper 95%	12	169	0.330	0.02	No
Cyanide	24.2	Upper 95%	5.2	[2.5] (a)	4.652	9.68	No
Lead (2)	ND		3.2	56.8			No
Manganese	19885	Arith. Mean		8350			No
Mercury	ND		0.012	0.65			No
Silver (2)	7.41	Upper 95%	0.12		61.750		No
Zinc (2)	129.0	Upper 95%	110	519	1.172	0.25	No
2,4,6-Trichlorophenol (1)	ND		970	[5.0]			No
2,4-Dichlorophenol (1)	ND		365	[5.0]			No
2,4-Dimethylphenol	8.5	Upper 95%		[5.0]		1.70	No
2-Methylphenol	3.0	Maximum		[5.0]		0.60	No
2-Nitrophenol (1)	ND		150	[5.0]			No
4-Methylphenol	7.6	Upper 95%		[5.0]		1.53	No
Bis(2-ethylhexyl)phthalate (1)	ND		360	[5.0]			No
Di-n-butylphthalate	ND			67			No
Di-n-octylphthalate	ND			[5.0]			No
Naphthalene (1)	ND		620	[5.0]			No
Phenol (1)	ND		2560	[5.0]			No
2,4,5-T	ND			[0.05]			No
2,4,5-TP	ND			[0.05]			No
2,4-D	ND			[0.05] (a)			No
4,4'-DDE (1)	ND			[0.05]			No
Alpha-BHC (1)	ND			[0.025]			No
Dieldrin	ND		0.0019	[0.05]			No
Endosulfan II	ND		0.056	[0.05]			No
Endrin Aldehyde (3)	ND		0.0023	[0.05]			No
1,1,1-Trichloroethane	ND			[5.0] (a)			No
1,1,2-Trichloroethane (1)	ND			[5.0] (a)			No
1,2-Dichloroethene (T) (1)	ND			[5.0] (a)			No
2-Butanone	7.5	Upper 95%		[5.0] (a)		1.50	No
Acetone	14.5	Upper 95%		[5.0] (a)		2.90	No
Benzene (1)	17.9	Upper 95%		[5.0] (a)		3.58	No
Bromoform	ND			[5.0] (a)			No
Carbon Disulfide	ND			[5.0] (a)			No
Chlorobenzene (3)	ND		50	[5.0] (a)			No
Chloroethane	16.0	Upper 95%		[5.0] (a)		3.20	No
Methylene Chloride	ND			[5.0] (a)			No
Toluene (1)	ND			[5.0] (a)			No

NOTES:
(1) Insufficient data to develop criteria. Value presented is the LOAEL.
(2) Criteria are hardness dependent. Value presented is for a minimum measured hardness of 65 mg/L.
(3) Values in brackets represent one-half the SQL where no detects were reported.

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2-Methylphenol was not observed above the method detection limit in any of the groundwater samples from back channel wells. An estimated value of 3.0 µg/L was reported for one of the wells. No toxicity data were found for 2-methylphenol; however, the estimated value was much lower than the acute LOEL (2120 µg/L) reported for 2,4-dimethylphenol, and 2-methylphenol was excluded from this assessment based on its presumed similar toxicity.

4-Methylphenol was not observed above the method detection limit in any of the groundwater samples from these wells. An estimated value of 10 µg/L was reported for one of the wells under the back channel of the Ohio River. No toxicity data were found for 4-methylphenol, but the estimated value was much lower than the acute LOEL (2120 µg/L) reported for 2,4-dimethylphenol, and 4-methylphenol was excluded from this assessment based on its presumed similar toxicity.

Manganese was detected in the back channel wells at concentrations above background. No AWQC value is available for manganese. Toxicity information from the AQUIRE database indicates LC 50s for fish, ranging from 2,000,000 µg/l to 75,000 µg/l (Schweiger, 1957). A NOEL value of 15,000 µg/l has been established for a crustacean (Schweiger, 1957). The average manganese concentrations was 19,885 µg/l. Manganese in the groundwater is likely to be less soluble under oxidizing conditions (i.e., in surface water), and dilution will occur as the groundwater is discharged into the river. Based on these considerations, manganese was eliminated from further consideration.

Cyanide was detected in the deep sample from one of the wells located in the back channel (i.e., NERT-5 screened approximately 23 feet below the river bed) but not in the other five wells. The mean concentration of cyanide was 13.4 µg/L. U.S. EPA (1985a) concluded from the data presented in the AWQC document that invertebrate species were less sensitive to cyanide than vertebrate species. Chronic life cycle toxicity tests were reported (U.S. EPA, 1985a) for isopods (34.06 µg/L) and amphipods (18.33 µg/L). Only one out of nine data points (from a deep well) exceeded these values. The concentration of cyanide from the mid-depth screen of that well was below the lower toxicity value. Six out of nine data points were below the lower life cycle toxicity test results. It is thus unlikely that adverse effects will be observed in benthic organisms at these concentrations. Moreover, the depth of elevated cyanide levels (i.e., 23 ft.) is many feet below the expected zone of typical benthic organisms. Cyanide was, therefore, eliminated from further consideration in the risk assessment.

Silver was detected in one groundwater sample. The maximum concentration of silver (14.8 µg/L) was greater than the acute and chronic AWQCs for silver. The maximum concentration of silver was observed at the deep-depth screen from one well (NERT-6). In another round of sampling from the same well and the same depth, silver was not detected at the method detection limit of 4 µg/l. Groundwater samples taken from shallower depths in the same well were also below the detection limit for silver. Silver was not detected in any of the other samples taken from these wells; therefore, silver was excluded from this assessment.

Zinc was detected in three of the groundwater samples from back channel wells. Even though the environmental effects quotient was slightly greater than 1 (i.e., 1.17), zinc was eliminated from further consideration in this risk assessment because mean background concentrations were much greater than the 95% UCL back channel well concentrations (519 µg/L in background well versus 129 µg/L in back channel wells).

Benzene was detected in one groundwater sample. The maximum concentration of benzene (44 µg/L) was much lower than the acute LOEL (5300 µg/L), and benzene was excluded from this assessment.

Based on the conservative evaluation presented above, none of the compounds evaluated above were included as site-specific COCs for groundwater in the ecological risk assessment.

5.5 Evaluation of Exposure Pathways

The site-specific level risk evaluation provides a list of COCs for surface water (both main and back channels), for sediments (both main and back channel), and soil (Table 5-5). The general relevant exposure pathways are described in Section 2.2. Exposure pathways which were relevant to specific representative species are fully described in Appendix F.

5.6 Characterization of Potential Environmental Risks

This section discusses the potential for adverse ecological effects for those compounds that were selected as site-specific COCs from the site-specific risk assessment. The site-specific COCs evaluated in the surface waters and sediments of the Ohio River are discussed in Section 5.6.1 and the site-specific COCs to which terrestrial receptors might be exposed are discussed in Section 5.6.2.

5.6.1 Aquatic Risk Analysis

The potential for ecological risks to occur in the surface water and sediments of the Ohio River was assessed for site-specific COCs. The surface water and sediment compounds were selected using compound concentrations, relevant criteria or guidelines, and toxicity benchmarks as described in Sections 3.0 and 4.0. Using this approach, all of the CPCs were analyzed for the

TABLE 5-5

Site-Specific COCs for ORS Identified By Medium

	Compound	Surface Soil	Surface Water		Sediments		Ground-water[2]
			Main Channel	Back Channel[1]	Main Channel	Back Channel	
METALS	Arsenic	●					
	Copper		●		●	●	
	Cyanide	●				●	
	Lead	●			●	●	
	Manganese	●					
	Mercury	●	●		●	●	
	Nickel				●	●	
	Zinc	●			●	●	
HERBICIDES	2,4,5-T	●					
	2,4,5-TP	●					
PESTICIDES/PCBs	4,4'-DDT	●					
	Alpha-BHC	●					
	Total PCBs				●		
	Beta BHC	●					
	Delta BHC	●					
	Gamma-BHC (Lindane)	●				●	
	Alpha Chlordane	●					
	Gamma-Chlordane	●					
	Heptachlor	●					

TABLE 5-5

Site-Specific COCs for ORS Identified By Medium

	Compound	Surface Soil	Surface Water		Sediments		Groundwater[2]
			Main Channel	Back Channel[1]	Main Channel	Back Channel	
SVOCs	Anthracene	●					
	Benzo(a)Anthracene	●				●	
	Benzo(a)Pyrene	●					
	Benzo(b)Fluoranthene	●					
	Benzo(k)Fluoranthene	●					
	Benzo(g,h,i)Perylene	●					
	Bis(2-Ethylhexyl)Phthalate	●					
SVOCs Cont.	Chrysene	●					
	Dibenzofuran					●	
	Fluoranthene	●					
	Indeno(1,2,3-cd)Pyrene	●					
	Naphthalene	●				●	
	Phenanthrene	●				●	
	Pyrene	●					
	Total PAH	●			●	●	
DIOXIN	2,3,7,8-TCDD	●					

[1] No site-specific COCs were identified in surface water on the back channel.

[2] No site-specific COCs were identified in groundwater.

screening level risk evaluation, and only those compounds which exceeded the first screening criteria were further evaluated in the secondary level risk evaluation. The results of the site-specific assessment approach to the aquatic risk analysis are described below.

5.6.1.1 Surface Water

The potential for ecological risks to occur in the surface water of the back channel of the Ohio River was assessed using the following approach. The toxicity quotient method (U.S. EPA, 1988) was used in the surface water level analyses to identify the potential for ecological risks in the surface water environment. A toxicity quotient is calculated by dividing an estimated environmental concentration of a compound by a compound-specific benchmark concentration. The estimated environmental concentration was the measured surface water concentration. The toxicity concentration may be a criteria value or a species-specific value determined from the literature. The equation used to derive the toxicity quotient is shown below.

Toxicity quotient (unitless) = estimated environmental concentration (µg/l) ÷ toxicity benchmark concentration (µg/l)

The toxicity concentrations used in the site-specific aquatic risk analysis were AWQCs or surface water toxicity benchmarks for freshwater chronic exposure. It was conservatively assumed that aquatic species inhabiting the back channel of the Ohio River will be chronically exposed to the mean compound concentrations in the surface water.

The toxicity quotient was interpreted as the likelihood that an environmental concentration of a compound may cause adverse ecological effects. The calculated toxicity quotients were evaluated according to U.S. EPA guidance (U.S. EPA, 1988) which states that an environmental compound concentration generating a toxicity quotient of less than 0.1 is considered to be of "no concern," a toxicity quotient calculated between 0.1 and 10 is interpreted as of "possible concern," and a concentration producing a toxicity quotient greater than 10 is expressed as of "probable concern." Further, U.S. EPA Region 3 guidance indicates quotients greater than 1.0 indicate potential risk, quotients higher than 10 are considered of moderately high risk, and those above 100 are considered of extreme risk.

Section 3.1 provides a conservative screening level risk evaluation of CPCs in surface waters. Most of the compounds were either below AWQCs or not different from background values and were excluded from this assessment. Copper and mercury were retained and further evaluated in an additional analysis. Mercury was only detected in two of the main channel surface water samples and none of the back channel samples.

The results of the screening level risk evaluation indicated a high toxicity quotient for mercury and copper. This conservative screening applied the chronic AWQC, derived to be protective of many sensitive species, including many coldwater species such as trout or salmon.

The Ohio River is a warmwater resource. Therefore, as a secondary analysis, coldwater species were excluded from the data used to derive the chronic toxicity benchmark. This application is part of the approach used in producing a site-specific water quality criteria. The surface water chronic toxicity benchmark represents the lowest reported chronic toxicity value of the available toxicity data for the lifestages of species that are known to or are likely to inhabit the surface water environment of the Ohio River near the ORS. Application of the surface water chronic toxicity benchmarks provides a comparison which is more representative of the biota in the Ohio River than is the AWQC which is designed to protect a large set of geographically-diverse species, some of which may not occur in the Ohio River.

The results of this analysis for copper and mercury are presented in Table 5-6. The upper 95% UCL of the compound concentrations measured in the surface water were compared with the surface water chronic toxicity benchmarks derived from the literature. The 95% UCL of mercury data was calculated from all of the data for mercury. Eleven measurements were made for mercury. Nine of these eleven data points were non-detects at a sample detection limit of 0.2 µg/l.

As shown in Table 5-6, both the fish receptor and the sediment invertebrate toxicity quotients for copper exceed 0.1. Both of the calculated ratios are at the low to moderate end of the range classified by U.S. EPA as of "possible concern" (U.S. EPA, 1988). Both of the toxicity quotients calculated for mercury were near or below 0.1. These ratios are classified by U.S. EPA as being of "no concern" (U.S. EPA, 1988). This analysis shows no potential for adverse effects to aquatic receptors from mercury and very low potential for adverse effects to aquatic receptors from copper.

5.6.1.2 Sediments

The potential for ecological risks to occur in the sediments of the main and back channels of the Ohio River due to compounds potentially originating from the ORS was also assessed. Guidance sediment values developed for the NOAA National Status and Trends Program (Long and Morgan, 1990; Long and MacDonald, 1992) were used to evaluate the potential for ecological risks to occur in the sediment habitat of the Ohio River. A screening level risk evaluation was conducted using the ER-L values presented in NOAA Technical Memorandum NOS OMA 52 (Long and Morgan, 1990) and in Long and MacDonald (1992).

TABLE 5-6
SURFACE WATER EVALUATION, MAIN CHANNEL
OHIO RIVER SITE, NEVILLE TOWNSHIP
ECOLOGICAL RISK ASSESSMENT

COMPOUND	Surface Water Mean Conc. (ug/l)	Fish Receptor Surface Water Chronic Toxicity Benchmark Value (ug/l)	Ref.	Fish Receptor Toxicity Quotient	Sub-surface Invert Surface Water Chronic Toxicity Benchmark Value (ug/l)	Sediment Sub-surface Invertebrate Toxicity Quotient	Ref.
COPPER	3.28E+01	2.90E+01	1	1.13E+00	1.63E+01	2.01E+00	3
MERCURY	3.50E-01	5.30E+00	2	6.60E-02	2.00E+01	1.75E-02	4

Notes:
1 = chronic value for bluegill from chemical-specific AWQC document.
2 = chronic value for dipteran midge larvae from chemical-specific AWQC document.
3 = chronic value for largemouth bass embryo from chemical-specific AWQC document.
4 = acute value for dipteran midge larvae from chemical-specific AWQC document.

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Based on the screening level risk evaluation, many CPCs were either above the ER-L values or greater than background concentrations (Table 3-3). The identified candidate CPCs were further evaluated in the secondary level risk evaluation.

The arithmetic means of the measured sediment concentrations were compared against the available NOAA ER-Ms (Tables 4-3 and 4-4) for compounds that exceeded the screening criteria described in Section 3.2. The results of the comparisons led to the selection of secondary level COCs for the main and back channel sediments. In addition, site-specific sediment benchmarks were derived and compared to mean concentrations (Tables 5-1 and 5-2).

Table 5-7 shows the site-specific sediment COCs for the main channel. The table compares the sediment mean concentration to ER-L/ER-M values for the metals, or to site-specific sediment criteria/benchmarks for other site-specific COCs. The following site-specific COCs were identified as of possible concern: copper, lead, mercury, nickel, zinc, total PCBs, and total PAHs. Of these, copper, lead, mercury, total PCBs and total PAHs exceed their ER-L values but not their ER-M values. According to the NOAA guidance for the interpretation of the ER-L/ER-M comparison, because some of the ER-L values were exceeded; however, none of the ER-M values were exceeded, it is concluded that the potential for adverse biological effects from these compounds in the Ohio River is low.

Both nickel and zinc exceed the respective ER-M values and thus show greater potential for possible adverse ecological effect. As noted earlier, the zinc value is affected by the unusually high zinc content in one sample (NSD-2). Nickel is more evenly distributed in the sediment.

Table 5-8 shows the list of site-specific sediment COCs for the back channel. The following site-specific COCs were identified as of possible concern: copper, lead, mercury, and zinc. These compounds exceeded their ER-L values but not their ER-M values which indicates that the potential for adverse ecological effects from these compounds is low.

Sediment compounds in the back channel exceeding the ER-M values are nickel, benzo(a)anthracene, naphthalene, phenanthrene and total PAHs. It should be noted that the site-specific sediment quality criteria are greater than the ER-M. For example, phenanthrene has a sediment quality criterion of 4500 µg/kg, while the corresponding ER-M is 1500 µg/kg. Inspection of the toxicity quotient derived for the ER-Ls and site-specific sediment criteria or benchmark values indicate that most of the toxicity quotients are near the mid-range of quotients associated with "possible concern" status. Only total PAH is indicated as being of probable concern.

TABLE 5-7
SEDIMENT EVALUATION, MAIN CHANNEL
OHIO RIVER SITE, NEVILLE TOWNSHIP
ECOLOGICAL RISK ASSESSMENT

COMPOUND	Sediment Mean Conc. (ug/kg)	ER-L or Sediment Benchmark (ug/kg)	(1)	Toxicity Quotient	ER-M (ug/kg)	(1)	Toxicity Quotient
COPPER	1.02E+05	3.40E+04		3.00E+00	2.70E+05		3.78E-01
LEAD	1.67E+05	4.67E+04		3.58E+00	2.23E+05		7.49E-01
MERCURY	4.40E+02	1.50E+02		2.93E+00	7.10E+02		6.20E-01
NICKEL	6.14E+04	2.09E+04		2.94E+00	5.16E+04		1.19E+00
ZINC	1.45E+06	1.50E+05		9.67E+00	4.10E+05		3.54E+00
TOTAL PCBs	1.66E+02	1.48E+02	(2)	1.12E+00	1.80E+02		9.22E-01
TOTAL PAHs	1.76E+04	2.48E+03	(2)	7.10E+00	4.48E+04		3.93E-01

Notes:
(1) ER-L and ER-M values are taken from Long and Morgan, 1990; Long and MacDonald, 1992.
(2) Derived site-specific criteria or benchmark.

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TABLE 5-8
SEDIMENT EVALUATION, BACK CHANNEL
OHIO RIVER SITE, NEVILLE TOWNSHIP
ECOLOGICAL RISK ASSESSMENT

COMPOUND	Sediment Mean Conc. (ug/kg)	ER-L or Sediment Benchmark (1) (ug/kg)		Toxicity Quotient	ER-M (1) (ug/kg)	Toxicity Quotient
COPPER	1.02E+05	3.40E+04		3.00E+00	2.70E+05	3.78E-01
CYANIDE(3)	4.78E+03	NA		-	NA	-
LEAD	9.55E+04	4.67E+04		2.04E+00	2.23E+05	4.28E-01
MERCURY	2.10E+02	1.50E+02		1.40E+00	7.10E+02	2.96E-01
NICKEL	7.33E+04	2.09E+04		3.51E+00	5.16E+04	1.42E+00
ZINC	3.60E+05	1.50E+05		2.40E+00	4.10E+05	8.78E-01
BENZO(A)ANTHRACENE	5.03E+03	3.45E+03	(2)	1.46E+00	1.60E+03	3.14E+00
DIBENZOFURAN(3)	2.20E+03	NA		-	NA	-
NAPHTHALENE	2.12E+03	1.89E+03	(2)	1.12E+00	2.10E+03	1.01E+00
PHENANTHRENE	5.45E+03	4.50E+03	(2)	1.21E+00	1.50E+03	3.63E+00
TOTAL PAHs	4.69E+04	3.10E+03	(2)	1.51E+01	4.48E+04	1.05E+00

Notes:

(1) ER-L and ER-M values are taken from Long and Morgan, 1990; Long and MacDonald, 1992.

(2) Derived site-specific sediment criteria or benchmark.

(3) Appropriate sediment benchmark values could not be derived.

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5.6.2 Riparian and Terrestrial Risk Analysis

In addition to the qualitative secondary assessment, a semi-quantitative assessment was considered appropriate to further evaluate potential adverse ecological effects to species present in the riparian and terrestrial habitats on the ORS. A semi-quantitative approach can be useful in estimating the magnitude of potential risk to individual species determined to be representative of conditions at the ORS.

The criteria for selecting candidate species are representative of important taxonomic groups within the aquatic and terrestrial habitats of interest at the ORS and include:

- tropical level and biological function;
- likely of documented presence at the ORS;
- likelihood of potential exposure;
- availability of appropriate toxicity data; and
- biological and cultural significance.

Representative species are those which best represent a major taxonomic group within the vicinity of the ORS or, because of their functional biology, have relatively high potential for exposure to the compounds assessed. Based on these guidelines, a small rodent (an eastern mole), and a large mammal (a raccoon) can be selected as representative of major taxonomic/functional groups potentially exposed to CPCs for a terrestrial semi-quantitative risk assessment. Although a semi-quantitative risk assessment is not presented in the text (at the request of the U.S. EPA), the results of the semi-quantitative risk assessment is presented in Appendix F.

The semi-quantitative risk assessment was performed for two mammalian species representative of those typical of the terrestrial and riparian ecosystems present at the ORS (i.e., the eastern mole and the raccoon). A description of the semi-quantitative risk assessment was necessary for an adequate evaluation of potential risks to animals in these ecosystems and to provide the following:

- a means of assessment of risks to terrestrial biota due to soil compounds, in an absence of available soil criteria;

- a means of assessment of risk to terrestrial biota due to potential exposure through the water and sediment pathways; and

- to provide a relative context for assessment of potential ecological risks in both aquatic and terrestrial areas of concern.

The descriptions, assumptions, and findings of the semi-quantitative risk assessments are presented in Appendix F.

5.7 Uncertainty Analysis

A number of assumptions that can lead to uncertainty are made in the assessment of the potential for adverse ecological impacts. Some of the limitations and uncertainties have already been identified for the secondary level evaluation (Section 4.7). Some of the sources of uncertainty in the ecological risk assessment are common to both the aquatic and terrestrial assessments, while some are specific to either the aquatic or terrestrial assessments. The assumptions made in the ecological risk assessment were chosen to be conservative and protective. The overall effects of combining several of these conservative assumptions is to greatly overestimate the potential for adverse ecological effects. A qualitative discussion of the major sources of uncertainty associated with the site-specific ecological risk assessment is presented below.

The aquatic risk assessment used toxicity values based on chronic effects to analyze the potential for ecological risk. Chronic toxicity values were used as benchmarks because it was assumed that surface water and sediment-dwelling species would experience continuous, chronic exposure. Exposure in the aquatic environment is likely to be continuous for benthic invertebrate species in the river sediments of the back channel directly adjacent to the ORS. However, fish species are generally transitory and are more likely to move up and down the river. Thus, the assumption of chronic exposure may be realistic for the sediment species; however, it is relatively conservative for the surface water species.

The assumption that site-specific COC concentrations detected in the Ohio River surface water and sediment are strictly attributable to the ORS overestimates the potential risk of the ORS to ecological receptors. Areas along the Ohio River upstream and downstream of the ORS have been developed for industrial use (e.g., steel, petrochemical, and coal coking production) for over 100 years. Further, the Ohio River has received and continues to receive wastewater discharges from industrial, commercial, municipal and mining effluents. In addition, there have been occasional catastrophic releases of compounds which are similar to site-specific COCs identified on the ORS (e.g., the No. 2 fuel oil release to the Monongahela River and subsequently Ohio River in the mid-1980s). Thus, the origin of the site-specific COCs in the water and sediments cannot be established with any confidence. The general historical impact of the Ohio River is further supported by the issuance of a fish consumption advisory by the PADER for channel catfish and carp due to PCBs and chlordane present in the lower Allegheny, lower Monongahela and Ohio Rivers upstream of the ORS.

A source of uncertainty in the application of the toxicity quotient method is the source of the toxicity data used in deriving the benchmark concentrations. The lowest data points among the available toxicity data were conservatively selected as the benchmark concentrations. The lowest data point observed in the laboratory, however, may not be representative of the actual toxicity that might occur in the environment. In establishing water quality criteria, for example, the U.S. EPA follows extensive guidelines in which toxicity data are screened so that questionable values are rejected, and geometric means are calculated to represent species mean acute and chronic values. Using the lowest reported toxicity data point as a benchmark concentration, as was done in this assessment, is a very conservative approach, especially when there is a wide range in reported toxicity values for the relevant species. Differential species sensitivity to the compounds may result in these benchmarks being underestimates or, more likely, overestimates of potential acute and chronic toxicity for many aquatic organisms.

Another source of uncertainty exists in the prediction of the bioavailability of compounds from measured concentrations in the different media. For example, if the compound is bound to sediment or soil, it may not be bioavailable to the receptor; and the total concentration measured in the sediment or soil may be an overestimate of the amount of compound to which the receptor is actually exposed. Certain physical and chemical characteristics of the aquatic ecosystem will affect the bioavailability and the toxicity of compounds. Some of these factors will vary depending on the season of the year. Temperature, pH, sorption, dissolved oxygen, organic carbon content, and hardness are some of the parameters that will affect the toxicity and bioavailability of a compound. By choosing the lowest toxicity benchmark, it is likely that potential risks will be significantly overestimated.

Chemical interaction is another area of uncertainty. Evidence exists that when organisms are exposed to combinations of two or three compounds, the effects are not always additive. Depending upon the duration of exposure, type of response, and the specific combination of compounds, the toxicity observed may be synergistic (i.e., greater than would have been expected if the effect of the individual compounds were simply additive) or the observed toxicity may be less than expected or antagonistic (Suter, 1993). Direct testing of mixtures of compounds or complex modeling must be conducted to predict whether effects will be additive, antagonistic, or synergistic. Available evidence indicates that in complex mixtures of compounds in riverine environments, the effects of individual compounds are less than additive (Di Toro et al., 1991). Thus, the effect of the whole mixture may be less, perhaps substantially less, than the effect predicted by evaluating each compound individually. By applying conservative assumptions in this ecological risk assessment, the results are conservative, and are expected to be protective even in the event of synergistic effects.

Extrapolation of the potential for community, population, or ecosystem effects from the examination of one or more representative species is a major source of uncertainty for both the aquatic and terrestrial analyses. The underlying assumption is that potential effects on one representative species are consistent with the effects on similar species and representative of the potential for effects on the particular ecosystem being investigated. For example, for the aquatic risk assessment, the lowest toxicity values for indigenous species that were found in the literature were chosen to represent the potential for compound effects on the aquatic ecosystem. The selection of representative species as indicators of the ecosystem is one source of uncertainty in the risk assessment.

It is difficult to predict how an adverse effect on an individual organism might affect the ecosystem as a whole. If effects were found to occur on an individual, it does not necessarily mean that the population, community, or ecosystem will be similarly affected. Even if one subset of the ecosystem is impacted at the Ohio River Site, it may not be a perceptible impact to the overall ecosystem (e.g., loss of selected benthos along the back channel river bank may not affect entire benthos or ecosystem functions dependent on benthos). Data reported in U.S. EPA (1989d) indicate that, for aquatic ecosystems, use of acute toxicity information for a representative species may adequately define the compound concentrations that might be expected to cause adverse effects at the ecosystem level. If this is the case, the analysis of surface water risks based on chronic toxicity data for the aquatic indicator species is likely to be overly conservative for use in evaluating the potential effects to the aquatic ecosystem.

5.8 Summary

This section will present the conclusions of the ecological assessment of the ORS for aquatic receptors (5.8.1) and for terrestrial receptors (5.8.2).

5.8.1 Aquatic Summary

The aforementioned analyses evaluated the potential impacts of concentrations of site-specific COCs to different media and representative receptors. With respect to the surface water in the main channel of the Ohio River, compounds evaluated for potential impacts were copper and mercury. Concentrations of copper in surface water were above the benchmark concentration for fish and invertebrates. Concentrations of mercury were below the benchmark values for both aquatic receptors.

No site-specific COCs were identified in the back channel surface water.

For the main channel sediments, copper, lead, mercury, total PCBs and total PAHs are of possible concern; however, their levels are indicative of a low potential for adverse ecological effects (Table 5-7). Nickel and zinc are of greater concern and are at levels approaching probable concern for potential adverse effects to the aquatic benthic environment.

For the back channel sediments, copper, lead, mercury and zinc have been identified as of possible concern. Nickel, benzo(a)anthracene, naphthalene, and phenanthrene exceed the ER-Ms and are of greater concern. Total PAHs in the back channel sediments were identified at levels indicative of probable adverse ecological risks. Dibenzofuran and cyanide were not evaluated due to a lack of appropriate sediment criteria.

It should be noted that because of the highly disturbed and industrialized nature of the Ohio River, these potential effects may be caused by a number of sources other than the ORS. For example, concentrations of copper in sediments may in fact result from deposition of particulates from sources upstream of the ORS or PAH concentrations in the sediment may have resulted from historical upstream discharges.

5.8.2 Terrestrial Summary

It should be noted that the site was used for commercial/industrial purposes for over 40 years and that the existing terrestrial system has reestablished itself on disturbed land.

The appearance of the existing vegetation is only one indicator of ecological effects. Soil criteria or ecotoxicological benchmarks provide another measure of potential adverse effects. Due to the lack of applicable soil criteria (i.e., ecotoxicological benchmarks), potential risks due to site-specific soil COCs are very difficult to estimate. One alternative method of estimating potential risks is through a semi-quantitative risk assessment, a method which is also recognized by U.S. EPA Region 3 guidance. A semi-quantitative risk assessment was conducted to provide a more quantitative basis for assigning potential ecological risk. The results of this assessment are presented in Appendix F.

6.0 COMPARISON BETWEEN SECONDARY LEVEL AND SITE-SPECIFIC RISK ASSESSMENTS

The secondary level evaluation provides a preliminary qualitative estimate of potential ecological risks associated with the COCs (Section 4.0). It examines the potential risks associated with the secondary level COCs which are not screened out by application of generic, site-independent factors. The site-specific risk assessment provides a more focused and detailed examination of the risks by incorporating available site information (Section 5.0). It is useful to compare the results of the two assessments as a means of evaluating the effect that application of site-specific information has on refining the estimated level of the potential risks at the ORS. This indicates how the characteristics and setting of the ORS affect estimates of potential risk to ecological receptors located on-site and in the vicinity. This also aids in the final interpretation of potential risk and the conclusions presented in Section 7.0.

The results of the two evaluations and potential risks associated with COCs are compared for each medium and potential reasons for the differences discussed. The evaluations are presented in the following sections: for surface water, Section 6.1; for sediments, Section 6.2; for soil, Section 6.3; and for groundwater, Section 6.4.

6.1 Surface Water

The comparison of the results of the two assessments of surface water was conducted by examining the selection of the COCs following the secondary level and site-specific evaluations (Section 6.1.1), comparing the results of the secondary level and site-specific risk assessments (Section 6.1.2), and discussing the differences (Section 6.1.3).

6.1.1 Selection of COCs Following Evaluations

There are no differences between the COCs selected in surface water during the secondary level evaluation (Table 4-1) and site-specific risk evaluation. Mercury and copper were selected as COCs in the main channel and there were no COCs identified in the back channel (Table 4-2).

Site-specific information (i.e., hardness) had previously been applied during the screening level risk evaluation (as suggested by U.S. EPA Region 3 staff). Additional site-specific information which could be considered if available would be the water-effects ratio, which would adjust the criteria to reflect the ambient water quality conditions in the Ohio River with respect to the fraction of total to dissolved fractions, the influence of dissolved organic compounds as chelating agents, etc (U.S.EPA, 1994).

6.1.2 Comparison of the Results Following Risk Assessments

The secondary level risk assessment indicated mercury at levels of probable environmental risk and copper at levels of possible risk, based on the EEQ. The site-specific risk assessment also indicates that chronic AWQCs are exceeded, but considered the potential impact to local benthic communities to be less than predicted by the AWQCs, based on comparison of mercury and copper levels to ecotoxicological benchmarks considered appropriate for the warmwater fishery found in the Ohio River at the ORS (Table 5-6).

Based on the site-specific risk assessment, it was concluded that neither copper or mercury would be likely to pose an adverse environmental risk. Further, the probability that the ORS is responsible for the elevated levels of these metals in the main and back channels of the Ohio River is considered extremely low.

6.1.3 Discussion

The finding of elevated mercury and copper in the main channel of the Ohio River is not unexpected, given the high level of industry, commercial, urban, and mining activities in the watershed and located immediately upstream. The contribution of the ORS to the level of copper and mercury can not be determined, but appears to negligible for the following reasons. The transport pathway of copper and mercury from the ORS to the Ohio River would presumably be via direct runoff, desorption from sediments, or groundwater discharge. Each of these is addressed below.

Given the size of the ORS, the quantitative hydrologic contribution of either direct runoff or groundwater to the flow volume of the Ohio River is minuscule and COC concentrations would be diluted below detection limits. Further, there is no pattern to the detections or concentrations in the main channel which is indicative of the ORS as a point source for these metals. Levels of these metals were below environmental concern in the back channel, which presumably would receive a larger proportional contribution (due to the lower flow volume of the back channel) than the main channel.

Mercury and copper are found in the sediments in the main channel and back channel, but the source of these metals in the sediments could potentially be due to hundreds of discharges and activities found in the Ohio River watershed. Desorption of these materials into the water column for copper and mercury will likely be slight. Finally, there was no mercury detected in the back channel monitoring wells which indicates the mercury transport through groundwater discharge is negligible. Overall, these factors indicate that the ORS does not pose a significant risk to the surface water quality in the Ohio River.

6.2 Sediments

The differences between the secondary level risk assessment and the site-specific risk assessment were examined separately for the main and back channel sediments. The main channel sediments are discussed in Section 6.2.1 and the back channel sediments in Section 6.2.2.

6.2.1 Main Channel Sediments

The comparison of the results of the two assessments of the main channel sediments was conducted by examining the selection of the COCs following the secondary level and site-specific evaluations (Section 6.2.1.1), comparing the results of the secondary level and site-specific risk assessments (Section 6.2.1.2), and discussing the differences (Section 6.2.1.3).

6.2.1.1 Selection of COCs Following Evaluations

There were 36 COCs selected during the screening level evaluation, including 14 for which no AWQC or ER-M values were available (Table 4-3). Application of site-specific sediment quality criteria or sediment benchmarks and consideration of relative enrichment reduced this number to 7 COCs (Table 5-1). A total of 24 COCs were eliminated based on concentrations below the site-specific sediment criteria and the other 5 were removed due to consideration of relative enrichment. Clearly, the distinguishing factor between the two lists of COCs was the application of site-specific sediment criteria or benchmarks.

6.2.1.2 Comparison of Results Following Risk Assessments

The secondary level risk assessment indicated that 8 COCs were of probable concern, 14 were of possible concern, and 14 were unassessed (i.e., no AWQC or ER-M values were available). The secondary level COCs of probable concern included nickel, zinc, 2-methylnaphthalene, acenaphthene, benzo(a)anthracene, dibenz(a,h)anthracene, fluorene, and fluoranthene. The 14 secondary level COCs identified as of possible ecological concern were metals, chlordanes, and PAHs (Table 4-3). In contrast, the site-specific risk assessment of the main channel sediment COCs indicated that nickel and zinc were of probable concern, and copper, lead, mercury, total PCBs, and total PAHs were of possible concern (Table 5-7).

The two risk assessments generally agree with the contaminants of greatest concern - namely nickel, zinc, and total PAHs. The reduction of individual PAH are due to the application of site-specific criteria or sediment benchmarks, adjusted for the channel-specific organic carbon content. These results may reflect the inherent differences between the NOAA sediment guidance values (i.e., ER-Ls/ER-Ms and sediment quality criteria) and the equilibrium partitioning based site-specific sediment benchmarks.

6.2.1.3 Discussion

It has been noted earlier that the ER-L/ER-M guidance values represent simple statistical parameters associated with data distributions of potential impacted benthic communities, particularly marine invertebrates. For example, sediment guidance values developed by Long and MacDonald are based on data derived only from estuarine and marine environments and freshwater data were excluded (Long and MacDonald, 1992). Since many compounds are more toxic to marine organisms than freshwater organisms, these values tend to be conservative and may overestimate potential ecological risk to freshwater benthic communities.

On the other hand, sediment quality criteria (SQC) are developed analogous to the development of ambient water quality criteria through direct toxicological testing of freshwater aquatic organisms. It is possible to use the relationship between the ER-L values and the three recently-issued sediment quality criteria for acenaphthene, fluoranthene, and phenanthrene (U.S. EPA 1993b; 1993e; 1993f) to illustrate the differences between the ER-L and SQC approaches. At 1% total organic carbon, a conservative value for the ORS sediments, the freshwater SQC values for acenaphthene (1,300 µg/kg), fluoranthene (6,200 µg/kg), and phenanthrene (1,800 µg/kg) are 10.3 times, 81 times, and 7.5 times higher than the corresponding ER-Ls for these compounds. In fact, all of the freshwater SQC exceed the ER-M values as well. It appears from this relationship that an exceedance of the ER-L is not necessarily an indication of potential harmful effects and the slight exceedances are unlikely to result in harmful effects on aquatic organisms.

The origin of the PAHs in the sediments of the main channel was not determined. Most of the reported PAHs were detected at levels below the upstream reference site (see Table 3-3). This suggests that the potential source of the PAHs is not directly linked to the ORS or, at least, it is very difficult to assess the contribution of ORS to the COC level in the main channel sediments.

Finally, the potential influence of the treatment of non-detected value as 1/2 SQL even when they exceed the report maximum (following the request of U.S. EPA Region 3) has already been discussed (see Section 4.7) as indicated by the example of dibenz(a,h)anthracene. The potential influence of this data reduction protocol was not evaluated for all parameters.

6.2.2 Back Channel Sediments

The comparison of the results of the two assessments of the back channel sediments was conducted by examining the selection of the COCs following the secondary level and site-specific evaluations (Section 6.2.2.1), comparing the results of the secondary level and site-specific risk assessments (Section 6.2.2.2), and discussing the differences (Section 6.2.2.3).

6.2.2.1 Selection of COCs Following Evaluations

There were 41 COCs selected during the screening level evaluation, including 20 for which no AWQC or ER-M values were available (Table 4-4). Application of site-specific sediment quality criteria or sediment benchmarks and consideration of relative enrichment reduced this number to 11 COCs (Table 5-2). A total of 24 COCs were eliminated based on concentrations below the site-specific sediment criteria, 4 were removed due to consideration of relative enrichment, and 2 were eliminated based on having a single detection. Again, as was the case with the main channel sediments, the key factor in identifying site-specific COCs was the application of site-specific sediment criteria or benchmarks.

6.2.2.2 Comparison of Results Following Risk Assessments

The secondary level risk assessment indicated that 14 COCs were of probable concern, 7 were of possible concern, and 20 were unassessed (i.e., no criteria). The secondary level COCs of probable concern included nickel, 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene and total PAHs. The 7 COCs identified as of possible ecological concern were metals, chlordanes, dieldrin and PCBs (Table 4-4). In contrast, the site-specific risk assessment of the back channel sediment COCs indicated that nickel, benzo(a)anthracene, naphthalene, phenanthrene, and total PAHs were of probable ecological concern (Table 5-8). Copper, lead, mercury, and zinc were of possible concern, while dibenzofuran and cyanide were not evaluated due to lack of ecotoxicological data to derive sediment quality criteria.

The two risk assessments identify similar contaminants of greatest concern - namely nickel and several individual and total PAHs. The higher toxicity quotients associated with the back channel sediments is indicative of the higher PAH levels that are found there than in the main channel.

6.2.2.3 Discussion

The results between the secondary level risk assessment and site-specific risk assessment are qualitatively similar. Nickel is of probable concern in both the main and back channel sediments. The source of the nickel does not appear to be due to simple migration of soil from the ORS because higher concentrations of nickel were found in the sediment than those found in the surface soils. The 95% UCL for soil nickel (26.9 mg/kg) was below the minimum sediment value. It is possible that upstream sources have contributed to the elevated levels of nickel in the sediments of both channels.

The disparity between the interpretation of sediment quality through comparison to NOAA guidance values vs. SQC/sediment benchmarks has already been discussed in Section 6.2.1.3. It would be expected that, due to the higher organic carbon content, the back channel sediments would accumulate a greater level of nonionic organic compounds than would the main channel, even under the same surface water quality regime. The higher organic carbon content found in the back channel is also consistent as an area of greater deposition for finer-grained materials than would the main channel.

6.3 Soils

The comparison of the results of the two assessments of soil was conducted by examining the selection of the COCs following the secondary level and site-specific evaluations (Section 6.3.1), comparing the results of the secondary level and site-specific risk assessments (Section 6.3.2), and discussing the differences (Section 6.3.3).

6.3.1 Selection of COCs Following Evaluations

There were 66 surface soils COCs selected during the secondary level evaluation, including 61 for which no ecotoxicological benchmarks (i.e., U.S. EPA Region 3 suggested soil criteria) were available (Table 4-5). Consideration of relative enrichment and detection frequency reduced this number to 31 COCs (Table 5-3). A total of 25 COCs were eliminated based on consideration of relative enrichment, and 6 were eliminated based on have a low detection frequency. A low detection frequency was defined as a frequency of detection less than or equal to approximately 5 percent. For the ORS soils, this meant that a compound detected only once or twice in the surface soil samples was eliminated. This evaluation of the frequency of detection is similar to the approach suggested for human health assessment of Superfund sites (U.S. EPA, 1989c). The key selection factor was the application of a relative enrichment criterion (i.e., soil compound concentration 10 times greater than background concentration) for selection of site-specific soil COCs.

6.3.2 Comparison of the Results Following Risk Assessments

The results of the secondary level risk assessment indicated that mercury was of probable concern and that arsenic, lead, manganese, and zinc were of possible concern, with the vast majority of the soil compounds unassessed due to a lack of soil criteria. Preliminary assessment of potential ecological risk was not merited due to the large number of unevaluated compounds. As a means to evaluate the potential effect of the soil compounds, the site-specific risk assessment using representative (surrogate) species was conducted. Due to the different potential pathways, eastern mole and raccoon were selected to evaluate potential risks associated with exposure to the soil pathways (see appendix F for details).

The chronic adverse health effect estimates for terrestrial species were calculated in a manner parallel to the calculation of human hazard indices. The exposure dose is divided by the appropriate dose-response value to derive a hazard quotient. The level of ecological concern assigned to the noncarcinogenic hazard quotient is defined by the criteria established by the U.S. EPA (1988). Conclusions are expressed as of "no concern" if the ratio is less than or equal to 0.1; "possible concern" if the ratio falls between 0.1 and 10; and "probable concern" if the ratio is greater than 10. Hazard estimates for each animal species evaluated are presented in Tables 5-9 and 5-10, and summarized below. A more detailed discussion and analysis of the results of the semi-quantitative risk assessment are presented in Appendix F.

Evaluation of the eastern mole as the representative species found that lead was of probable ecological risk and that arsenic, manganese, methylmercury, zinc, 2,3,7,8-TCDD, and total PAHs were of possible concern. A number of site-specific COCs were identified as of possible concern, but had toxicity quotients above 0.1 but below 1.0. Due to the level of the toxicity quotients, these were considered of very low concern. These included cyanide, inorganic mercury, benzo(a)-anthracene, benzo(a)pyrene, chrysene, fluoranthene, and pyrene.

All other site-specific soil COCs had hazard quotients which were below 0.1, and were considered of no concern. Since the eastern mole is potentially more highly exposed to these compounds and is used as an indicator for other terrestrial mammalian species in the area, the analysis indicates no potential adverse effect exists in those species from those compounds either.

The raccoon risk assessment indicated fewer compounds of concern than that for the eastern mole. Compounds of possible concern included copper, lead, manganese, mercury, zinc, 2,3,7,8-TCDD, and total PAHs. No compounds of probable concern were identified.

6.3.3 Discussion

In the case of surface soil compounds, other than a few metals, sufficient ecotoxicological information was not available to perform a preliminary risk assessment. The general lack of meaningful soil criteria for secondary level soil COCs limits the utility of any pronouncements of risk at this level. Unlike human health assessment, where soil limits have been determined by a number of regulatory agencies (e.g. PADER), soil limits based on ecological considerations are few in number and not systematically derived.

During earlier conversations, U.S. EPA Region 3 staff suggested using 2 times the ER-L limit as a possible soil criteria (R. Davis, pers. comm. to W. Alsop, dated February 9, 1994). After careful consideration, this suggested approach was not used. It was considered that extrapolation of guidance values for sediments to soil was not appropriate due to the unevaluated and fundamental differences in soil chemistry and physical conditions (e.g. saturated, anaerobic vs. dry, aerobic) between the two solid matrices. This leaves little alternative but to consider additional means such as the semi-quantitative assessment (recognized by U.S. EPA Region 3 guidance) with representative ecological receptor.

A closer look at the surface soil COCs of probable and possible concern identified in the site-specific risk assessment using eastern mole examined the risk associated with individual pathways. The majority of the risk identified with the site-specific COCs of probable and possible concern is associated with the consumption of earthworms and incidental ingestion of soil. The moles were assumed to spend their entire lifetime on the ORS, an assumption which results in a hazard quotient for a highly exposed organism.

The mammalian receptors used in the semi-quantitative assessment were assumed to spend their entire lives exposed to concentrations of the site-specific COCs. This assumption is likely to overestimate exposure because it does not address degradation of the compounds, nor movement of the representative species in and out of the area. For example, it was assumed that raccoons would obtain all their food from the ORS rather than foraging in the residential areas adjacent to the ORS. Similarly, conservative exposure assumptions were also made that would be likely to overestimate risk. The assessment also assumed that raccoons will consume twenty-five percent of their daily diet by feeding on fish or amphibians in the back channel of the Ohio River for each year of their lives. Although fish move freely within the river system, the assessment assumed that some fish would inhabit the stretch of the river near the ORS and would not move outside of this area. It is unlikely that fish will remain solely in this stretch of the river and that the fish tissue concentrations will be as high as predicted using conservative BCF values which do not address biological uptake, metabolism, or depuration. It is also unlikely, because of the freezing of the shallower areas of the back channel that the raccoon will be able to obtain this portion of its diet from this limited stretch of the river during the winter months.

The dose-response values used for the terrestrial species were extrapolated from data on similar species because no direct dose-response information was available for the mole or raccoon. The extrapolation from laboratory species involved conservative assumptions; thus, it is likely that the dose-response values chosen will result in overestimates of the potential for adverse effects.

For the terrestrial assessment, the selection of these receptors overestimates potential ecosystem effects. The receptors were chosen based on their potentially higher exposures, resulting from trophic level (raccoon) or limited home range (mole). Thus, it is assumed that if these representative species are minimally affected, the potential for ecosystem-level effects are also unlikely. The effect of these assumptions is to overestimate the potential for adverse ecological effects to other species.

The compounds of highest concern are 2,3,7,8-TCDD and lead. The majority of risk associated with 2,3,7,8-TCDD is due to a single soil sample, while lead is more evenly distributed over this site. Comparison of ORS soil levels to the average and range of soil concentrations found in the eastern United States indicated that arsenic, lead, manganese, and zinc were higher than average; however, they are well within the range observed elsewhere in the region (ATSDR, 1992).

The risk associated with methylmercury is probably an overestimate of potential ecological risk, since a value of 10% mercury was used to estimate the amount of organic mercury levels in surface soils. Typical sediment values are 0.01 to 10% (EPRI, 1987) and aerobic surface soils would be expected to have even less (due to reduced methylcarbon under aerobic conditions).

6.4 Groundwater

The comparison of the results of the two assessments of groundwater was conducted by examining the selection of the COCs following the secondary level and site-specific evaluations (Section 6.4.1), comparing the results of the secondary level and site-specific risk assessments (Section 6.4.2), and discussing the differences (Section 6.4.3).

6.4.1 Selection of COCs Following Evaluations

There were 40 groundwater COCs selected during the secondary level evaluation, including 22 for which no ecotoxicological benchmarks were available (Table 4-6). A site-specific exposure pathway - groundwater discharge to the back channel - as indicated by the water quality in the back channel wells was the basis for eliminating all groundwater COCs (Table 5-4).

It was assumed that concentrations in the three back channel wells were indicative of groundwater quality that might be discharged to the back channel of the Ohio River. This was a conservative assumption because it assumed no mixing would occur before potential exposure to the biota. It was also assumed that if groundwater discharge to the back channel was of no concern, then groundwater discharge to the main channel was also of no concern, since the flow volume in the main channel is much greater. Inspection of the groundwater data indicated that only 11 site-specific COCs were measured and the rest were not detected. The data for the 11 site-specific COCs were carefully inspected and the site-specific COCs were determined to be of no concern due to concentrations below the chronic AWQCs or available ecotoxicological benchmarks, low detection frequencies, and/or concentrations below background concentrations. The individual site-specific COCs and reasons for their removal from further evaluation are discussed in Section 5.4.2.

6.4.2 Comparison of the Results Following Risk Assessments

The results of the secondary level risk assessment indicated that mercury, silver, zinc, dieldrin, and endrin aldehyde were of probable concern and that cadmium, total chromium, copper, cyanide, lead, 2,4,6-trichlorophenol, 2,4-dichlorophenol, 2-nitrophenol, bis(2-ethylhexyl)phthalate, naphthalene, phenol, endosulfan II, and carbon disulfide were of possible concern. The site-specific risk assessment found no COCs of probable or possible concern based on concentrations in the back channel wells. All of the site-specific COCs were non-detects except silver, zinc, total chromium, copper, and cyanide. Silver and cyanide were found rarely and only in deep wells, chromium and copper were at levels below AWQCs, and zinc was below background concentrations (Section 5.4.2).

6.4.3 Discussion

The distinct difference between the findings of the secondary level risk assessment and the site-specific risk assessment is due to the application of a reasonable, qualitative fate and transport scenario to groundwater concentrations at the ORS. Briefly, the scenario reasoned that if groundwater was to be of potential ecological risk to biota it would require groundwater flow to a discharge point in the Ohio River. By making use of the available data from the back channel wells, it was shown that groundwater quality, as it was nearing the potential discharge point was not of ecological concern. It should be noted that this conclusion is independent of application of any mixing model that would account for the dilution of the groundwater, with the numerically-dominant river flow volume in the back channel.

6.5 Summary

Comparisons of the results of the secondary level and site-specific risk assessment for the various media at ORS show general agreement for surface water and sediment; however, they arrive at different conclusions of potential risk for the soil and groundwater assessments. The major reasons for the differences are (1) application of a semi-quantitative risk assessment using representative (surrogate) species for assessing soil conditions at ORS, and (2) application of a site-specific groundwater exposure pathway through the back channel wells. Application of site-specific information helps to refine the list of site-specific COCs and provide a more accurate portrayal of potential ecological risk at ORS.

7.0 CONCLUSIONS

A series of risk evaluations and assessments were made to identify COCs at the ORS and to provide an estimate of the potential for adverse ecological effects associated with levels of these COCs. The evaluations included screening level, secondary level, and site-specific risk evaluations. Estimates of potential risk were based on comparisons to ecotoxicological benchmarks, to background concentrations, and by application of best professional judgement. The major conclusions of the ecological risk assessment were based on all of the information from the conceptual site model, screening level evaluation, secondary level evaluation, as well as the results of the site-specific risk assessment.

7.1 Surface Water

The major findings of the ecological risk assessment of COCs in the main and back channel surface water of the Ohio River are:

- copper and mercury were identified as site-specific COCs for the main channel surface water, but application of ecological benchmarks appropriate to the local biota indicate that neither COC is likely to pose an adverse environmental risk;
- no COCs were identified in the surface water of the back channel of the Ohio River; and
- it was concluded that the ORS does not pose a potential adverse ecological risk to the aquatic biota in the surface waters of the Ohio River.

7.2 Sediments

The major findings of the ecological risk assessment of the COCs in the sediments of the main and back channels of the Ohio River are:

- nickel, zinc, and total PAHs were of probable ecological concern in the main channel sediments, and copper, lead, mercury, and total PCBs were of possible ecological concern;
- nickel, benzo(a)anthracene, naphthalene, phenanthrene, and total PAHs were of probable ecological concern in the back channel sediments, and copper, lead, mercury, and zinc were of possible ecological concern;

- it was concluded that the sediments in the main and back channels of the Ohio River pose a low to moderate potential adverse ecological risk to the aquatic benthic communities residing there; and

- the origin of the COCs in the sediments is not certain due to the large number of potential sources upstream of ORS.

7.3 Surface Soil

The major findings of the ecological risk assessments for the surface soil at the ORS are:

- both screening level and secondary level evaluations indicate a larger number or COCs including many metals, herbicidal pesticides, PCBs, PAHs, and volatile/semi-volatile organic compounds;

- direct comparison of soil compound concentration to ecotoxicological criteria was not possible due to a general lack of soil criteria;

- therefore, a semi-quantitative risk assessment using eastern mole and raccoon as representative species was used to provide an estimate of potential ecological risks due to soil;

- risk assessment of the eastern mole indicated that lead, 2,3,7,8-TCDD, and total PAHs were of probable ecological concern, and arsenic, manganese, mercury, zinc, and several individual PAHs were of possible ecological concern;

- risk assessment of the raccoon indicated copper, lead, manganese, mercury, 2,3,7,8-TCDD, and total PAHs to be of possible ecological concern;

- application of site-specific information about the site distributions of the COCs and comparison to ranges of naturally occurring soil concentrations mitigated the level of concern for some COCs; and

- it was concluded that the ORS surface soils pose a low potential adverse ecological risk to the terrestrial species residing there.

7.4 Groundwater

The major findings of the ecological risk assessment for the groundwater at the ORS are:

- ecological risk assessment of COCs in groundwater was limited by uncertainty regarding their effective concentrations at the point of exposure to aquatic biota;
- a groundwater pathway scenario using groundwater quality from back channel monitoring wells was used to provide an estimate of the potential ecological risk;
- application of the groundwater pathway scenario, and back channel well water quality data indicate no COCs in the groundwater potentially discharging to the river; and
- it was concluded that groundwater at the ORS does not pose a potential for adverse ecological risk to the aquatic biota in the Ohio River.

7.5 Discussion

The potential ecological effects were also assessed by examining the distribution of organisms caught in previous studies in the Ohio River (as discussed in Section 2.1.7) and did not indicate major differences in species between the Dashields and Emsworth Pools in the Ohio River. However, uncertainty associated with sampling locations prevents direct correlation of the findings to the potential effects to the benthic community posed by the ORS.

It is worth considering that the finding of no major differences between the two adjacent pools does not mean that the river is unaffected by anthropogenic activities. The Ohio River watershed is a large basin which drains many land uses, including agricultural, industrial, municipal and residential. It is impossible to completely differentiate the influence that these upstream activities have on the surface water and sediment quality around Neville Island and the Ohio River Site.

Likewise, it is impossible to eliminate the natural level of physical and biological disturbance inherent to the flow dynamics of the Ohio River, which leads to variable rates of erosion, deposition and changes in habitat suitability. These physical disturbances range from barge traffic to dredging operations to maintain the channels in both the Ohio River main and back channels. These two factors, the upstream land use and the river's dynamics, need to be considered when evaluating possible stresses that are acting on the organisms in the back channel of the Ohio River.

Another consideration is the potential cumulative effects of the toxicity posed by individual compounds. The toxicity quotient method does not account for the possibility of additive or synergistic effects of multiple compounds in the aquatic environment. According to U.S. EPA guidance, toxicity quotients cannot be added but rather must be ranked relative to one another (U.S. EPA, 1988). Addition of toxicity quotients would be inappropriate because the benchmarks upon which the toxicity quotients are based represent a variety of different species and a variety of different toxicity endpoints. Recent research conducted on the Naugatuck River in Connecticut demonstrated that the observed toxicity in that river system was less than the additive toxicity of the individual compound concentrations discharged to the river by industrial and sewage treatment plant sources (Di Toro et al., 1991). Although potential additive effects cannot be evaluated by summing toxicity quotients, it is unlikely that significant additive effects would occur because the individual toxicity quotients are comparatively low or negligible.

7.6 Summary

An ecological risk assessment of the ORS has been conducted to estimate the potential ecological risk posed by COCs in the various media at ORS. The risk assessment includes a conservative screening level evaluation which identified CPCs. These CPCs were further evaluated through a secondary level evaluation and, finally, through a site-specific evaluation which incorporated knowledge of site characteristics, specific exposure pathways, the magnitude of the COCs, and best professional judgement to provide a quantitative measure of the potential ecological risk.

The results of the ecological risk assessment, incorporating both aquatic and terrestrial risk analyses, indicate that the surface water and groundwater do not pose a potential adverse ecological risk to the Ohio River. Surface soil at the ORS was judged to pose a low potential ecological risk to terrestrial receptors. Sediments in the main and back channels pose low and low to moderate ecological risks, respectively.

The conclusions of the ecological risk assessment are subject to the normal limitations and uncertainties associated with data collection and the underlying assumptions necessary to conduct an assessment. The ecological risk assessment provides estimates of potential ecological risk at various levels of site specificity. These estimates can be used to support risk management decisions related to these ecological communities at the ORS.

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TABLE A-7

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	42.50	903.00	246.01	83.79	458.14	6: 9: 9
ANTIMONY	22.30	82.50	20.92	15.78	35.41	2: 9: 9
ARSENIC	2.10	8.30	3.47	2.30	5.16	4: 9: 9
BARIUM	27.00	217.00	94.95	70.35	144.93	8: 8: 8
CALCIUM	25500.00	501000.00	232855.56	137686.45	354671.87	9: 9: 9
CHROMIUM	11.80	11.80	3.91	3.32	6.05	1: 8: 8
COBALT	20.20	34.00	9.30	6.32	15.91	2: 9: 9
COPPER	7.10	7.10	3.01	2.81	3.96	1: 9: 9
CYANIDE	19.70	55.20	13.04	6.19	24.19	3: 9: 9
IRON	52.00	424000.00	101610.17	5466.10	210549.45	8: 9: 9
MAGNESIUM	3820.00	190000.00	72227.78	31954.54	118671.13	9: 9: 9
MANGANESE	3.60	86300.00	19885.29	697.22	42673.81	8: 9: 9
NICKEL	18.40	27.20	10.79	8.40	16.14	3: 9: 9
POTASSIUM	1870.00	7020.00	4218.89	3593.74	5676.95	9: 9: 9
SILVER	17.70	17.70	4.24	3.07	7.41	1: 9: 9
SODIUM	16700.00	882000.00	228711.11	80881.78	444184.89	9: 9: 9
THALLIUM	1.00	1.00	2.67	1.70	4.41	1: 9: 9
ZINC	15.10	217.00	62.19	19.11	128.96	3: 7: 7

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	42.50	903.00	246.01	83.79	458.14	6: 9: 9
ANTIMONY	22.30	82.50	20.92	15.78	35.41	2: 9: 9
ARSENIC	2.10	8.30	3.47	2.30	5.16	4: 9: 9
BARIUM	27.00	217.00	94.95	70.35	144.93	8: 8: 8
CALCIUM	25500.00	501000.00	232855.56	137686.45	354671.87	9: 9: 9
CHROMIUM	11.80	11.80	3.91	3.32	6.05	1: 8: 8
COBALT	20.20	34.00	9.30	6.32	15.91	2: 9: 9
COPPER	7.10	7.10	3.01	2.81	3.96	1: 9: 9
CYANIDE	19.70	55.20	13.04	6.19	24.19	3: 9: 9
IRON	52.00	424000.00	101610.17	5466.10	210549.45	8: 9: 9
MAGNESIUM	3820.00	190000.00	72227.78	31954.54	118671.13	9: 9: 9
MANGANESE	3.60	86300.00	19885.29	697.22	42673.81	8: 9: 9
NICKEL	18.40	27.20	10.79	8.40	16.14	3: 9: 9
POTASSIUM	1870.00	7020.00	4218.89	3593.74	5676.95	9: 9: 9
SILVER	17.70	17.70	4.24	3.07	7.41	1: 9: 9
SODIUM	16700.00	882000.00	228711.11	80881.78	444184.89	9: 9: 9
THALLIUM	1.00	1.00	2.67	1.70	4.41	1: 9: 9
ZINC	15.10	217.00	62.19	19.11	128.96	3: 7: 7

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A7 - BACK CHANNEL GROUNDWATER

TABLE A-6

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4,6-TRICHLOROPHENOL	1.00	210000.00	7092.46	14.91	13127.35	13: 71: 71
2,4-DICHLOROPHENOL	1.00	36000.00	1447.18	12.36	2616.52	14: 71: 71
2,4-DIMETHYLPHENOL	1.00	19000.00	1019.22	11.64	1775.80	16: 71: 71
2-CHLOROPHENOL	17.00	6700.00	388.13	10.72	656.79	6: 71: 71
2-METHYLPHENOL	1.00	58000.00	2613.08	10.69	4748.43	16: 71: 71
2-NITROPHENOL	1.00	20000.00	863.43	11.32	1562.35	1: 71: 71
4-METHYLPHENOL	2.00	76000.00	3498.30	11.60	6350.12	21: 71: 71
BIS(2-ETHYLHEXYL)PHTHALATE	1.00	20000.00	863.48	11.09	1562.40	8: 71: 71
DI-N-BUTYLPHTHALATE	1.00	20000.00	863.43	11.32	1562.35	1: 71: 71
DI-N-OCTYLPHTHALATE	1.00	20000.00	863.29	10.99	1562.22	4: 71: 71
NAPHTHALENE	1.00	20000.00	863.39	11.18	1562.31	2: 71: 71
PHENOL	3.00	85000.00	3329.30	12.95	6158.46	11: 71: 71
TOTAL NON-CARCINOGENIC PAH	1.00	2.00	1.50	1.41	4.66	2: 2: 2
TOTAL PAH	1.00	2.00	1.50	1.41	4.66	2: 2: 2

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-6
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
VOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
1,1,1-TRICHLOROETHANE	1.90	2500.00	126.49	9.23	217.21	3: 79: 79
1,1,2-TRICHLOROETHANE	8.00	2500.00	127.10	8.88	217.81	2: 79: 79
1,2-DICHLOROETHANE	0.88	2500.00	125.22	8.77	215.90	3: 79: 79
1,2-DICHLOROETHENE (T)	4.40	2500.00	127.05	9.07	217.76	1: 79: 79
2-BUTANONE	7.00	2500.00	130.38	9.72	223.38	2: 77: 77
ACETONE	6.00	2500.00	137.69	11.97	230.54	9: 77: 77
BENZENE	3.00	50000.00	1074.73	10.88	2171.96	13: 79: 79
BROMOFORM	4.00	29000.00	974.59	12.53	1820.92	12: 79: 79
CARBON DISULFIDE	4.00	2500.00	130.31	9.61	223.30	2: 77: 77
CHLOROBENZENE	10.00	2500.00	127.06	8.83	217.77	1: 79: 79
CHLOROETHANE	38.00	2500.00	127.42	8.98	218.11	1: 79: 79
METHYLENE CHLORIDE	0.85	2500.00	127.01	8.89	217.72	1: 79: 79
TETRACHLOROETHENE	1.20	2500.00	127.01	8.92	217.72	1: 79: 79
TOLUENE	3.00	2500.00	126.92	8.63	217.64	4: 79: 79
TRICHLOROETHENE	0.27	2500.00	127.15	8.93	217.85	3: 79: 79

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-8

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4,5-T	0.60	1.00	0.09	0.06	0.12	1: 69: 69
2,4,5-TP	0.11	1.50	0.15	0.08	0.21	11: 69: 69
2,4-D	1.20	190.00	3.91	0.70	8.44	5: 69: 69

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-6

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
4,4'-DDE	0.01	0.60	0.15	0.08	0.18	1: 69: 69
ALPHA-BHC	0.01	0.29	0.07	0.04	0.09	1: 69: 69
DIELDRIN	0.01	0.60	0.15	0.08	0.18	1: 69: 69
ENDOSULFAN II	0.01	0.60	0.14	0.08	0.18	3: 69: 69
ENDRIN ALDEHYDE	0.01	0.60	0.14	0.07	0.18	8: 69: 69

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-8
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	33.00	229000.00	28251.23	2905.48	36921.09	57: 69: 69
ANTIMONY	21.00	91.80	18.28	15.16	21.57	13: 67: 67
ARSENIC	2.10	62.20	7.29	3.89	9.21	31: 67: 67
BARIUM	18.30	3820.00	641.41	252.75	822.71	67: 67: 67
BERYLLIUM	1.50	30.70	2.52	1.16	3.41	26: 66: 66
CADMIUM	5.80	203.00	6.48	2.49	11.33	11: 69: 69
CALCIUM	25500.00	604000.00	228207.25	29308.66	264022.26	69: 69: 69
CHROMIUM	5.40	202.00	40.51	14.47	52.03	41: 63: 63
COBALT	8.10	402.00	64.10	22.99	81.81	45: 69: 69
COPPER	7.10	1890.00	85.67	22.43	132.01	48: 69: 69
CYANIDE	5.10	335.00	22.80	7.99	33.23	32: 68: 68
IRON	10.40	455000.00	102696.69	17461.94	128641.40	65: 69: 69
LEAD	1.00	510.00	27.66	7.61	41.28	28: 66: 66
MAGNESIUM	3820.00	190000.00	55418.99	29308.66	63811.03	69: 69: 69
MANGANESE	3.60	187000.00	27791.63	6312.49	35588.02	67: 69: 69
MERCURY	0.22	1.00	0.19	0.12	0.24	21: 69: 69
NICKEL	13.90	943.00	103.47	33.30	136.03	45: 69: 69
POTASSIUM	1320.00	20100.00	6479.86	5270.37	7304.90	69: 69: 69
SELENIUM	10.00	10.00	2.60	1.77	3.52	1: 20: 20
SILVER	3.50	33.90	4.57	3.28	5.67	12: 69: 69

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-6
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
ALL SAMPLES COMBINED GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
SODIUM	4980.00	882000.00	99235.36	29308.66	126598.57	69: 69: 69
THALLIUM	1.00	7.50	1.53	1.09	1.85	4: 69: 69
VANADIUM	5.00	238.00	44.55	9.59	58.04	32: 66: 66
ZINC	4.90	185000.00	3088.77	104.71	7623.35	49: 67: 67

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A6 - COMBINED AREA GROUNDWATER

TABLE A-5

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
DIOXINS

COMPOUND	MINIMUM DETECT (PG/G)	MAXIMUM DETECT (PG/G)	ARITH. MEAN (PG/G)	GEOMETRIC MEAN (PG/G)	UPPER 95% CONF. LIMIT (PG/G)	FREQUENCY OF DETECTION[1]
2,3,7,8-TCDD	2.90	420.00	68.76	14.77	151.92	7: 9: 9

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
HEXACHLOROBUTADIENE	5200.00	5200.00	1319.53	877.46	1661.02	1: 32: 34
INDENO(1,2,3-CD)PYRENE	130.00	19000.00	3132.06	1330.61	4398.86	26: 34: 34
NAPHTHALENE	53.00	340000.00	12229.94	1179.84	28125.13	26: 35: 35
PHENANTHRENE	89.00	100000.00	7518.35	2239.87	12494.17	29: 34: 34
PHENOL	1200.00	1200.00	577.38	485.26	703.66	1: 21: 34
PYRENE	70.00	63000.00	7644.26	2789.04	11143.10	31: 34: 34
TOTAL CARCINOGENIC PAH	1229.00	144900.00	27277.76	12443.28	37400.04	34: 34: 34
TOTAL B(A)P-TE	393.44	36109.00	6761.50	3355.92	9089.91	34: 34: 34
TOTAL NON-CARCINOGENIC PAH	1924.00	353000.00	45775.97	17865.03	67599.50	35: 35: 35
TOTAL PAH	3153.00	453200.00	72274.37	31242.38	101027.05	35: 35: 35

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
VOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
1,1,1-TRICHLOROETHANE	3.00	8.00	6.16	6.10	6.38	2: 34: 35
1,1-DICHLOROETHENE	5.00	5.00	5.00	5.00	NC	1: 1: 35
1,2-DICHLOROETHENE (T)	5.00	9.00	6.25	6.21	6.47	3: 34: 35
4-METHYL-2-PENTANONE	10.00	10.00	6.30	6.26	6.53	1: 32: 33
ACETONE	16.00	16.00	6.54	6.41	7.04	1: 34: 35
BENZENE	4.00	22.00	7.18	6.67	8.24	6: 34: 35
CARBON DISULFIDE	4.00	4.00	4.00	4.00	NC	1: 1: 35
CHLOROBENZENE	4.00	4.00	4.00	4.00	NC	1: 1: 33
CHLOROFORM	3.00	12.00	6.29	6.04	6.80	12: 34: 35
ETHYLBENZENE	3.00	14.00	6.03	5.80	6.56	9: 33: 34
METHYLENE CHLORIDE	3.00	14.00	6.97	6.61	7.69	10: 33: 35
TETRACHLOROETHENE	3.00	7.00	5.64	5.50	5.96	10: 33: 34
TOLUENE	3.00	29.00	7.53	6.42	9.09	19: 33: 34
TOTAL BTEX	15.00	53.00	20.43	19.44	22.72	34: 34: 34
TOTAL XYLENES	3.00	3.00	3.00	3.00	NC	1: 1: 33
TRICHLOROETHENE	3.00	22.00	8.04	7.02	9.39	22: 34: 35

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM. DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
HEPTACHLOR	4.60	240.00	14.62	3.94	26.56	10: 34: 34
HEPTACHLOR EPOXIDE	0.58	47.00	5.80	3.03	8.29	13: 34: 34
METHOXYCHLOR	0.98	590.00	48.34	24.61	76.17	2: 34: 34
TOTAL PCB	50.00	720.00	215.51	156.47	266.30	34: 34: 34
TOXAPHENE	500.00	500.00	235.58	185.24	292.85	1: 26: 34

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,6-TRICHLOROPHENOL	260.00	970.00	479.32	421.31	569.92	6: 22: 34
2,4-DICHLOROPHENOL	120.00	2000.00	815.40	590.56	1034.60	4: 25: 34
2-METHYLNAPHTHALENE	140.00	13000.00	1705.29	833.10	2418.63	15: 35: 35
ACENAPHTHENE	160.00	4900.00	1082.58	713.49	1383.80	12: 33: 34
ACENAPHTHYLENE	520.00	520.00	353.21	332.02	409.72	1: 14: 34
ANTHRACENE	240.00	18000.00	2231.18	935.63	3280.99	27: 34: 34
BENZO(A)ANTHRACENE	140.00	35000.00	5255.74	2214.52	7363.30	30: 34: 34
BENZO(A)PYRENE	130.00	25000.00	4270.29	1687.38	5911.62	27: 34: 34
BENZO(B)FLUORANTHENE	130.00	42000.00	6793.68	2429.34	9636.76	30: 34: 34
BENZO(G,H,I)PERYLENE	140.00	20000.00	2869.71	1171.03	4059.48	25: 34: 34
BENZO(K)FLUORANTHENE	340.00	20000.00	2401.62	1229.17	3434.41	27: 34: 34
BIS(2-ETHYLHEXYL)PHTHALATE	180.00	71000.00	4423.09	1100.15	8006.98	16: 34: 34
CARBAZOLE	120.00	3100.00	915.47	604.90	1157.71	13: 32: 33
CHRYSENE	89.00	34000.00	4479.82	1843.16	6384.15	30: 34: 34
DI-N-BUTYLPHTHALATE	180.00	180.00	180.00	180.00	NC	1: 1: 33
DIBENZ(A,H)ANTHRACENE	210.00	3600.00	1003.59	709.30	1249.46	10: 32: 33
DIBENZOFURAN	150.00	11000.00	1432.35	785.76	1997.54	15: 34: 34
DIETHYLPHTHALATE	150.00	1100.00	558.42	474.53	681.05	2: 19: 33
FLUORANTHENE	72.00	97000.00	10187.71	3331.18	15317.32	32: 34: 34
FLUORENE	120.00	4500.00	1129.85	706.81	1459.80	17: 34: 34

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	1.20	2900.00	193.81	32.64	336.04	31: 35: 35
2,4,5-TP	1.20	3900.00	146.18	12.87	352.17	25: 31: 31
2,4-D	12.00	10000.00	692.74	191.04	1177.45	34: 35: 35

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
4,4'-DDD	0.55	210.00	12.23	4.91	22.17	4: 34: 34
4,4'-DDE	0.33	17.00	5.74	3.75	7.04	6: 33: 34
4,4'-DDT	0.86	360.00	40.28	9.04	61.57	18: 34: 34
ALDRIN	0.71	260.00	23.22	5.38	37.86	19: 34: 34
ALPHA-BHC	0.45	830.00	50.92	7.59	91.61	18: 34: 34
ALPHA-CHLORDANE	0.27	450.00	25.23	3.68	47.73	23: 34: 34
AROCLOR-1242	13.00	110.00	54.57	41.48	66.02	3: 30: 34
AROCLOR-1254	11.00	140.00	62.55	47.14	74.70	4: 32: 34
AROCLOR-1260	25.00	500.00	108.50	61.66	145.38	7: 34: 34
BETA-BHC	5.50	1800.00	65.62	4.38	152.67	9: 34: 34
DELTA-BHC	0.60	410.00	18.58	3.80	38.27	13: 34: 34
DIELDRIN	0.72	140.00	18.91	5.82	29.78	13: 34: 34
ENDOSULFAN I	17.00	17.00	3.63	2.54	4.57	1: 34: 34
ENDOSULFAN II	0.48	54.00	8.29	4.75	11.20	8: 34: 34
ENDOSULFAN SULFATE	2.40	48.00	7.99	5.14	10.58	4: 34: 34
ENDRIN	1.80	12.00	5.60	4.31	6.73	4: 32: 34
ENDRIN ALDEHYDE	2.00	6.20	2.66	2.48	3.15	2: 19: 34
ENDRIN KETONE	0.27	74.00	8.75	4.51	12.64	6: 34: 34
GAMMA-BHC (LINDANE)	0.87	2100.00	146.41	9.64	268.82	17: 34: 34
GAMMA-CHLORDANE	0.37	900.00	44.02	4.97	88.74	21: 34: 34

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	7410.00	27100.00	13795.76	13131.67	15133.24	33: 33: 33
ARSENIC	2.30	43.00	10.71	9.56	12.60	33: 33: 33
BARIUM	24.00	345.00	193.30	177.40	213.27	33: 33: 33
BERYLLIUM	0.64	5.10	1.29	0.81	1.70	19: 24: 24
CALCIUM	886.00	128000.00	36205.03	17526.39	46739.32	33: 33: 33
CHROMIUM	8.50	56.00	21.85	19.52	25.14	33: 33: 33
COBALT	2.60	36.00	11.21	9.30	13.18	32: 33: 33
COPPER	13.00	390.00	55.39	38.86	76.21	33: 33: 33
CYANIDE	0.67	114.00	13.09	3.32	20.95	25: 31: 31
IRON	16300.00	67300.00	34406.06	32850.11	37672.22	33: 33: 33
LEAD	13.00	294.00	67.70	52.25	84.20	33: 33: 33
MAGNESIUM	381.00	8330.00	3267.61	2797.13	3796.34	33: 33: 33
MANGANESE	193.00	6600.00	1602.64	1353.90	1918.64	33: 33: 33
MERCURY	0.15	8.60	0.52	0.19	0.94	19: 33: 33
NICKEL	7.30	67.00	23.46	21.23	26.91	33: 33: 33
POTASSIUM	520.00	2260.00	1358.58	1293.23	1476.38	33: 33: 33
SELENIUM	1.30	2.50	0.49	0.33	0.66	4: 33: 33
SILVER	2.40	2.40	0.68	0.65	0.77	1: 33: 33
SODIUM	82.00	528.00	290.79	258.66	356.45	14: 14: 14
THALLIUM	0.56	1.80	0.72	0.64	0.83	13: 33: 33

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-5

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
COMBINED AREAS A & B SURFACE SOIL
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
VANADIUM	10.00	298.00	28.91	21.01	42.90	33: 33: 33
ZINC	10.00	955.00	166.64	122.28	217.38	33: 33: 33

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A5 - SURFACE SOILS

TABLE A-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
TOTAL CARCINOGENIC PAH	7820.00	49700.00	20587.50	15481.55	43689.85	4: 4: 4
TOTAL B(A)P-TE	1580.30	10201.70	4456.80	3441.30	9077.01	4: 4: 4
TOTAL NON-CARCINOGENIC PAH	9040.00	69800.00	26325.00	17915.59	60661.43	4: 4: 4
TOTAL PAH	16860.00	119500.00	46912.50	33462.65	104338.06	4: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
VOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2-BUTANONE	45.00	950.00	273.25	78.32	805.37	2: 4: 4
ACETONE	180.00	950.00	370.00	155.28	851.74	2: 4: 4
CARBON DISULFIDE	5.00	950.00	243.25	24.83	797.58	1: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
4,4'-DDD	1.30	2.45	1.89	1.81	2.62	3: 4: 4
ALPHA-CHLORDANE	0.53	1.80	1.15	1.05	1.77	3: 4: 4
AROCLOR-1242	40.00	40.00	31.75	31.28	39.23	1: 4: 4
AROCLOR-1260	35.00	70.00	45.63	42.23	69.23	3: 4: 4
DIELDRIN	1.50	2.70	2.21	2.16	2.82	3: 4: 4
ENDRIN	0.64	3.25	2.54	2.12	4.02	1: 4: 4
ENDRIN KETONE	1.70	3.25	2.63	2.55	3.46	1: 4: 4
GAMMA-BHC (LINDANE)	0.67	1.65	1.31	1.23	1.85	1: 4: 4
GAMMA-CHLORDANE	1.60	3.50	2.01	1.86	3.20	3: 4: 4
TOTAL PCBs	49.00	101.50	77.38	74.82	103.12	4: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2-METHYLNAPHTHALENE	290.00	5500.00	2190.00	1112.97	5075.55	2: 4: 4
ACENAPHTHENE	250.00	5500.00	1840.00	906.92	4751.94	3: 4: 4
ANTHRACENE	430.00	5500.00	2530.00	1623.43	5290.26	3: 4: 4
BENZO(A)ANTHRACENE	2100.00	12000.00	5025.00	3841.30	10548.60	4: 4: 4
BENZO(A)PYRENE	1100.00	7300.00	3150.00	2417.00	6474.18	4: 4: 4
BENZO(B)FLUORANTHENE	1700.00	11000.00	4625.00	3531.76	9677.45	4: 4: 4
BENZO(G,H,I)PERYLENE	750.00	4900.00	2112.50	1638.24	4328.35	4: 4: 4
BENZO(K)FLUORANTHENE	920.00	5500.00	3205.00	2330.53	6189.72	3: 4: 4
BIS(2-ETHYLHEXYL)PHTHALATE	330.00	50000.00	14757.50	3821.08	42588.82	4: 4: 4
CARBAZOLE	770.00	5500.00	2042.50	1361.98	4771.43	1: 4: 4
CHRYSENE	1100.00	8700.00	3500.00	2511.89	7644.00	4: 4: 4
DI-N-OCTYLPHTHALATE	2600.00	2600.00	1775.00	1530.88	2932.22	1: 4: 4
DIBENZ(A,H)ANTHRACENE	330.00	5500.00	2270.00	1323.40	5064.84	1: 4: 4
DIBENZOFURAN	230.00	5500.00	2195.00	1298.88	4897.82	2: 4: 4
FLUORANTHENE	2800.00	22000.00	8225.00	5589.00	19075.36	4: 4: 4
FLUORENE	220.00	5500.00	2185.00	1072.14	5077.84	3: 4: 4
INDENO(1,2,3-CD)PYRENE	900.00	5400.00	2375.00	1878.10	4779.16	4: 4: 4
NAPHTHALENE	400.00	5500.00	2117.50	1321.44	4860.51	3: 4: 4
PHENANTHRENE	1500.00	16000.00	5450.00	3223.71	13739.39	4: 4: 4
PYRENE	2400.00	18000.00	7200.00	5192.68	15773.13	4: 4: 4

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	9530.00	16600.00	11575.00	11259.84	15539.84	4: 4: 4
ARSENIC	10.00	16.00	12.00	11.80	15.19	4: 4: 4
BARIUM	107.00	174.00	140.50	138.33	173.70	4: 4: 4
BERYLLIUM	2.00	2.00	1.08	0.56	6.90	1: 2: 2
CALCIUM	4420.00	13600.00	8870.00	7859.21	14459.07	4: 4: 4
CHROMIUM	29.00	103.00	67.00	60.48	104.39	4: 4: 4
COBALT	23.00	55.00	33.75	31.84	50.70	4: 4: 4
COPPER	65.00	170.00	101.50	94.57	157.02	4: 4: 4
CYANIDE	2.00	10.00	4.78	3.83	9.16	4: 4: 4
IRON	48800.00	181000.00	118450.00	106990.81	182483.13	4: 4: 4
LEAD	65.00	121.00	95.50	93.23	122.61	4: 4: 4
MAGNESIUM	1220.00	2700.00	1945.00	1862.36	2701.96	4: 4: 4
MANGANESE	1460.00	2390.00	1930.00	1901.20	2376.76	4: 4: 4
MERCURY	0.20	0.29	0.21	0.20	0.31	3: 4: 4
NICKEL	56.00	83.00	73.25	72.45	87.18	4: 4: 4
POTASSIUM	819.00	1630.00	1073.50	1029.51	1523.59	4: 4: 4
SELENIUM	1.00	4.20	1.46	0.81	3.64	2: 4: 4
VANADIUM	23.00	23.00	23.00	23.00	NC	1: 1: 1
ZINC	327.00	409.00	359.50	358.21	401.65	4: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-4

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SEDIMENT
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	1.50	340.00	96.63	22.47	287.88	3: 4: 4
2,4,5-TP	1.50	25.00	15.75	10.55	27.66	3: 4: 4
2,4-D	15.50	200.00	132.63	93.59	227.74	2: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A4 - BACK CHANNEL SEDIMENTS

TABLE A-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
TOTAL PAH	6650.00	30910.00	17592.00	15534.41	26348.77	5: 5: 5

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-3

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SEDIMENT
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
4,4'-DDD	2.55	8.00	3.36	2.77	5.89	1: 5: 5
ALPHA-CHLORDANE	0.82	12.00	4.52	2.33	9.44	5: 5: 5
AROCLOR-1242	24.50	80.00	33.40	27.50	58.79	1: 5: 5
AROCLOR-1248	9.10	80.00	30.82	22.27	58.43	2: 5: 5
AROCLOR-1254	13.00	380.00	133.00	54.44	291.07	3: 5: 5
AROCLOR-1260	69.00	80.00	42.30	33.83	71.02	1: 5: 5
DIELDRIN	2.55	8.00	3.36	2.77	5.89	1: 5: 5
ENDRIN	2.55	8.00	3.36	2.77	5.89	1: 5: 5
ENDRIN ALDEHYDE	1.65	8.00	3.36	2.77	5.89	2: 5: 5
ENDRIN KETONE	0.52	8.00	2.87	1.96	5.69	1: 5: 5
GAMMA-CHLORDANE	1.90	13.00	4.17	2.38	9.06	2: 5: 5
TOTAL PCBs	38.60	380.00	166.12	112.38	308.41	5: 5: 5

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2-METHYLNAPHTHALENE	240.00	1600.00	854.00	649.10	1486.58	2: 5: 5
ACENAPHTHENE	435.00	1600.00	775.00	683.61	1233.43	2: 5: 5
ANTHRACENE	230.00	810.00	518.00	474.16	735.57	4: 5: 5
BENZO(A)ANTHRACENE	540.00	3500.00	1698.00	1369.62	2823.94	4: 5: 5
BENZO(A)PYRENE	290.00	3000.00	1388.00	1075.96	2354.94	5: 5: 5
BENZO(B)FLUORANTHENE	490.00	3300.00	1738.00	1475.16	2700.58	5: 5: 5
BENZO(G,H,I)PERYLENE	190.00	1800.00	830.00	662.19	1391.93	4: 5: 5
BENZO(K)FLUORANTHENE	370.00	1000.00	606.00	566.28	852.48	4: 5: 5
CHRYSENE	270.00	1600.00	1022.00	880.15	1494.68	5: 5: 5
DIBENZ(A,H)ANTHRACENE	435.00	1600.00	751.00	656.27	1219.61	2: 5: 5
DIBENZOFURAN	435.00	1600.00	955.00	813.38	1508.44	1: 5: 5
FLUORANTHENE	830.00	4200.00	2866.00	2467.51	4240.20	5: 5: 5
FLUORENE	435.00	1550.00	761.00	675.05	1200.30	2: 5: 5
INDENO(1,2,3-CD)PYRENE	200.00	1900.00	904.00	723.37	1492.70	5: 5: 5
NAPHTHALENE	170.00	1600.00	715.00	534.87	1270.73	4: 5: 5
PHENANTHRENE	390.00	3600.00	1778.00	1403.01	2937.51	5: 5: 5
PYRENE	640.00	4000.00	2428.00	2052.50	3664.16	5: 5: 5
TOTAL CARCINOGENIC PAH	2670.00	14830.00	7637.00	6610.52	11914.93	5: 5: 5
TOTAL B(A)P-TE	857.67	4411.60	2110.08	1794.86	3440.40	5: 5: 5
TOTAL NON-CARCINOGENIC PAH	3980.00	16080.00	9955.00	8870.58	14605.88	5: 5: 5

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-3
ONIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SEDIMENT
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	16100.00	22400.00	19120.00	18923.79	22055.20	5: 5: 5
ARSENIC	9.50	20.00	14.90	14.29	19.35	5: 5: 5
BARIUM	157.00	370.00	219.00	208.51	300.63	5: 5: 5
BERYLLIUM	2.70	3.60	2.98	2.96	3.32	5: 5: 5
CALCIUM	3720.00	99800.00	30612.00	14475.21	69486.20	5: 5: 5
CHROMIUM	24.00	97.00	66.80	59.71	96.03	5: 5: 5
COBALT	18.00	45.00	28.60	26.97	39.10	5: 5: 5
COPPER	53.00	169.00	101.80	92.36	147.97	5: 5: 5
CYANIDE	8.80	29.00	12.47	7.26	22.35	4: 5: 5
IRON	58900.00	107000.00	88340.00	86640.49	105561.31	5: 5: 5
LEAD	134.00	214.00	166.60	163.80	199.58	5: 5: 5
MAGNESIUM	2420.00	6750.00	3486.00	3204.84	5239.73	5: 5: 5
MANGANESE	1210.00	4900.00	2346.00	2023.20	3815.70	5: 5: 5
MERCURY	0.45	0.67	0.44	0.34	0.65	4: 5: 5
NICKEL	32.00	98.00	61.40	56.28	87.79	5: 5: 5
POTASSIUM	1490.00	2200.00	1804.00	1788.47	2059.27	5: 5: 5
SELENIUM	0.78	1.80	0.90	0.67	1.56	3: 5: 5
SODIUM	360.00	719.00	539.50	508.76	1672.86	2: 2: 2
VANADIUM	17.00	28.00	23.25	22.88	28.63	4: 4: 4
ZINC	221.00	5170.00	1450.40	767.01	3441.04	5: 5: 5

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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ORIGINAL
(Red)

TABLE A-3

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SEDIMENT
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	22.00	320.00	84.00	40.49	209.97	3: 5: 5
2,4,5-TP	13.00	22.00	17.20	16.81	21.04	1: 5: 5
2,4-D	130.00	220.00	172.00	168.10	210.38	1: 5: 5

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A3 - MAIN CHANNEL SEDIMENTS

TABLE A-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SURFACE WATER
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
GAMMA-CHLORDANE	0.02	0.03	0.02	0.02	0.03	1: 4: 4

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SURFACE WATER
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
DI-N-BUTYLPHTHALATE	2.00	5.00	4.25	3.98	6.01	1: 4: 4

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-2

OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SURFACE WATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	134.00	314.00	225.75	215.66	314.04	4: 4: 4
BARIUM	38.00	40.00	39.00	38.99	39.96	4: 4: 4
CALCIUM	19600.00	26000.00	22750.00	22634.33	25861.99	4: 4: 4
CHROMIUM	19.00	19.00	7.75	5.91	16.57	1: 4: 4
COPPER	13.00	13.00	5.50	4.33	11.38	1: 4: 4
IRON	519.00	803.00	631.25	621.05	788.40	4: 4: 4
MAGNESIUM	5050.00	6660.00	5825.00	5796.02	6615.42	4: 4: 4
MANGANESE	170.00	204.00	186.75	186.35	203.43	4: 4: 4
POTASSIUM	1350.00	1580.00	1467.50	1464.96	1584.51	4: 4: 4
SODIUM	8960.00	13800.00	11590.00	11451.52	13963.42	4: 4: 4
ZINC	20.00	24.00	22.00	21.94	24.15	4: 4: 4

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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Original (Rev)

TABLE A-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL SURFACE WATER
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4,5-T	0.05	0.05	0.05	0.05	0.05	1: 4: 4
2,4,5-TP	0.05	0.05	0.05	0.05	0.05	1: 4: 4
2,4-D	0.50	0.50	0.50	0.50	0.50	1: 4: 4

---

[1] Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A2 - BACK CHANNEL SURFACE WATER

TABLE A-1
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SURFACE WATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	111.00	406.00	206.20	182.48	321.66	5: 5: 5
BARIUM	37.00	42.00	39.00	38.94	41.24	5: 5: 5
CALCIUM	17400.00	25200.00	23040.00	22823.78	26214.89	5: 5: 5
CHROMIUM	10.00	15.00	7.40	6.26	12.15	2: 5: 5
COPPER	21.00	87.00	32.80	15.24	67.01	3: 5: 5
IRON	400.00	1090.00	608.60	566.15	878.29	5: 5: 5
MAGNESIUM	4430.00	6570.00	5918.00	5859.92	6749.68	5: 5: 5
MANGANESE	153.00	243.00	201.60	197.76	242.74	5: 5: 5
MERCURY	0.64	0.79	0.35	0.22	0.67	2: 5: 5
POTASSIUM	1320.00	1800.00	1604.00	1593.65	1793.93	5: 5: 5
SODIUM	7210.00	14300.00	12242.00	11898.02	14990.18	5: 5: 5
ZINC	19.00	31.00	24.20	23.64	29.82	5: 5: 5

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.

NC: Not calculated.

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Original (Red)

TABLE A-1
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL SURFACE WATER
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4,5-T	0.05	0.05	0.05	0.05	0.05	4: 5: 5
2,4,5-TP	0.05	0.05	0.05	0.05	0.05	4: 5: 5
2,4-D	0.50	0.50	0.50	0.50	0.50	4: 5: 5

---

[1] Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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A1 - MAIN CHANNEL SURFACE WATER

APPENDIX A - SITE SUMMARY DATA TABLES

- A1 - MAIN CHANNEL SURFACE WATER
- A2 - BACK CHANNEL SURFACE WATER
- A3 - MAIN CHANNEL SEDIMENTS
- A4 - BACK CHANNEL SEDIMENTS
- A5 - SURFACE SOILS
- A6 - COMBINED AREA GROUNDWATER
- A7 - BACK CHANNEL GROUNDWATER

TABLE A-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
VOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2-BUTANONE	10.00	10.00	6.11	5.83	7.48	1: 9: 9
ACETONE	6.00	33.00	8.78	6.80	14.50	2: 9: 9
BENZENE	44.00	44.00	9.89	6.88	17.89	1: 9: 9
CHLOROETHANE	38.00	38.00	9.22	6.77	15.99	1: 9: 9
TOTAL BTEX	20.00	59.00	26.56	24.36	35.14	9: 9: 9

---

[1] Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
TOTAL PCBs	4.00	4.00	4.00	4.00	4.00	8: 8: 8

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE A-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4-DIMETHYLPHENOL	1.00	15.00	5.95	4.62	8.48	5: 10: 10
2-METHYLPHENOL	1.00	3.00	3.95	3.36	5.03	4: 10: 10
4-METHYLPHENOL	3.00	12.00	5.95	5.42	7.63	5: 10: 10

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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APPENDIX B - BACKGROUND SUMMARY DATA TABLES

- B1 - MAIN CHANNEL SURFACE WATER
- B2 - BACK CHANNEL SURFACE WATER
- B3 - MAIN CHANNEL SEDIMENTS
- B4 - BACK CHANNEL SEDIMENTS
- B5 - SURFACE SOILS
- B6 - COMBINED AREA GROUNDWATER
- B7 - BACK CHANNEL GROUNDWATER

B1 - MAIN CHANNEL SURFACE WATER

TABLE B-1
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL BACKGROUND SURFACE WATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	270.00	270.00	270.00	270.00	NC	1: 1: 1
BARIUM	41.00	41.00	41.00	41.00	NC	1: 1: 1
CALCIUM	20900.00	20900.00	20900.00	20900.00	NC	1: 1: 1
IRON	697.00	697.00	697.00	697.00	NC	1: 1: 1
MAGNESIUM	5310.00	5310.00	5310.00	5310.00	NC	1: 1: 1
MANGANESE	221.00	221.00	221.00	221.00	NC	1: 1: 1
POTASSIUM	1490.00	1490.00	1490.00	1490.00	NC	1: 1: 1
SODIUM	10000.00	10000.00	10000.00	10000.00	NC	1: 1: 1
ZINC	39.00	39.00	39.00	39.00	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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B2 - BACK CHANNEL SURFACE WATER

TABLE B-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SURFACE WATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	199.00	199.00	199.00	199.00	NC	1: 1: 1
BARIUM	39.00	39.00	39.00	39.00	NC	1: 1: 1
CALCIUM	25800.00	25800.00	25800.00	25800.00	NC	1: 1: 1
IRON	628.00	628.00	628.00	628.00	NC	1: 1: 1
MAGNESIUM	6610.00	6610.00	6610.00	6610.00	NC	1: 1: 1
MANGANESE	194.00	194.00	194.00	194.00	NC	1: 1: 1
POTASSIUM	1700.00	1700.00	1700.00	1700.00	NC	1: 1: 1
SODIUM	13800.00	13800.00	13800.00	13800.00	NC	1: 1: 1
ZINC	15.00	15.00	15.00	15.00	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SURFACE WATER
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4,5-T	0.05	0.05	0.05	0.05	NC	1: 1: 1
2,4,5-TP	0.05	0.05	0.05	0.05	NC	1: 1: 1
2,4-D	0.50	0.50	0.50	0.50	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-2
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SURFACE WATER
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
BIS(2-ETHYLHEXYL)PHTHALATE	2.00	2.00	2.00	2.00	NC	1: 1: 1

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[1] Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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B3 - MAIN CHANNEL SEDIMENTS

TABLE B-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL BACKGROUND SEDIMENT
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	12300.00	12300.00	12300.00	12300.00	NC	1: 1: 1
ARSENIC	18.00	18.00	18.00	18.00	NC	1: 1: 1
BARIUM	189.00	189.00	189.00	189.00	NC	1: 1: 1
CALCIUM	34500.00	34500.00	34500.00	34500.00	NC	1: 1: 1
CHROMIUM	25.00	25.00	25.00	25.00	NC	1: 1: 1
COBALT	24.00	24.00	24.00	24.00	NC	1: 1: 1
COPPER	44.00	44.00	44.00	44.00	NC	1: 1: 1
CYANIDE	5.30	5.30	5.30	5.30	NC	1: 1: 1
IRON	61300.00	61300.00	61300.00	61300.00	NC	1: 1: 1
LEAD	57.00	57.00	57.00	57.00	NC	1: 1: 1
MAGNESIUM	4710.00	4710.00	4710.00	4710.00	NC	1: 1: 1
MANGANESE	2250.00	2250.00	2250.00	2250.00	NC	1: 1: 1
NICKEL	44.00	44.00	44.00	44.00	NC	1: 1: 1
POTASSIUM	798.00	798.00	798.00	798.00	NC	1: 1: 1
VANADIUM	14.00	14.00	14.00	14.00	NC	1: 1: 1
ZINC	246.00	246.00	246.00	246.00	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL BACKGROUND SEDIMENT
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	11.00	11.00	11.00	11.00	NC	1: 1: 1
2,4,5-TP	1.20	1.20	1.20	1.20	NC	1: 1: 1
2,4-D	12.50	12.50	12.50	12.50	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL BACKGROUND SEDIMENT
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
ALPHA-CHLORDANE	0.85	0.85	0.85	0.85	NC	1: 1: 1
AROCLOR-1248	14.00	14.00	14.00	14.00	NC	1: 1: 1
AROCLOR-1254	26.00	26.00	26.00	26.00	NC	1: 1: 1
ENDRIN ALDEHYDE	1.65	1.65	1.65	1.65	NC	1: 1: 1
TOTAL PCBs	40.00	40.00	40.00	40.00	NC	1: 1: 1

---

1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-3
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
MAIN CHANNEL BACKGROUND SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
ANTHRACENE	2100.00	2100.00	2100.00	2100.00	NC	1: 1: 1
BENZO(A)ANTHRACENE	6400.00	6400.00	6400.00	6400.00	NC	1: 1: 1
BENZO(A)PYRENE	5500.00	5500.00	5500.00	5500.00	NC	1: 1: 1
BENZO(B)FLUORANTHENE	6500.00	6500.00	6500.00	6500.00	NC	1: 1: 1
BENZO(G,H,I)PERYLENE	2300.00	2300.00	2300.00	2300.00	NC	1: 1: 1
BENZO(K)FLUORANTHENE	3000.00	3000.00	3000.00	3000.00	NC	1: 1: 1
CHRYSENE	5700.00	5700.00	5700.00	5700.00	NC	1: 1: 1
FLUORANTHENE	12000.00	12000.00	12000.00	12000.00	NC	1: 1: 1
FLUORENE	600.00	600.00	600.00	600.00	NC	1: 1: 1
INDENO(1,2,3-CD)PYRENE	2300.00	2300.00	2300.00	2300.00	NC	1: 1: 1
PHENANTHRENE	5800.00	5800.00	5800.00	5800.00	NC	1: 1: 1
PYRENE	9200.00	9200.00	9200.00	9200.00	NC	1: 1: 1
TOTAL CARCINOGENIC PAH	29400.00	29400.00	29400.00	29400.00	NC	1: 1: 1
TOTAL B(A)P-TE	7055.70	7055.70	7055.70	7055.70	NC	1: 1: 1
TOTAL NON-CARCINOGENIC PAH	32000.00	32000.00	32000.00	32000.00	NC	1: 1: 1
TOTAL PAH	61400.00	61400.00	61400.00	61400.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

B4 - BACK CHANNEL SEDIMENTS

TABLE B-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SEDIMENT
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	10800.00	10800.00	10800.00	10800.00	NC	1: 1: 1
ARSENIC	7.60	7.60	7.60	7.60	NC	1: 1: 1
BARIUM	156.00	156.00	156.00	156.00	NC	1: 1: 1
BERYLLIUM	1.10	1.10	1.10	1.10	NC	1: 1: 1
CALCIUM	4130.00	4130.00	4130.00	4130.00	NC	1: 1: 1
CHROMIUM	17.00	17.00	17.00	17.00	NC	1: 1: 1
COBALT	17.00	17.00	17.00	17.00	NC	1: 1: 1
COPPER	33.00	33.00	33.00	33.00	NC	1: 1: 1
IRON	37300.00	37300.00	37300.00	37300.00	NC	1: 1: 1
LEAD	40.00	40.00	40.00	40.00	NC	1: 1: 1
MAGNESIUM	2090.00	2090.00	2090.00	2090.00	NC	1: 1: 1
MANGANESE	760.00	760.00	760.00	760.00	NC	1: 1: 1
NICKEL	27.00	27.00	27.00	27.00	NC	1: 1: 1
POTASSIUM	1160.00	1160.00	1160.00	1160.00	NC	1: 1: 1
VANADIUM	19.00	19.00	19.00	19.00	NC	1: 1: 1
ZINC	101.00	101.00	101.00	101.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

TABLE B-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SEDIMENT
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	14.50	14.50	14.50	14.50	NC	1: 1: 1
2,4,5-TP	14.50	14.50	14.50	14.50	NC	1: 1: 1
2,4-D	145.00	145.00	145.00	145.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SEDIMENT
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
ALDRIN	0.45	0.45	0.45	0.45	NC	1: 1: 1
ALPHA-CHLORDANE	0.32	0.32	0.32	0.32	NC	1: 1: 1
AROCLOR-1260	41.00	41.00	41.00	41.00	NC	1: 1: 1
DIELDRIN	2.80	2.80	2.80	2.80	NC	1: 1: 1
GAMMA-CHLORDANE	1.30	1.30	1.30	1.30	NC	1: 1: 1
TOTAL PCBs	41.00	41.00	41.00	41.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-4
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL BACKGROUND SEDIMENT
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
BENZO(A)ANTHRACENE	250.00	250.00	250.00	250.00	NC	1: 1: 1
BENZO(A)PYRENE	170.00	170.00	170.00	170.00	NC	1: 1: 1
BENZO(B)FLUORANTHENE	240.00	240.00	240.00	240.00	NC	1: 1: 1
BENZO(G,H,I)PERYLENE	120.00	120.00	120.00	120.00	NC	1: 1: 1
BENZO(K)FLUORANTHENE	69.00	69.00	69.00	69.00	NC	1: 1: 1
BIS(2-ETHYLHEXYL)PHTHALATE	110.00	110.00	110.00	110.00	NC	1: 1: 1
CHRYSENE	130.00	130.00	130.00	130.00	NC	1: 1: 1
DI-N-BUTYLPHTHALATE	88.00	88.00	88.00	88.00	NC	1: 1: 1
FLUORANTHENE	270.00	270.00	270.00	270.00	NC	1: 1: 1
INDENO(1,2,3-CD)PYRENE	100.00	100.00	100.00	100.00	NC	1: 1: 1
PHENANTHRENE	170.00	170.00	170.00	170.00	NC	1: 1: 1
PYRENE	260.00	260.00	260.00	260.00	NC	1: 1: 1
TOTAL CARCINOGENIC PAH	959.00	959.00	959.00	959.00	NC	1: 1: 1
TOTAL B(A)P-TE	229.82	229.82	229.82	229.82	NC	1: 1: 1
TOTAL NON-CARCINOGENIC PAH	820.00	820.00	820.00	820.00	NC	1: 1: 1
TOTAL PAH	1779.00	1779.00	1779.00	1779.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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B5 - SURFACE SOILS

TABLE B-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES SURFACE SOIL
INORGANICS

COMPOUND	MINIMUM DETECT (MG/KG)	MAXIMUM DETECT (MG/KG)	ARITH. MEAN (MG/KG)	GEOMETRIC MEAN (MG/KG)	UPPER 95% CONF. LIMIT (MG/KG)	FREQUENCY OF DETECTION[1]
ALUMINUM	13100.00	13100.00	13100.00	13100.00	NC	1: 1: 1
ARSENIC	8.30	8.30	8.30	8.30	NC	1: 1: 1
BARIUM	130.00	130.00	130.00	130.00	NC	1: 1: 1
CALCIUM	2160.00	2160.00	2160.00	2160.00	NC	1: 1: 1
CHROMIUM	16.00	16.00	16.00	16.00	NC	1: 1: 1
COBALT	15.00	15.00	15.00	15.00	NC	1: 1: 1
COPPER	20.00	20.00	20.00	20.00	NC	1: 1: 1
IRON	30900.00	30900.00	30900.00	30900.00	NC	1: 1: 1
LEAD	36.00	36.00	36.00	36.00	NC	1: 1: 1
MAGNESIUM	1920.00	1920.00	1920.00	1920.00	NC	1: 1: 1
MANGANESE	1080.00	1080.00	1080.00	1080.00	NC	1: 1: 1
NICKEL	21.00	21.00	21.00	21.00	NC	1: 1: 1
POTASSIUM	1260.00	1260.00	1260.00	1260.00	NC	1: 1: 1
VANADIUM	21.00	21.00	21.00	21.00	NC	1: 1: 1
ZINC	83.00	83.00	83.00	83.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

TABLE B-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES SURFACE SOIL
HERBICIDES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
2,4,5-T	12.50	12.50	12.50	12.50	NC	1: 1: 1
2,4,5-TP	12.50	12.50	12.50	12.50	NC	1: 1: 1
2,4-D	125.00	125.00	125.00	125.00	NC	1: 1: 1

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[1] Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

TABLE B-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES SURFACE SOIL
PESTICIDES AND PCBS

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
AROCLOR-1260	27.00	27.00	27.00	27.00	NC	1: 1: 1
GAMMA-CHLORDANE	0.36	0.36	0.36	0.36	NC	1: 1: 1
TOTAL PB	27.00	27.00	27.00	27.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

TABLE B-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES SURFACE SOIL
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
BENZO(A)ANTHRACENE	170.00	170.00	170.00	170.00	NC	1: 1: 1
BENZO(A)PYRENE	66.00	66.00	66.00	66.00	NC	1: 1: 1
BENZO(B)FLUORANTHENE	150.00	150.00	150.00	150.00	NC	1: 1: 1
BENZO(G,H,I)PERYLENE	76.00	76.00	76.00	76.00	NC	1: 1: 1
CHRYSENE	75.00	75.00	75.00	75.00	NC	1: 1: 1
DI-N-BUTYLPHTHALATE	63.00	63.00	63.00	63.00	NC	1: 1: 1
FLUORANTHENE	200.00	200.00	200.00	200.00	NC	1: 1: 1
INDENO(1,2,3-CD)PYRENE	60.00	60.00	60.00	60.00	NC	1: 1: 1
PHENANTHRENE	80.00	80.00	80.00	80.00	NC	1: 1: 1
PYRENE	170.00	170.00	170.00	170.00	NC	1: 1: 1
TOTAL CARCINOGENIC PAH	521.00	521.00	521.00	521.00	NC	1: 1: 1
TOTAL B(A)P-TE	104.08	104.08	104.08	104.08	NC	1: 1: 1
TOTAL NON-CARCINOGENIC PAH	526.00	526.00	526.00	526.00	NC	1: 1: 1
TOTAL PAH	1047.00	1047.00	1047.00	1047.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-5
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES SURFACE SOIL
VOLATILES

COMPOUND	MINIMUM DETECT (UG/KG)	MAXIMUM DETECT (UG/KG)	ARITH. MEAN (UG/KG)	GEOMETRIC MEAN (UG/KG)	UPPER 95% CONF. LIMIT (UG/KG)	FREQUENCY OF DETECTION[1]
1,2-DICHLOROETHENE (T)	4.00	4.00	4.00	4.00	NC	1: 1: 1
TOLUENE	4.00	4.00	4.00	4.00	NC	1: 1: 1
TOTAL BTEX	4.00	4.00	4.00	4.00	NC	1: 1: 1

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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B6 - COMBINED AREA GROUNDWATER

TABLE B-6
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACKGROUND SAMPLES GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	59800.00	134000.00	96900.00	89516.48	331149.40	2: 2: 2
ANTIMONY	18.00	39.30	28.65	26.60	95.89	2: 2: 2
ARSENIC	11.60	11.60	7.55	6.37	33.12	1: 2: 2
BARIUM	837.00	1720.00	1278.50	1199.85	4066.13	2: 2: 2
BERYLLIUM	6.40	6.60	6.50	6.50	7.13	2: 2: 2
CALCIUM	55000.00	58800.00	56900.00	56868.27	68896.60	2: 2: 2
CHROMIUM	101.00	230.00	165.50	152.41	572.75	2: 2: 2
COBALT	64.60	130.00	97.30	91.64	303.77	2: 2: 2
COPPER	100.00	238.00	169.00	154.27	604.67	2: 2: 2
IRON	138000.00	299000.00	218500.00	203130.50	726777.00	2: 2: 2
LEAD	56.80	57.00	56.90	56.90	57.53	1: 2: 2
MAGNESIUM	27400.00	38600.00	33000.00	32521.38	68358.40	2: 2: 2
MANGANESE	5400.00	11300.00	8350.00	7811.53	26976.30	2: 2: 2
MERCURY	0.37	0.93	0.65	0.59	2.42	2: 2: 2
NICKEL	140.00	261.00	200.50	191.15	582.50	2: 2: 2
POTASSIUM	9570.00	15900.00	12735.00	12335.44	32718.81	2: 2: 2
SODIUM	21600.00	22200.00	21900.00	21897.95	23794.20	2: 2: 2
VANADIUM	99.40	237.00	168.20	153.49	602.60	2: 2: 2
ZINC	314.00	724.00	519.00	476.80	1813.37	2: 2: 2

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

B7 - BACK CHANNEL GROUNDWATER

TABLE B-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
INORGANICS

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
ALUMINUM	42.50	903.00	246.01	83.79	458.14	6: 9: 9
ANTIMONY	22.30	82.50	20.92	15.78	35.41	2: 9: 9
ARSENIC	2.10	8.30	3.47	2.30	5.16	4: 9: 9
BARIUM	27.00	217.00	94.95	70.35	144.93	8: 8: 8
CALCIUM	25500.00	501000.00	232855.56	137686.45	354671.87	9: 9: 9
CHROMIUM	11.80	11.80	3.91	3.32	6.05	1: 8: 8
COBALT	20.20	34.00	9.30	6.32	15.91	2: 9: 9
COPPER	7.10	7.10	3.01	2.81	3.96	1: 9: 9
CYANIDE	19.70	55.20	13.04	6.19	24.19	3: 9: 9
IRON	52.00	424000.00	101610.17	5466.10	210549.45	8: 9: 9
MAGNESIUM	3820.00	190000.00	72227.78	31954.54	118671.13	9: 9: 9
MANGANESE	3.60	86300.00	19885.29	697.22	42673.81	8: 9: 9
NICKEL	18.40	27.20	10.79	8.40	16.14	3: 9: 9
POTASSIUM	1870.00	7020.00	4218.89	3593.74	5676.95	9: 9: 9
SILVER	17.70	17.70	4.24	3.07	7.41	1: 9: 9
SODIUM	16700.00	882000.00	228711.11	80881.78	444184.89	9: 9: 9
THALLIUM	1.00	1.00	2.67	1.70	4.41	1: 9: 9
ZINC	15.10	217.00	62.19	19.11	128.96	3: 7: 7

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

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TABLE B-7
OHIO RIVER SITE - NEVILLE TOWNSHIP, PA
SUMMARY STATISTICS FOR DETECTED COMPOUNDS
BACK CHANNEL WELLS GROUNDWATER
SEMIVOLATILES

COMPOUND	MINIMUM DETECT (UG/L)	MAXIMUM DETECT (UG/L)	ARITH. MEAN (UG/L)	GEOMETRIC MEAN (UG/L)	UPPER 95% CONF. LIMIT (UG/L)	FREQUENCY OF DETECTION[1]
2,4-DIMETHYLPHENOL	1.00	15.00	5.95	4.62	8.48	5: 10: 10
2-METHYLPHENOL	1.00	3.00	3.95	3.36	5.03	4: 10: 10
4-METHYLPHENOL	3.00	12.00	5.95	5.42	7.63	5: 10: 10

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1. Frequency of Detection = Number detected : Number used to calculate statistics : Number of sampling points.
NC: Not calculated.

Printed: 07/14/94

PENNSYLVANIA
DER

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
P.O. Box 8552
Harrisburg, PA 17105-8552
December 16, 1993

717/787-3444

Bureau of Forestry

Mr. Kenneth Battanyi
ENSR Consulting and Engineering
1001 Liberty Avenue
Pittsburgh, PA 15222

Dear Mr. Battanyi:

Re: PNDI Review of Neville Island and adjacent Ohio River Area, Allegheny County, Pennsylvania.

Your request of December 9, to review an area of the Ohio River including Neville Island for the presence of natural resources of special concern was processed using the Pennsylvania Natural Diversity Inventory (PNDI) [illegible]ation system.

Moxostoma c[illegible]a, the River Redhorse, was found in this reach of the Ohio Rive[illegible]5. This species is a candidate for possible future listing by [illegible]ennsylvania Fish and Boat Commission. In addition, specimen lists of the Carnegie Museum show that several freshwater mussel species of special concern were collected in this area before 1919 but the continued presence of these bivalves at this location has not been recently confirmed. These species are listed in a separate enclosure.

Legal authority for management of fish and aquatic organisms resides with the Pennsylvania Fish and Boat Commission (PFBC). Please contact Andy Shiels of the PFBC at 814/359-5113 for recommendations concerning any measures necessary to protect aquatic biological resources at this location.

PNDI is a site specific information system which describes significant natural resources of Pennsylvania. PNDI includes data descriptive of plant and animal species of special concern, exemplary natural communities and unique geological features. This response represents the most up-to-date summary of the PNDI data files.

Bill,
I received this
today.

FAX MEMO
PAGES 4 DATE 12/21 FAX#
TO Bill Blaxe
FROM KB
CO. FAX#
PH#

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Please phone our office if you have any questions regarding this response or the PNDI information system.

Sincerely,

Edward T. Dix
Botanist
Forest Advisory Services

Enclosure

cc: Andy Shiels, PFBC
Gregory Grabowicz, PGC
Charles Bier, PNDI-West
Charles Kulp, USFWS
John Arway, PFBC

FEDERALLY LISTED SPECIES THAT *NO LONGER OCCUR* (*OR MAY NO LONGER OCCUR**) IN PENNSYLVANIA

COMMON NAME	SCIENTIFIC NAME	STATUS**	FORMER DISTRIBUTION
MAMMALS			
Delmarva Peninsula fox squirrel	*Sciurus niger cinereus*	E	mature forests of southeastern PA (Delaware and Chester Co.)
Eastern cougar	*Felis concolor couguar*	E	state-wide
Grey wolf	*Canis lupus*	E	state-wide
MOLLUSKS			
Dwarf wedge mussel*	*Alasmidonta heterodon*	E	Delaware River drainage
Fanshell*	*Cyprogenia stegaria*	E	Ohio River drainage
Orange pimpleback*	*Plethobasus striatus*	E	Ohio River drainage
Pink mucket pearly mussel*	*Lampsilis abrupta*	E	Ohio River drainage
Ring pink mussel*	*Obovaria retusa*	E	Ohio River drainage
Rough pigtoe*	*Pleurobema plenum*	E	Ohio River drainage
INSECTS			
American burying beetle	*Nicrophorus americanus*	E	state-wide
Karner blue butterfly	*Lycaeides melissa samuelis*	E	pine barrens, oak savannas (wild lupine habitat) (Wayne Co.)
Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	T	along large rivers in southeastern PA
PLANTS			
Eastern prairie fringed orchid	*Platanthera leucophaea*	T	wet prairies, bogs (Crawford Co.)
Sensitive joint-vetch	*Aeschynomene virginica*	T	freshwater tidal marshes of Delaware river (Delaware and Philadelphia Co.)
Virginia spiraea	*Spiraea virginiana*	T	along Youghiogheny River (Fayette Co.)
Smooth coneflower	*Echinacea laevigata*	E	serpentine barrens (Lancaster Co.)

* Remnant populations of some of these species (indicated with an *) may still occur in Pennsylvania, however, there have been no confirmed sightings of these species for over 70 years.

** E = Endangered, T = Threatened

The following is a <u>partial</u> list of additional species that no longer occur in Pennsylvania: moose, bison, lynx, wolverine, passenger pigeon, Bachman's sparrow, common tern, lark sparrow, tiger salamander, mud sunfish, longjaw cisco, lake whitefish, butterfly mussel, precious underwing moth, American barberry, small white lady's-slipper, etc. etc.

FEDERALLY LISTED SPECIES IN PENNSYLVANIA

COMMON NAME	SCIENTIFIC NAME	STATUS*	DISTRIBUTION
FISHES			
Shortnose sturgeon**	*Acipenser brevirostrum*	E	Delaware River and other Atlantic coastal waters
REPTILES & AMPHIBIANS			
None			
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	E	Entire state. Recent nesting in Butler, Crawford, Dauphin, Lancaster, Pike, Tioga, York Counties
Peregrine falcon (American)	*Falco peregrinus anatum*	E	Entire state. Recent nesting in and around Philadelphia and Pittsburgh
Peregrine falcon (Arctic)	*Falco peregrinus tundrius*	T	Entire state-migratory
Piping plover	*Charadrius melodus*	E	Presque Isle-no current nesting
MAMMALS			
Indiana bat	*Myotis sodalis*	E	Entire state
MOLLUSKS			
Clubshell mussel	*Pleurobema clava*	E	French Creek and Allegheny River watersheds: Clarion, Crawford, Erie, Forest, Mercer and Venango Counties
Northern riffleshell	*Epioblasma torulosa rangiana*	E	French Creek and Allegheny River watersheds: Crawford, Erie, Forest, Venango and Warren Counties
PLANTS			
Northeastern bulrush	*Scirpus ancistrochaetus*	E	Current - Blair, Centre, Clinton, Cumberland, Dauphin, Franklin, Huntingdon, Lackawanna, Lehigh, Monroe, and Union Counties. Historic - Northampton County
Small-whorled pogonia	*Isotria medeoloides*	E	Current - Centre and Venango Counties. Historic - Berks, Chester, Greene, Monroe, Montgomery, Philadelphia Counties

* E = Endangered, T = Threatened

** Shortnose sturgeon is under the jurisdiction of the National Marine Fisheries Service

PREPARED BY THE U.S. FISH AND WILDLIFE SERVICE
315 S. ALLEN ST., SUITE 322, STATE COLLEGE, PA 16801

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Suite 322
315 South Allen Street
State College, Pennsylvania 16801

November 30, 1993

Mr. Kenneth Battyanyi
RI Task Manager
ENSR Consulting and
Engineering
Liberty Center, 9th Floor
1001 Liberty Avenue
Pittsburgh, PA 15222

Dear Mr. Battyanyi:

This responds to your letter of November 29, 1993 requesting information about federally listed or proposed endangered and threatened species within the area affected by the completion of a remedial investigation report on the Ohio River Superfund site located in Allegheny County, Pennsylvania.

Except for occasional transient species, no federally listed or proposed threatened or endangered species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required with the Fish and Wildlife Service. Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered. A compilation of federally listed endangered and threatened species in Pennsylvania is enclosed for your information.

This response relates only to endangered or threatened species under our jurisdiction based on an office review of the proposed project's location. No field inspection of the project area has been conducted by this office. Consequently, this letter is not to be construed as addressing other Service concerns under the Fish and Wildlife Coordination Act or other legislation.

Federal Candidate and State-listed Species

Candidate species are species under consideration by the Service for possible inclusion on the Federal List of Endangered and Threatened Wildlife and Plants. Because many of these species are known to have suffered population declines, the Service encourages federal agencies and other planners to consider candidate species when planning and implementing their projects.

The Pennsylvania Natural Diversity Inventory (PNDI) is maintained by the Pennsylvania Department of Environmental Resources, The Nature Conservancy and the Western Pennsylvania Conservancy. The Pennsylvania Fish and Wildlife Database is maintained by the Pennsylvania Game Commission. These databases contain the most up-to-date information about candidate and State-listed species in Pennsylvania. Requests for a PNDI review for the presence of candidate and State-listed species, as well as other natural resources of special concern, should be directed to:

Pennsylvania Department of Environmental Resources
Bureau of Forestry
Division of Forest Advisory Services
400 Market Street (MSSOB), 3rd Floor
P.O. Box 8552
Harrisburg, PA 17105-8552

Requests for a review of the Pennsylvania Fish and Wildlife Database should be directed to:

Pennsylvania Game Commission
Bureau of Land Management
Division of Wildlife Data Base
2001 Elmerton Avenue
Harrisburg, PA 17110-9797

Should the data search reveal the presence of any candidate species on the site, the Service should be contacted to ensure that these species are not adversely affected by project activities.

Requests for information regarding State-listed endangered or threatened species should be directed to the Pennsylvania Game Commission (birds and mammals), the Pennsylvania Fish and Boat Commission (fish, reptiles, and amphibians), and the Pennsylvania Department of Environmental Resources (plants).

Please contact Philip Edmunds of my staff at 814-234-4090 if you have any questions or require further assistance regarding endangered, threatened, or candidate species.

Sincerely,

Charles Kulp

Charles J. Kulp
Supervisor

Enclosure

APPENDIX C - THREATENED AND ENDANGERED SPECIES

Pennsylvania Fish and Wildlife Data Base
LIST B: Potential Endangered, Threatened, and Special Concern Species
(Includes Accidental and Migrant Species)
** Ohio River Site - Neville Island **
Allegheny County
05 JAN 1994

Note: The purpose of the following list is to identify endangered, threatened, and special concern species which may potentially occur within a designated area. This list includes species which may exist on your project area as well as migrating and accidental species. This information is based on records of these animals inhabiting specific habitat types within Allegheny County.

Status..	No. of Species Listed
PA / Fed Endangered	2
PA Endangered	5
Fed Endangered	3
PA Threatened	6
Candidate Species	26
al Species Listed:	42

Pennsylvania Fish and Wildlife Data Base
LIST B: Potential Endangered, Threatened, and Special Concern Species
(Includes Accidental and Migrant Species)
** Ohio River Site - Neville Island **
Allegheny County
05 JAN 1994

Common Name................	Scientific Name...........	Status...............
Eagle, Bald	Haliaeetus leucocephalus	PA / Fed Endangered
Falcon, Peregrine	Falco peregrinus	PA / Fed Endangered
Massasauga	Sistrurus catenatus	PA Endangered
Snake, Kirtland's	Clonophis kirtlandii	PA Endangered
Osprey	Pandion haliaetus	PA Endangered
Owl, Short-eared	Asio flammeus	PA Endangered
Tern, Black	Chlidonias niger	PA Endangered
Mussel, Pink Mucket Pearly	Lampsilis abrupta	Fed Endangered
Pigtoe, Rough	Pleurobema plenum	Fed Endangered
Pimpleback, Orange	Plethobasus striatus	Fed Endangered
Lamprey, Ohio	Ichthyomyzon bdellium	PA Threatened
Snake, Rough Green	Opheodrys aestivus	PA Threatened
Bittern, American	Botaurus lentiginosus	PA Threatened
Egret, Great	Casmerodius albus egretta	PA Threatened
Flycatcher, Yellow-bellied	Empidonax flaviventris	PA Threatened
Sandpiper, Upland	Bartramia longicauda	PA Threatened
Harrier, Northern	Circus cyaneus	Candidate - At Risk
Owl, Common Barn	Tyto alba	Candidate - At Risk
Snipe, Common	Gallinago gallinago	Candidate - At Risk
Sparrow, Henslow's	Ammodramus henslowii	Candidate - At Risk
Coot, American	Fulica americana	Candidate - Rare
Goshawk, Northern	Accipiter gentilis	Candidate - Rare
Grebe, Pied-billed	Podilymbus podiceps	Candidate - Rare
Grosbeak, Blue	Guiraca caerulea	Candidate - Rare
Tanager, Summer	Piranga rubra	Candidate - Rare
Teal, Green-winged	Anas crecca	Candidate - Rare
Thrush, Swainson's	Catharus ustulatus	Candidate - Rare
Bat, Silver-haired	Lasionycteris noctivagans	Candidate - Rare
Bobwhite, Northern	Colinus virginianus	Candidate - Undeterm
Crossbill, Red	Loxia curvirostra	Candidate - Undeterm